



## Amgen Scholars:

# Best Practices in Summer Undergraduate Research Programs

*Edited by*  
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**Amgen Scholars:**  
Best Practices in  
Summer Undergraduate  
Research Programs

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## INTRODUCTION

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**A** university professor. An epidemiologist. A biomedical scientist. These are the scientific careers of just three of the nearly 3,000 students to date who have had the opportunity to participate in the Amgen Scholars Program (ASP).

The ASP was developed in partnership with premier academic and research institutions to serve as a springboard for undergraduates into scientific careers through a powerful hands-on summer research experience. Ten years into the Amgen Foundation's 12-year \$50-million commitment to make such opportunities possible, the program is accomplishing just that. At this juncture, over 95% of ASP alumni who have completed their undergraduate studies are pursuing advanced scientific degrees and careers.

The ASP has grown significantly since its launch in 2006. Today it includes 17 host institutions—10 in the United States, 5 in Europe, and 2 in Japan. By design, the program casts a wide net among undergraduates, as high-quality research opportunities are not available for many students at their home campuses. Response has been overwhelming: Amgen Scholars have hailed from nearly 600 colleges and universities across the globe thus far.

We know that every undergraduate summer research program is unique: It has its own institutional culture, its own distinguished faculty and diverse student cohort, its own signature research projects underway in its labs. There is no one “recipe” or “checklist” for developing an enriching, successful undergraduate summer research program. Rather, thoughtful collaboration, and an overall culture that encourages exploration, communication and risk-taking, paves the way.

Over the years, we have learned a great deal from students, faculty, and program staff about how to develop that collaborative culture. We share those lessons with you in *Amgen Scholars: Best Practices in Summer Undergraduate Research Programs*.

Chief among them is the importance of creating an infrastructure across participating institutions that enables data-based improvements. To that end, we work closely with program administrators to collect quantitative and qualitative data based on common survey questions to assess each host institution's program against the others' along a number of metrics. From these evaluations we have learned, for example, how best to match students with faculty mentors, communicate and set expectations at individual sites, and give students a leg up in winning top awards.

Academic and research institutions that host undergraduate summer research programs do more than provide an invaluable learning experience for participants. They invest in a virtuous cycle of innovation: Their students will go on to solve the most pressing scientific problems of the day while simultaneously preparing the next generation of young scientists and researchers to follow in their footsteps. Those students, in turn, will take on the investigatory mantle, and pass it along to those who come afterward.

We have seen the fires being lit in the minds and hearts of the many young Amgen Scholars who have continued in careers in science. We hope that the practices described in this book will help you do the same.

Sincerely,

**Eduardo Cetlin**

President, Amgen Foundation

**Scott Heimlich**

Vice President, Amgen Foundation

#### ABOUT AMGEN AND THE AMGEN FOUNDATION

*Amgen is committed to unlocking the potential of biology for patients suffering from serious illnesses by discovering, developing, manufacturing and delivering innovative human therapeutics. This approach begins by using tools like advanced human genetics to unravel the complexities of disease and understand the fundamentals of human biology. Amgen focuses on areas of high unmet medical need and leverages its expertise to strive for solutions that improve health outcomes and dramatically improve people's lives. A biotechnology pioneer since 1980, Amgen has grown to be one of the world's leading independent biotechnology companies, has reached millions of patients around the world and is developing a pipeline of medicines with breakaway potential.*

*Amgen's main philanthropic vehicle, the Amgen Foundation, seeks to advance excellence in science education to inspire the next generation of innovators, and invest in strengthening communities where Amgen staff members live and work. To date, the Foundation has donated more than \$250 million in grants to local, regional and international nonprofit organizations that impact society in inspiring and innovative ways.*



# Creating a New Summer Science Research Program

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**A** summer science research program leverages campus resources and expertise to provide rich, transformative experiences for undergraduates seeking to develop their knowledge and skills in a specific area of study and to sample the life of a researcher. In addition to the research experience, most summer programs provide instruction in associated skills—collaboration, teamwork, ethics, writing, and presenting research, for example. Summer research programs may also provide opportunities for career exploration, professional development, preparation for postgraduate education, networking, and the development of a scholarly cohort. This is a great deal to accomplish in a typical summer session of 8 to 10 weeks. The experience is intensive for the students and also presents an administrative challenge that requires thoughtful preparation and attention to many details.

Careful planning pays off for all participants: Students benefit from an enriching experience. Faculty members benefit from students' eagerness, energy, and naiveté by revisiting important basic questions and seeking novel answers. Campuses benefit from students' contributions to ongoing work and from the possibility of their returning to enroll in graduate programs. From a more global perspective, the scientific disciplines benefit from capturing the longer-term interest and passions of a new generation of practitioners who will contribute their ideas and leadership to the development of a particular field of study.

In the United States, the Amgen Scholars Program (ASP) was launched in a higher-education environment that embraced undergraduate research—in particular, summer research programs—as a best practice. In Europe, however, the environment was very different: Undergraduate research was not yet institutionalized as an important element of university education and existed only in isolated pockets of excellence in specific departments or disciplines. In this chapter, we will address best practices for a variety of institutional environments in the hopes of serving both new and seasoned undergraduate research staff and faculty as they expand or refine their summer programs.

## Define the program

The first step in creating a new program may seem obvious but is worth highlighting: You must define the program under development and identify a small number of goals and outcomes that will lay the foundation of the program.

Here are the key questions to address:

### **What existing campus resources and expertise will shape the program's research focus?**

The research focus of the program may be disciplinary or interdisciplinary, and may be interpreted in a flexible way to allow many different faculty research groups to participate. However, it is important to define the focus upfront as it provides an organizing principle for all program components. For example, if your campus has a spectacular environmental-science field site and relevant faculty expertise, you might choose environmental science as the program theme. A new nanotechnology center may suggest an interdisciplinary theme, drawing in several different academic departments. A biomedical-sciences theme might bring in various basic-science and medical-science disciplines. The theme does not have to be narrow or broad; it simply has to reflect your campus expertise and represent an area students will perceive as exciting, offer them potential longer-term opportunities, and include faculty leaders who are good mentors of undergraduate researchers.

It is not necessary to have an official Undergraduate Research Office to establish a focused summer science program. For example, at the ASP at Ludwig-Maximilians-Universität München (LMU), the Office of International Affairs, which runs the Munich International Summer University (MISU), takes the lead in handling logistics, as it has much experience in recruiting and hosting international students. On the scientific side, a large network of scientific experts and staff experienced in running undergraduate and graduate programs at the Munich Center for Neuroscience (MCN) sets up a rich variety of research placements for Amgen Scholars. LMU staff members who are experienced in managing undergraduate programs coordinate the program, providing the critical link between the existing resources.

We often think of research-intensive universities as the host institutions for summer research programs. However, any institution that has the resources and research expertise to build meaningful student experiences may be an excellent site for a summer program.

### **What does the program offer beyond the intensive research experience?**

While research drives the program, additional learning experiences help make it unique. Questions to answer include: What other types of instruction will be offered? Will there be a focus on graduate school, career, and/or professional-school preparation? What extracurricular activities will be incorporated? Is the program cohort-based, or does it support individual student-faculty partnerships only?

These features are not only important for student recruitment, but also may help faculty decide whether or not they wish to participate as mentors. For example, a signature component of the ASP as a whole is the Symposium, where leading scientists working in industry and academia discuss their work and students present their research projects. Amgen Scholars from across the United States have historically met in California and those from across Europe have met in England. The ASP also offers industry tours, networking events, and other activities at the various ASP sites. It's important that all participants understand that these opportunities are part of the program from the beginning, so they can plan their participation and work accordingly.

If your program will be integrated into a larger campus effort, such as a range of summer research opportunities operating out of individual departments, the unique features of your program may play a larger role in the selection of students and faculty but a smaller role in program recruitment and the application process. However, even if the program is not stand-alone, some aspect of it will distinguish the students under its title (and funding)—and the better defined it is, the easier it will be to identify and support the participants.

**What are the program goals and desired student outcomes?**

From the very beginning of the process, it is important to identify the program goals and desired outcomes. These should drive programmatic decisions. They will also enable you to capture the interest of campus leaders and develop partnerships based on shared goals, and aid you in recruiting and selecting the students best suited to benefit from this opportunity and identifying the most effective faculty mentors to guide the students' work. In addition to providing transformative research experiences for student participants, program outcomes may include the successful transition of students to relevant graduate programs and the retention of students from groups underrepresented in the sciences in relevant fields of study.

If you are establishing an externally funded program, you will likely have identified goals and outcomes as part of the proposal process, and know how important it is to provide evidence of having achieved those goals to ensure continued support. But even if your program is internally funded by institutional and/or gift funds, identifying goals and outcomes will help crystallize the purpose and character of the program for participants and the campus at large, ensuring its smooth integration into the institution's offerings.

**Determine the administrative framework**

Once the overall program has been defined, there are many decisions to make regarding its implementation. Summer programs require substantial staff effort, particularly if they involve recruiting participants beyond the home institution.

**Select an appropriate administrative home.** The ultimate success of a program depends on the strength of the administrative framework supporting it. If an existing Undergraduate Research Office has the capacity to take on the direction of a new summer program, that is a good place to situate it administratively, as the program will benefit from existing structures that support marketing, recruitment, application processing, financial tracking, and logistics. In addition, many Undergraduate Research Offices include faculty and/or professional staff who can provide instruction on research-related topics, student advising, mentor training, project placements, and final project-presentation venues. For programs that are situated within a specific academic discipline, a department—graduate or undergraduate—or a relevant college may be the most appropriate location for the administrative home.

**Establish a strong administrative team.** Wherever the program is housed, staff support will be needed year-round, as the planning and recruitment

processes for the following year begin immediately after a summer program ends. Good insights into different types of Undergraduate Research Office administrative practices may be found in *Undergraduate Research Offices & Programs: Models & Practices* (Kinkead and Blockus, eds., 2012).

Assigning roles based on the particular strengths of your staff, while permitting the team as a whole to determine how to proceed, contributes to the collaborative effort: For example, a staff member who is very familiar with the lifestyles of undergraduates may be the best person to work on housing issues, while an experienced traveler may excel at arranging travel plans for students. But emphasizing good communication skills among team members will enable them to set priorities and put all the pieces together.

Externally funded programs will require financial oversight, budget planning and reconciliation, and processing of purchasing, payroll, and travel arrangements. The unit in which the program is housed typically provides staff time for financial oversight, although this responsibility should be clearly defined at the outset of the program.

The ASP sites were selected, in part, based upon the scope and depth of scientific and biomedical research at each institution, ensuring that selected students would benefit from a rich and up-to-date array of potential research projects. In addition, each site had a knowledgeable staff devoted to undergraduate research to implement the program effectively.



(PHOTO: MARTIN BOND, MARTIN BOND PHOTOGRAPHY)

**Choose an administrative model.** The 10 U.S. ASP sites employ a variety of administrative frameworks. Several of them are situated in the campus Undergraduate Research Office, while others are housed in the graduate school or an office of sponsored programs. In addition, some of the sites incorporate the ASP into a broad array of summer research offerings, while others implement the program as more of a stand-alone effort, run in coordination with, but separate from, other opportunities on campus. There is no universal right way to administer these programs; each campus must decide where the administrative staff and research knowledge and capacity exist to best execute their program.

For examples, see the sidebars “The ASP at Washington University in St. Louis (WUSTL): Administrative Implementation,” “The ASP and the ASP European Coordinating Centre at University of Cambridge (Cambridge): Administrative Implementation.”

#### THE ASP AT WUSTL: ADMINISTRATIVE IMPLEMENTATION

WUSTL’s long history of undergraduate research opportunities and the well-developed infrastructure to support them made the school ideally suited to become an ASP site. Among WUSTL’s unique administrative structures is the Division of Biology and Biomedical Sciences (DBBS). This unit is physically housed at the School of Medicine; however, it is administratively situated in both the School of Medicine and the Graduate School of Arts and Sciences. The resulting university-wide consortium transcends departmental lines and provides Amgen Scholars with a choice of 450 potential mentors. There is a particularly strong relationship between the Danforth (undergraduate) and Medical campuses, and a long history of School of Medicine faculty mentoring undergraduate students in their research laboratories.

The ASP design at WUSTL draws on the university’s successful Biomedical Research Apprenticeship Program (BioMedRAP) for disadvantaged and under-represented minority students. It has been successful in steering students to research: More than 60 percent of the program alumni are now in Ph.D. or M.D.-Ph.D. programs. Amgen Scholars are integrated into activities with BioMedRAP trainees and offered additional ASP-specific sessions such as an intensive science-writing course that meets twice weekly. DBBS also has the administrative staff to implement the program. The DBBS Director of Diversity and Summer Programs, her coordinator, three staff members (two from Ph.D. and one from M.D./PhD admissions) work to execute the program every year.

## Identify campus partners

Support from campus partners enables program staff to share knowledge, resources, and processes to optimize the student experience. In addition to UR offices, key campus partners may include: the graduate school, campus office of sponsored programs, office of merit scholarships and fellowships, housing and food services (if you are housing the students on campus), visitor center, office of minority affairs, student counseling center, office of student conduct, and other colleges, schools, or departments that run their own summer research programs.

The University of Washington (UW), for example, has more than a dozen disciplinary and interdisciplinary summer research programs; some are run by the Undergraduate Research Office, and others are run by academic units. At UW a few years ago, we formed a coalition of summer research program administrators to coordinate activities such as a welcome barbecue, a graduate school fair, and a culminating summer research poster session. The graduate school was a key partner in these efforts, as many summer students were interested in returning to campus as graduate or professional students.

On the European campuses—where undergraduate research is a newer practice—identifying campus partners has required more outside-the-box thinking, with administrative partnerships being established with the international student office and the financial administration.

### THE ASP AND THE ASP EUROPEAN COORDINATING CENTRE AT CAMBRIDGE: ADMINISTRATIVE IMPLEMENTATION

At Cambridge—site of both the ASP and the ASP European Coordinating Centre—there is no central Undergraduate Research Office or related enterprise. Hence both ASP efforts were established within the Office of the School of Biological Sciences, the administrative office for all the biology-related departments, as it was most closely related to the content of the program. The office has a staff of about 12 people who deal with administrative issues across all departments—including health and safety, undergraduate and graduate education, and financial management.

For the ASP, administrative tasks are tacked onto various people's "day jobs"—spread across four to five people rather than having a single office contact. The office secretarial staff processes student applications up to the point of selection, and a committee of faculty select the student participants. Other professional staff administer the program, including dealing with the participants and arranging the activities. This enables the faculty to focus on the content of the summer research itself.

## Develop faculty and administrative advocates

When introducing a new program, it is important to identify and develop leaders across campus as advocates. They can help raise awareness of the initiative, recruit faculty colleagues to participate in the program, and assist with any obstacles to implementation. When we established the ASP on the UW campus, we identified a small group of faculty leaders during the proposal process who provided feedback on the narrative, helped to recruit colleagues to serve as mentors when funding was awarded, and provided key suggestions on the program activities and calendar during the first summer of the program. Their time commitment was very small, but their support enabled us to recruit some of the top UW faculty in biomedical research to participate in the new program.

At Cambridge, Professor Tony Minson, the Academic Director for the ASP's European Coordinating Centre until 2013, was uniquely positioned to be a strong champion in developing the program. He had previously served as the university's Pro-Vice Chancellor for Planning and Resources; as such, he was known to almost all academic staff, which helped in establishing credibility for this new effort, gaining central acceptance, and "signing up" departments and individual staff members to participate as mentors and supporters of the program.

Sometimes faculty advocates are established only after a successful summer or two. At LMU and most European universities, for example, this type of structured summer research program offering paid independent research opportunities on a selected cohort basis did not yet exist, so many potential faculty members were in need of extensive clarification before joining. Only the researchers who had spent considerable time in the United States "got it" right away. Some had to be convinced; but after seeing the work of participants during the first years of the program and hearing strong support from their colleagues, faculty now come to the LMU ASP staff to request student participants for their labs. We would strongly advise new program directors



Cambridge Professor Trevor Robbins interacts with Amgen Scholars.

(PHOTO: MARTIN BOND PHOTOGRAPHY)

to enlist their first cohort of mentors to help spread the word to their colleagues about the benefits of participation for themselves, their students, and their departments.

### **Consult with colleagues in grappling with new issues**

Even the most seasoned Undergraduate Research Office director can learn from colleagues across campus and at other institutions when implementing a new program or expanding an existing one. Use your networks and resources to secure the best possible experience for your students. A summer program forces you to deal with issues that may not arise with your own students during the academic year, such as insurance coverage for visiting students. The Council on Undergraduate Research (CUR, [www.cur.org](http://www.cur.org)), for example, has a discussion list where faculty and Undergraduate Research Office directors can ask for advice from colleagues. CUR's *How to* book series and the *CUR Quarterly* also include articles that are relevant to developing and nurturing campus undergraduate-research enterprises.

### **Develop a public-relations (PR) campaign**

A new summer research program, especially if it is externally funded, should be introduced with a PR campaign. In addition to marketing to students, you want to let your faculty, departments, and the campus at large know about the exciting new effort. Ideally, you want your program to be so desirable that more faculty than can be included will ask to be part of the program! Of course, you also want to attract a large student applicant pool so that you can make your selection based on the best fit for the opportunity.

Start your PR efforts early. News organizations, online and off, decide what to publish based on timeliness—and if you miss that period when the program is fresh, you may not get the attention you desire later. Put your effort into marketing that first year, for example, with a press release and visible campus announcement, and focus later on updates, student accomplishments, and symposia to showcase your students and the program outcomes. Each time you meet a milestone, whether it is with funding renewals or student achievement, put out a press release. Also consider collecting hometown data on your students to attract articles in their hometown press (send your press releases) or on their home campuses if they are not native students. As with all other aspects of running a good program, PR takes planning and effort. A good resource for Undergraduate Research Office directors is *Advancing Undergraduate Research: Marketing, Communications, and Fundraising*, by Joyce Kinhead (Council on Undergraduate Research, 2010).

For more information, see Chapter 2, “Marketing Your Program.”

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**LESSONS LEARNED****Implement, assess, analyze, improve, repeat!**

All of us—at UW, WUSTL, Cambridge, and LMU—made adjustments to our programs' plans, administration, and structure as we received feedback from participants and reviewed our experiences at the end of each summer. After the first year, for example, one comment we received at UW was that we were overly ambitious in terms of student schedules and activities. According to both faculty and students, we had planned too many events, lectures, and seminars. We responded to the feedback by scaling back on these activities by approximately 20 percent for our second year, giving students more time to reflect on their experience and relax between their research and other activities.

**Find a good balance.** When establishing a new program, it is important to find a good balance as soon as possible, because reputation is critical to the recruitment of both faculty mentors and student participants. Feedback can help you to find that “sweet spot” between too little and too much free time for your summer students, which will allow them to grow scientifically and personally without getting “burned out.”

**Focus on feedback and improvement.** The best approach to introducing any new program is to plan as thoughtfully as possible for the first iteration, collect feedback and evaluation data along the way, analyze the outcomes after the summer program ends, make adjustments, and do it all over again.

The brevity of a summer program—the main challenge of these programs—offers the advantage of a relatively swift feedback-and-improvement loop. Think of your work in the context of research; you will continue to learn how to improve student learning and outcomes in your program through assessment, analysis, and adjustments to your practice.

**Use students as advocates.** Growing your program and its reputation are extremely important for continued success. Cambridge, for example, has found that their students are the best advocates when it comes to recruiting future participants. Students return to their home campuses and spread the word among their professors and peers. Developing campus support for program activities at the host institution is equally important. Cambridge excelled at that as well. The program administration at Cambridge is divided among staff members who do not regularly interact with student participants during the summer. So the directors made sure to invite them to the end-of-program Symposium, which included a poster session with students from all three current European sites (there are now five sites in Europe). The opportunity to meet the students and see what they had achieved generated tremendous enthusiasm among the staff for the ASP as a whole.



## Best practices at a glance

### **Define the program**

- Determine what campus resources and expertise will shape the program
- Decide what the program will offer in addition to the research experience
- Identify the program goals and desired outcomes

### **Determine the administrative framework**

- Select the administrative home
- Establish a strong administrative team
- Choose an administrative model

### **Identify campus partners**

- Share knowledge, resources and processes
- Form a coalition of program administrators to coordinate activities such as a welcome barbecue and a wrap-up poster session

### **Develop faculty and administrative advocates**

- Request feedback and help with faculty recruitment
- Enlist the first cohort of mentors to share the value of participation with colleagues

### **Consult with colleagues in grappling with issues**

### **Develop a PR campaign**

- Market, both online and off, to faculty, departments, and the campus at large as well as students
- Start PR efforts early
- Launch with press releases and campus announcements first, follow with updates, student accomplishments, and symposia

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**CHAPTER 2**

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# Marketing Your Program

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**M**arketing your undergraduate summer research program has two main goals: to recruit student participants and to reach additional stakeholders through program visibility. The recruitment process must be done with care, because you want to select a group of students whose backgrounds and abilities complement one another. Recruiting participants with a variety of backgrounds and levels of experience also allows students to teach and learn from one another.

This chapter will explore the strategies that we have found to be particularly successful in marketing the Amgen Scholars Program (ASP).

## Identify program goals: Consistency is key

A successful summer research program requires a coherent marketing and recruitment approach that is in line with both the structure and overriding goals of the program. Consistency across the board is crucial: The experience of students and other stakeholders should align with the program you are advertising. As the program evolves, the marketing approach must be re-evaluated and adjusted accordingly. Many summer programs, however, do not have the financial means to access professional marketing expertise. Moreover, many program administrators will likely find themselves faced with the challenge of building operational structures and launching a first marketing campaign simultaneously, which may affect the ultimate success of the program.

To ensure that your marketing strategies align with the focus of your program, ask these questions before you even consider the numerous marketing tools and channels available:

### **What is the actual “product” to be marketed?**

Ideally, the goals of the program should be transparent to all program staff to encourage coherence between the internal structures and the external representation of the program. You want to be sure that the intent of the program matches the way it is perceived.

### **Do the staff and location accurately represent the program?**

The ASP has two primary goals:

- To increase the learning and networking opportunities for undergraduate students committed to pursuing science or engineering careers
- To spark the interest and broaden the perspective of undergraduate students who are considering scientific careers

The program's structures were developed with these goals in mind, and the marketing strategies, at both the national and international level, are driven by them. The Amgen Foundation, which funds the program, and the individual ASP sites also highlight the unique qualities of each site in their marketing efforts. The effectiveness of this approach shows in the success of the program: As of September 2015, over 95% of ASP alumni who had completed their undergraduate work were pursuing an advanced degree or career in a scientific field.

## Target your audience—from marketing to recruiting

Summer research programs seek to attract highly motivated and promising students. A clear set of criteria is necessary for both the Admissions Committee and the marketing strategy. Advertisements, articles, flyers, posters, and websites must appeal to targeted groups of students and clearly convey the eligibility information at a glance. Students want to know what the program is about and if it is right for them.

**Consider geographical issues in targeting participants.** Is the program open to students worldwide? To U.S. citizens studying in the United States? To European students studying in the United States? What are the language requirements? Is it necessary to advertise the program in different languages, or are students expected to understand English-only advertising?

**If the program is international, find out how students inform themselves about international research and study abroad opportunities in target countries.** In the United States, for example, most universities have a study abroad office or an undergraduate research office, where students receive personal counseling regarding appropriate programs. This is not always the case in Europe, where study abroad offices might only be involved in counseling incoming students, or where structured summer research programs do not have a long tradition and so their representation through the university has not been firmly established.

Most universities in Europe and elsewhere will have an international office that can at least suggest appropriate contacts for advertising purposes. International student organizations can also provide information, and some organizations promote study abroad in certain countries, such as the German Academic Exchange Service (DAAD), which has a global network of branch offices and information centers providing study abroad information for foreigners. The DAAD maintains an extensive searchable online database of study programs in Germany and aims to reach international students. Also helpful in getting the word out are existing contacts of participating faculty members and university partnerships in target regions or countries. In past years, a great number of ASP students have noted that they heard of our programs via word of mouth.

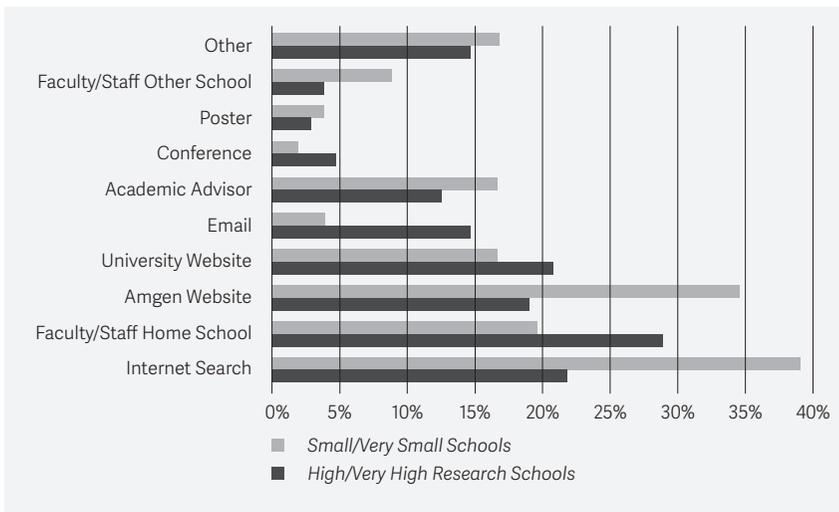
At the Ludwig-Maximilians-Universität München (LMU) ASP, we are fortunate to have access to an extensive list of international contacts in science through the LMU Office of International Affairs. This list has grown over the past few years because of our success in reaching our target audience. Since science is international and scientists often move, such lists serve as a good foundation; however, they do require continual maintenance. We have found that short emails announcing the application phase with a colorful

and concise e-card—a pre-designed electronic card that advertises your program—are effective and efficient in reaching relevant faculty members who, in turn, pass on program information to interested students.

**Once your summer research program becomes established, use program alumni as a valuable resource in reaching eligible students.** Data collected from ASP applicants show that the primary focus should be on visibility via the internet and through recommendations by university staff. Which works best varies somewhat depending on the profile and size of the home school. Students from smaller universities tend to find out about summer programs via an internet search, whereas students from large, high-research universities tend to find out about programs via university staff (see Figure 1).

**FIGURE 1**

**Profile and Size of the Home School Influence which Marketing Method Is Most Successful**



Source: Center for Evaluation and Education Policy (CEEP)

**Before the initial marketing stage, the target group intended for recruitment should be defined, based on your program's goals.** For example, if your goal is to provide research opportunities for students with no or limited research opportunities, then your recruitment efforts should focus on small colleges and first- and second-year college students. If your goal is to increase the number of students in your graduate programs, then your recruitment strategies may include students with prior research experience or with the potential to do graduate-level research.

In many cases, the target group may change or be refined over the course of time as a result of new developments in program goals, such as program expansion. Hence, program staff should continuously monitor program goals to be sure they remain aligned with targeted participants, and adjust their marketing strategy accordingly.

### **Focus on the tools that reach your target audience, partner with others**

Marketing tools and resources will vary depending on the financial structure of the summer research program, but in many cases, the marketing budget will be quite limited. To get the most value for the money, summer research programs should focus first on the tools needed to reach their target audience and seek to partner with other university organizations disseminating marketing materials. The marketing budget should be planned carefully from the beginning and reassessed each year to determine its effectiveness based on return on investment.

Since the majority of students learn about the ASP through an internet search, their first real point of contact with your program is your website. Most universities will provide the resources for setting up a website. Since students may decide to apply to the program based on the information provided on the website, it is worth investing time and money in creating an attractive, user-friendly site targeted at qualified applicants. The site should include a straightforward online application platform. It should be welcoming, have a clear structure, and represent the program goals. It should not include too much text on its home and other landing pages.

Eligible applicants should be able to identify with the overall content. For that reason, many programs include pictures of smiling students participating in program activities and shots of relevant local landscapes to appeal to students seeking a stimulating and fun experience. Science research programs tend to show colorful lab shots, regardless of the actual experimental focus of the program. These images are available at a nominal cost through online photo agencies; however, authenticity is essential—the images must reflect the program under consideration.

Since most summer science programs are embedded within a university, the strategic focus and corporate identity of the university should also be represented when marketing the program. This can be financially advantageous, as programs can often use existing university press as well as online or other resources for marketing purposes. Your university may have a summer academy that could partner with your program, and include your program in its advertisements for undergraduate summer research programs. The

ASP at LMU is listed among the programs participating in the Munich International Summer University (MISU), a compendium of courses and short research programs covering the natural sciences, social sciences, and the humanities at all levels of study. At the national level, there may be cost-effective ways to advertise programs in your country, such as through the DAAD or GATE-Germany, a publicly funded organization focused on promoting German higher education and providing international students and faculty with information about Germany during their stay. The Amgen Scholars Global/U.S. Program Office (GPO) plays a key role in promoting the stateside programs through a variety of means, including mass emailing of program information—including flyers and links—to other academic institutions.

Summer research programs vary in how they evaluate the effectiveness of their marketing strategies. The ASP sites are fortunate to receive feedback on a regular basis from a commissioned external evaluator, which conducts regular surveys of student participants and site visits, including discussions with leadership, staff, and faculty members. The evaluator analyzes application and admissions data, and provides the ASP sites with the information they need to evaluate the effectiveness of both their program structures and marketing strategies. At LMU, for example, we have used this data to refine our recruiting measures to target underrepresented countries. For more information, see Chapter 14, “Ensuring That Your Undergraduate Research Program Is Successful.”

If your program budget does not allow for external evaluation of your marketing strategy, open-source survey tools and local staff are an effective way to gather and evaluate as much information about your applicants as possible. Print ads are especially costly and should be evaluated for effectiveness. Your program website will be the most important information source for potential applicants; therefore, it should be developed in tandem with your summer program.

### **Establish a recruiting time frame and select marketing tools**

With your program goals clear and consistent, administrative structures in place, target audience defined, and marketing budget clearly allotted, you are ready to establish a recruiting time frame and select your marketing tools.

#### **Establish a recruiting time frame**

The two most effective times for recruitment are (a) before the application period begins and (b) shortly before your program deadline. For most programs, recruitment season is during the fall. However, you might consider

implementing online, print, or other marketing strategies such as visibility at science conferences and campus events throughout the year. At many ASP sites, recruitment efforts are often combined with recruitment efforts for graduate or other academic programs, since promising students often begin looking at graduate opportunities early on and graduate programs want to attract exactly these students. We recommend recruiting students as early as possible; if you wait, those you target may have already taken high-paying summer jobs. Early recruiting also allows students and their faculty mentors to begin corresponding with one another and planning their research projects.

The program timing may also affect the eligibility of certain student groups. Whereas most U.S. universities have similar semester schedules and programs are timed accordingly, semester schedules in Europe tend to vary. Even if you are operating a single program and accepting students from one country within one university system, you will find that many of the universities will have different semester schedules, which may impact the ability of students to participate in your program. This concern is even more relevant in an international setting. One example: The Bologna Process encompasses 46 European countries and has created a European Higher Education Area (EHEA) to facilitate transparency among higher education systems, including implementing a three-cycle degree system—bachelor's, master's and doctoral degrees—in all participating countries. However, there is still a great deal of variation in the actual structure and duration of schedules.

The best time to reach eligible students will depend upon the requirements of your program. For example, a program open only to undergraduates who have not yet completed their degree should target mostly second-year bachelor's degree students in Europe and second- and third-year bachelor's-degree students in the United States.

### **Choose marketing tools**

With a wealth of marketing tools available, how do you go about selecting the most effective ones for your summer research program? Here are the approaches we have found to be most effective.

**SHINE ONLINE.** A *user-friendly and informative website* is crucial. Faculty members who are impressed by your program or by the marketing of your program will pass on the information to students, but most students will look for summer research opportunities on the internet using a search engine. To make sure that your program is visible on the web, search for it online yourself. Use search engine optimization (SEO) tools to make your website more visible to search engines. There are free online resources and tools available explaining how to do that, but remember: You can do a lot to improve your search engine visibility by simply keeping your information concise, using catchy images and links to further details, and presenting the information in

an intuitive format. Following these guidelines will also help students find the answers to their most pressing questions. They want to know the scope, time frame, location, impact, and cost of your program. Are scholarship opportunities available? What are the eligibility requirements? What is special about the host site? What are some past and potential research projects? How will participation in your program impact their future studies or career goals in science? Include up-to-date faculty profiles. Use alumni statements to highlight certain aspects of your program (see examples on this page). Did participation lead to a publication or admission to a top graduate program? Satisfied alumni will gladly allow you to use positive statements and fitting photographs to advertise your program.

“

*I came into this program thinking that I had done research before. I came out of the Amgen Scholars Program with a strong sense of where I want to go in the future, along with the tools and contacts necessary to get me there. The friendships and countless memories that I made in the process will stay with me for a lifetime.”*

Revathy Sampath-Kumar  
2011 Alum, UC San Diego

Visit the Amgen Scholars Program website at [www.amgenscholars.com](http://www.amgenscholars.com) for an example of an excellent site. (See next page, Figures 2 and 3.)

“

*Taking part in the Amgen Scholars programme was an incredible experience, and one that I have no doubt will serve me very well in the future. The programme offered me opportunities that I never would have otherwise had the chance to experience. Being actively involved in and gaining practical experience of research was both exciting and fulfilling and allowed me to broaden my perspectives. I learnt so much in eight weeks, from new lab techniques and skills to poster making and presenting.”*

Carol O'Brien  
2010 Alum, LMU

Many universities and university programs use **Facebook, Twitter, and other social media platforms** to reach current and potential students—many of whom use social media daily—and they can be a good way for you to reach potential applicants to your summer research program as well. Social media offer an informal and interactive communication pathway that is well-suited to highlighting the less formal aspects of your program. Photos, alumni statements, video clips, and ongoing dialogue about the program can provide a more personal approach than a static website, and can be easily integrated into an existing website. Consider investing in resources for creating positive video clips, since this easy form of information transfer is especially popular with students. Universities that include video clips on their media platforms report that the number of clicks for videos far surpasses clicks on any other media featured (Borgwardt, 2011).

**FIGURE 2**  
Amgen Scholars Program homepage



(SOURCE: AMGEN FOUNDATION)

**FIGURE 3**  
Amgen Scholars Program Symposium webpage



(SOURCE: AMGEN FOUNDATION)

There are some drawbacks to using social media. Most social media services are free, but you must actively maintain the platforms you choose to use. So be sure to factor in the costs for personnel who are savvy about both social media and many types of writing. Users expect regular interaction, so relatively quick responses to queries, comments, and concerns is very important.

**GET THE WORD OUT.** Once your website is in place, it is time to get out the word. You can now launch your full marketing campaign. **E-cards** are a relatively easy and effective way to reach a large number of contacts. All ASP sites are provided with an eye-catching e-card that can be sent to individual networks, such as your faculty mailing list and international partners. Figure 4, below, shows an e-card used to advertise the Amgen Scholars European Programme.

If yours is an international program, make use of your institution's existing international network in advertising it. At LMU, we send out the e-card advertising the European ASP sites to our faculty mailing lists and also have access to an extensive list of LMU's international partners in the natural and life sciences through the LMU Office of International Affairs. We continually update and expand the list based in part upon applicant statistics in order to reach out to students in underrepresented regions in Europe. The list includes individual researchers, university departments, international offices, national research-agency participants, program directors, faculty who

**FIGURE 4**

E-card used to advertise the Amgen Scholars European Programme



www.amgenscholars.eu

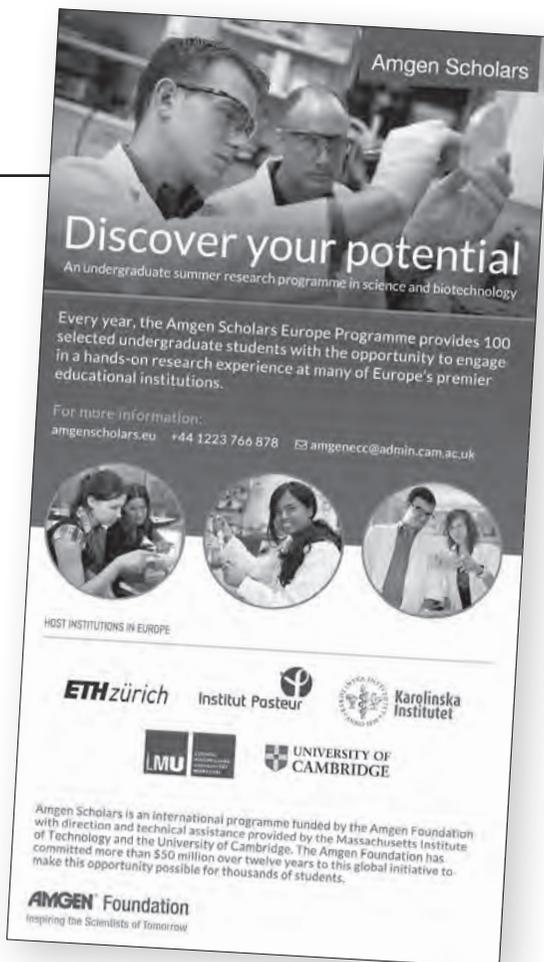
## Discover Your Potential

|   |  |
|---|--|
| <p><b>Amgen Scholars</b></p> <p>Host Universities in Europe:</p> <ul style="list-style-type: none"> <li>Karolinska Institutet<br/>Sweden</li> <li>Ludwig-Maximilians-Universität München<br/>Germany</li> <li>University of Cambridge<br/>United Kingdom</li> </ul> <p><b>AMGEN</b> Foundation<br/>Inspiring the Scientists of Tomorrow</p> | <p>An Undergraduate Summer Research Program in Science and Biotechnology</p> <p>The Amgen Scholars European Programme provides selected undergraduate students with the opportunity to engage in a hands-on research experience at some of Europe's leading educational institutions.</p>  <p>For more information, please go to <a href="http://www.amgenscholars.eu">www.amgenscholars.eu</a> or contact the Amgen Scholars European Coordinating Centre at +44 (0)1223 747459 or <a href="mailto:asp-enquiries@biomed.cam.ac.uk">asp-enquiries@biomed.cam.ac.uk</a>.</p> <p>Amgen Scholars is an international programme funded by the Amgen Foundation with direction and technical assistance provided in Europe by the University of Cambridge and in the United States by the Massachusetts Institute of Technology.</p> |
|---|--|

procured funding for student summer research opportunities or academic year research opportunities, national undergraduate research networks, science-discipline societies, and undergraduate research conferences. Alumni also are generally happy to pass on the e-card to potential applicants or their university contacts. We have found that it is most effective to send the e-card out at the beginning of our yearly application phase, in November, and we resend the card to many contacts again in January, one month before the end of the application phase.

**READ ALL ABOUT IT.** Although most students look for information about summer programs on the internet or hear about programs via faculty advisers, several of our students have reported that they first found information about our programs on a **poster** or **flyer** at their university. See Figure 5, below, for an example of an effective poster. Many of the graphics and

**FIGURE 5**  
Poster used to advertise  
the Amgen Scholars  
European Programme



much of the text from the website and the e-card can be used on the poster. Consistency is important—in general, make your program recognizable by reusing key images and colors across marketing tools. Due to the costs of updating print materials, list the details that are subject to change, such as program dates, only on the website, e-card, and social media; do not include them on the posters and flyers.

Ask representatives from your university's international office or undergraduate research office to display your poster and flyer in their offices and at student fairs, and be sure to display your posters in relevant science departments.

Based on feedback from students, we have stayed with our website/e-card/poster strategy and have not focused on print advertising, which tends to be expensive and ineffective for student recruitment. We have occasionally written short program profiles for university newsletters geared to an international audience, which are free. Although ads in glossy journals do look impressive, this is usually not where students are looking to find undergraduate summer research opportunities.

In past, the ASP also was fortunate to have a high-quality annual report covering the European and U.S. programs, which we used when reaching out to other stakeholders, including potential faculty members, university leadership, and research institutions with whom we planned to partner. If this extensive and expensive form of advertising is not within your budget, focus on creating an eye-catching poster and flyer, which—at a fraction of the cost—also make a good impression when you meet with potential partners and other stakeholders. A good website and e-card will suffice if print advertising is not an option.

**INSTALL A CENTRAL OFFICE.** The ASP sites in Europe are represented by the European Coordinating Centre (ECC), which coordinates combined marketing efforts that are relevant to all the European sites (such as posters and flyers). The Centre also sends representatives to student fairs and conferences and/or makes visits to universities in underrepresented regions as agreed upon by the European sites. If your program is set up to include multiple sites, it may be advantageous to install a central coordinating office or have one site office oversee recruitment efforts relevant to all sites. Regardless of how marketing efforts are coordinated, if you have the available program staff, consider sending representatives to student fairs and conferences as well. If they are professionally organized, they may provide tracking tools to help you compile data on the students who attend. If such tools are not available, keep a list of interested students whom you have met, including their email addresses, and make sure they receive some small,

novel giveaway (pens, key chains, etc.) with your contact information and the program's web address. Be sure to follow up with timely information about your program and application dates.

## Evaluate your marketing strategy

The number and quality of applications you receive is the first indicator of the success of your marketing strategy. If you were successful, you will receive a good number of qualified applications representing the groups you have targeted.

Some questions to help guide you:

### ***Do we have a large enough pool of applicants for a competitive selection?***

Our experience shows that the majority of applications will be submitted in the final week of the application phase. However, if a significant number of inquiries come in early, you will know that you have reached the students you targeted and that there is interest in your program.

### ***Are applications coming in on a regular basis or are they trickling in slowly?***

If they are trickling in slowly, you may consider resending your e-card midway through the application phase to increase visibility.

### ***Are applications coming in from targeted regions, or is it necessary to reach out more directly to contacts in certain regions?***

After evaluating application statistics, the Amgen Scholars European Programme made a concerted effort to reach out to students in Portugal, Italy, and Eastern European countries. Since the European program strives to include students from both top and underrepresented universities, we included many smaller universities with fewer resources in our outreach efforts. This was done mostly by sending e-cards to researchers and relevant university departments in those regions, and led to a significant increase in applications from them in the next application phase.

### ***Does the language you use in your marketing efforts matter?***

In the European program, we repeatedly discuss the best language to use in our marketing tools. Since all of our research programs are conducted in English, we generally distribute materials in English; however, posters have been translated into a few other languages to target students in particular regions. Since English is the *lingua franca* of science and most students look for research opportunities via internet searches, printed materials translated into other languages may not be feasible or necessary for most programs.

***How often should you evaluate your marketing strategy?***

We continually evaluate our marketing strategy, but most intensely when gearing up for the next application phase. In addition to looking at application statistics, we make sure that the information we provide still aligns with our program goals and logistics. We are always in dialogue with our students during the summer program, and seriously consider both the direct feedback we receive and the written evaluations students turn in at the program's end. Students' comments can lead to new and exciting program features to include in the next advertising round. Students can also give you direct feedback about the information you provide on your website. For example, we thought the information on our website concerning travel costs was clear, but students—who often have a different perspective and concerns about financial issues than program administrators—let us know otherwise through their questions. Hence, in the first years of our program, we did quite a bit of fine-tuning based upon direct student feedback and student inquiries throughout the year. As a general rule of thumb: If the same question is asked repeatedly, it is probably time to change something on your website.

***What tools do you use to evaluate your marketing strategy?***

We gather the first marketing-relevant feedback via our online application form by asking students to indicate how they heard about our program. In almost all cases, students indicate that they found the ASP via an online search or heard about the program from a professor at their home school. In other cases, students have heard about the ASP from a friend or saw our poster on a bulletin board at their university. Our external evaluator provides more detailed statistics regarding marketing effectiveness as a result of pre- and post-program surveys. We consider all this data when reassessing our marketing approach.

**BRINGING IT ALL TOGETHER: RECRUITMENT AT BERKELEY AND LMU**

Berkeley has a comprehensive marketing approach that combines attending targeted science undergraduate research conferences; campus visits to selected colleges and universities; summer research presentations and workshops; and an email campaign that encompasses faculty, staff, and students across the nation as well as national research program directors and participating institutions of national research agencies.

At each event, student data are collected, including contact information, program interests, career goals, and degree majors. This information is sent to staff at various summer programs and to academic departments, and additional information is sent to the students about the Berkeley summer programs along with an invitation to apply. The effectiveness of these efforts is determined based on an increase in the number of students attending the events, the number of those students applying and participating in summer programs, and eventually the number of these students who enroll in Berkeley's graduate programs.

Personal contact campaigns take more staff time but have been the most effective recruitment strategy in increasing the number of students who accept Berkeley's offers. The ASP at Berkeley is consistently rated very highly by participants and is particularly successful in recruiting students with diverse backgrounds.

At the ASP at LMU, we employ all of the marketing methods and tools described in this chapter and have consistently increased or maintained a highly competitive and diverse application base. We embrace the international character of our program and use our multinational alumni network to continue to reach out to target groups throughout Europe. Since 2009, we have successfully recruited over 150 excellent young international researchers based on approximately 1,500 applications for our undergraduate summer research program.

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**LESSONS LEARNED****Target specific groups, address cultural differences, combine resources**

**Target difficult-to-reach groups.** Some student groups may be difficult to reach despite an excellent website and eye-catching posters, and may require specific recruitment strategies. For example, if the goal is to increase diversity, the recruitment plan should include attending research conferences with a majority of diverse undergraduates attending and targeting research programs, faculty, and universities with a large and diverse student body.

The ASP sites in Europe found themselves faced with this issue. We were repeatedly disappointed by the low number of qualified applications from a particular country, which we felt should be well represented based on educational statistics. Whereas an increase in e-card contacts worked well to increase applications in other targeted countries, this approach did not have any effect in this particular country. A translated poster also had little effect. We were able to meet with a representative of this country at a higher-education marketing conference and only then learned that the problem had much more to do with the actual application process—in particular, the required reference letters, which have a very different format and function in that country. Although we were not able to change our application process, we decided to use contacts more strategically at key universities in the targeted region. This led to a more favorable result.

**Address cultural differences.** Understanding cultural differences can increase the effectiveness of your marketing campaign or recruitment strategy. For instance, some populations or cultures will respond more positively to personal contact and networking than to general outreach efforts. Track your efforts to determine the effectiveness of each strategy and use your existing or emerging multicultural base to build up and strengthen existing marketing strategies.

Our group at LMU is always highly international; in our first year, for example, we had 19 nationalities represented in a group of 25 students. There is a great deal of culture sharing throughout the program, which tends to bring the group together. Students who consider applying to our program are generally encouraged by its international character, which we highlight on our website. Our alumni are also an excellent resource when targeting students in their home countries. Many are involved in networks of young scientists and are happy to serve as program ambassadors after returning home.

**Take advantage of your marketing network.** Marketing is about getting the word out. Once the appropriate tools have been created, use your existing networks to let people know about your program. An eye-catching and clearly laid out e-card is an effective way to quickly inform a large number of contacts. Use your department and university mailing lists and be sure to ask your colleagues to pass on the e-card to scientific collaborators or others who are in touch with students.

Are you in contact with business and industry leaders interested in promoting science? By reaching out to partnering research institutions and industrial partners, we have been able to increase the visibility of our program to nonstudent stakeholders and, in turn, to potential applicants via researchers in those networks. Keeping in touch with these stakeholders via email updates and personal meetings is an important component of our marketing strategy, and it has led to combined marketing campaigns and increased program visibility.

We are also in the fortunate position of being able to partner with a number of outstanding European and U.S. universities represented by the European Coordinating Centre and the Amgen Scholars Global/U.S. Program Office (GPO) (see page 17), which allows us to combine our marketing efforts strategically using the best resources available. As an individual ASP site, we also have access to a vast network of international contacts and services through our university's Office of International Affairs. Many U.S. universities have an Undergraduate Research Office, which may be able to help in advertising summer research programs. Be sure to reach out to every resource available to get the word out about your program effectively. In just its first year, the ASP at LMU received about 150 applications for the 10-week summer research program thanks to a combined marketing effort.



## Best practices at a glance

### **Define your marketing targets and goals based on the goals of your program, the budget at hand, and the best time frame**

- Consider geographical issues in targeting participants
- Enlist program alumni to reach eligible students
- Focus on the tools that reach your target audience
- Establish a recruiting time frame

### **Create a clear, concise, and catchy website with attractive images and links to further details**

- Include all of the information your potential students and other stakeholders need to know in an intuitive format
- Use search engine optimization tools to make sure your site is easy to find online
- Include faculty profiles and alumni statements to highlight certain aspects of your program

### **Use your extended network to get the word out using marketing tools such as e-cards and flyers**

- Keep your program recognizable by reusing key images and colors in your marketing tools
- Regularly update and expand your network list to ensure you reach your target audience
- Enlist alumni to distribute the e-card to potential applicants or their university contacts—successful program participants are the best advertisement!

### **Continually evaluate, reassess, and update your marketing strategy**

- Ask yourself: Are students sending inquiries? Did you meet your goal regarding student applications? How did students find out about your program?
- Maintain a constant dialogue with students during the summer to get direct feedback on your website and other marketing tools
- Consider bringing in an external evaluator for detailed statistics based on surveys

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**CHAPTER 3**

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# Designing an Application Process

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**A** well-designed application is a critical component of a new summer science research program. It will allow you to easily identify the students who are eligible for the program, and help you select the applicants that are the best match for the program.

The total number of applications to the Amgen Scholars Program (ASP) has skyrocketed over the past eight years, from just 2,246 applications for 10 sites in 2007 to 7,945 for 10 U.S. and 3 European sites in 2014. Each site solicits and receives its own applications and is responsible for selecting participants that are not only eligible but also able to fulfill the program's goals. To facilitate this process, the ASP has identified a number of best practices to ensure an effective application process. This chapter explains the key steps to creating such a process for your undergraduate summer research program. Remember that designing an application is a dynamic process that you should revisit every year.

## Establish a timeline

There are two key questions you should answer before beginning the design process:

### **When will your summer program begin?**

The answer to this key question will set your application cycle in motion. Most commonly, the start and end dates will coincide with the summer session on your campus, as dormitories will then be available to house your summer students. Most programs that host students from other campuses have application deadlines between February 1 and 15. For example, in 2015, nine of the U.S. ASP sites had a deadline of February 2, and one (California Institute of Technology, Caltech), had a deadline of February 14. Those programs begin in either May or June. All three European ASP sites had a deadline of February 2, but the programs don't start until June or July. The two sites in Japan also had a delivery deadline of February 2 and started in early June and July. Given these timeframes, an early February deadline is a good choice as it ensures that admissions decisions are made early enough to capture the best students before they commit to another summer program.

### **When will the application be available?**

Most students submit their application materials in the last two weeks before the deadline. However, inquiries begin in November, as students use the Thanksgiving holiday to search for possible summer opportunities. If your application is in place by mid-November, students will have ample time to contact you with questions. In addition, many students will start submitting materials over winter break.

## Create an online application

For administrative purposes, an online or web-based application is superior to a paper version. An online application is secure; it allows students to create an account where they can enter, save, and submit their information; and it facilitates easy export of student information to a spreadsheet for analyses. Perhaps most important, an online system can send automated application-progress updates, eliminating time-consuming email correspondence between applicants and the program office.

The ASP sites use a variety of application interfaces, including web-based campus portals and online services such as SurveyMonkey.com or KwikSurveys.com. Online services can be limited, however, as some cannot accept the multiple uploaded documents necessary for a complete application. To circumvent this problem, students can email their application documents to a single email account. However, a dedicated staff person will need

to respond to and catalog the documents. At the University of California, Los Angeles (UCLA), we recommend that summer programs find a division within the university that already has a secure online application in place. This may be the Human Resources Office or Graduate Division, as these units need secure servers to receive résumés as well as student applications and recommendation letters. The Graduate Division often will be a willing partner, as summer research programs provide an opportunity to reach out to potential graduate students. If you can modify an existing application portal to meet your needs, you will save yourself the prohibitive cost of creating a campus application system from scratch.

## Determine the content

Once you have an online portal, it is time to design your application. In general, applications for summer research programs have the following five sections. You should customize the application for your program.

### The personal-information page

Creating prompts for **demographic data** is often the best place to start. The demographic information page should contain the following entry fields: name, home address, school address, telephone, email address, gender, major, and the university or college that the student attends. Gender is particularly important to gather if the students will be housed in shared facilities.

We suggest using the next entry fields to confirm **student eligibility**. For example, the Amgen Foundation requires that all scholars for the 10 U.S. sites be U.S. citizens or permanent residents, sophomores or above, and have a cumulative grade point average (GPA) above 3.2. Eligibility inquiries can include citizenship status (U.S. citizen, permanent resident, visa status, state residency); ethnicity (if required by your institution for federally funded programs); GPA (number); year in school; and proposed graduation date. You should also ask your university administration or funding agency if they require additional information. Other common entry fields are financial-aid status (to determine eligibility for funding) and educational level of parents (if the program is specifically for first-generation students).

Occasionally, students have their own funding for summer research. This may make a student either more attractive or ineligible for your program. We recommend that you specifically ask if the student is involved in a research program that provides support for summer research. In this way, there are no surprises after a student is selected. A sample question is: "List any local or national undergraduate programs that support your research." Then offer a list of check boxes. Common programs include Maximizing Access to Research Careers (MARC), Mellon Mays Undergraduate

Fellowship (MMUF), Howard Hughes Medical Institute Exceptional Research Opportunities Program (HHMI EXROP), and McNair Scholars.

The next questions on the application should focus on whether or not the student can **fulfill the goals** of the program. The ASP seeks participants who are interested in pursuing a Ph.D. or an M.D.-Ph.D. after graduation. On the personal information page, we explicitly ask about the student's career interest: "What is your ultimate degree objective?" Then the student selects from a variety of options (M.D., Ph.D., M.D.-Ph.D., Dentistry, M.P.H., and M.S.). The answer to this question makes it easy to determine if the student's career interest and the program's goals match.

You may also need to ask questions about possible time conflicts with the applicant's undergraduate program or concurrent summer-school enrollment. Answers to these questions will prevent conflicts that may arise just before your program begins.

### **The personal statement**

Information from the personal statement helps to gauge each student's level of preparedness for your program. The personal statement also gives applicants the opportunity to sell themselves to you by sharing their interests, successes, and career goals. Furthermore, the personal statement provides a sample of the student's writing and contains information about his or her level of commitment to and interest in your program. If a personal statement is full of typographical errors, you know that is not the student you want.

In designing questions for the personal statement, you need to determine the specific information you want to know about the student. This information, in turn, will help you determine which students best fit your program goals.

There are two styles of personal statements. The first offers a general question such as: "Tell us about your research experiences and future goals." It is then up to you and your staff to read through the essay and pull out the information you need. The second approach is to ask for specific information in several separate questions. An advantage of the second strategy is that direct comparisons among applicants are easier to make as all students provide short answers to the same questions. For this reason, many ASP sites use this second approach in designing their applications. Example questions are presented in Table 1, on page 34.

In summary, a well-crafted set of questions for the personal-statement section can give you detailed information on the applicant's background and experience. This information often proves critical in selecting the most suitable candidates by uncovering the student's true interests. For example, say that your program is focused on students interested in a Ph.D. and a research

TABLE 1: COMPARATIVE PERSONAL STATEMENT

| Question  | What the answer can tell you   |
|---|--|
| 1. Describe any prior research experience or Describe activities where you collaborated or worked as part of a research team. <i>Be explicit—provide the faculty mentor’s name, department, dates, summary of project, and list of techniques used.</i> | This question allows you to gauge the experience level of the applicant. The answer also may facilitate matching with faculty mentors who have a preference for students with more (or less) experience. |
| 2. What are your academic career goals and how do you plan to reach them? How will this program help you reach your goals?  | These questions allow you to determine whether your program’s goals align with the career goals of the student.  |
| 3. List extracurricular and community activities. <i>Give a time frame—say, the last three years.</i>   | This information helps you evaluate whether the student’s extracurricular activities are in line with his or her career goals.   |
| 4. List honors, awards, and other recognition.  | This information helps you identify students who have already been recognized for their excellence.  |
| 5. Are there additional factors in your background or life experiences that would help you benefit from this program? Discuss social, economic, educational, or other obstacles, if appropriate.  | This question often helps you to predict if the summer experience is likely to be transformative.  |

career. A student may check a box claiming a Ph.D. career interest, but the list of extracurricular activities may show a stronger interest in a medical degree.

### The transcript

The transcript confirms that the student is enrolled at the institution listed on the application and his or her GPA. It also helps you gauge the student’s level of preparation for research. The ASP requires that students complete their sophomore year, but freshmen with advanced placement or community college units may apply. By looking at the transcript, you can confirm

whether students meet this eligibility requirement. For the ASP at UCLA, we ask that the applicant submit an “unofficial” transcript for the application process. Upon acceptance to the program, we request that the registrar mail the official transcript to verify the GPA. This procedure saves everyone time, money, and paper, as an unofficial transcript can be sent by email or uploaded into an application.

### **The letter of recommendation**

The letter of recommendation is an important tool for learning more about the student’s experience and potential. It is important to provide specific instructions for the letter of recommendation so that both the student and the letter writer are fully informed about who should be writing the letter and what type of information should be included.

**Who should write the letter?** The ASP requires that a faculty member, rather than a counselor or a graduate teaching assistant, write the letter. Faculty have the experience to compare the current student to others they have mentored, and are in the best position to evaluate the student’s potential as a future Ph.D. candidate.

**What should the letter contain?** The content we request focuses on the student’s exposure to research and his or her potential for graduate school. Sample questions for the letter writer include:

1. How long and in what capacity have you known the student?
2. Describe the student’s motivation for graduate study versus aspirations to attend professional (e.g., medical) school.
3. Describe the student’s qualifications and potential for research and academic success.

We ask that the letter be signed on professional letterhead as a way to ensure that it is written by the faculty member and not by someone else on the faculty member’s behalf.

Before finalizing the instructions for your letter of recommendation, you should consult with your campus counsel and familiarize yourself with the Family Educational Rights and Privacy Act (FERPA). The standard waiver form, which accompanies the letter of recommendation, asks students whether or not they waive their right to read the letter. The student should indicate who will be writing the letter, sign the form, and give it to the faculty member. In this way, the letter writer will know in advance if it is a confidential letter. As a procedural suggestion, we recommend that the faculty member submit the signed FERPA form with his or her letter of recommendation. This extra step ensures that the faculty member is informed.

Finally, the letter must be easy to submit—either via an online or email mechanism or fax, or through the mail. The deadline for submission must be clearly stated in the instructions. From our experience, it is best for students to be responsible for ensuring that the letter is received on time. That way, it is up to them to remind their letter writers of the submission deadline.

A final question to consider is whether to request one or two letters of recommendation. The ASP sites vary on this point. Some programs always ask for two letters, as a way to look for similarities (or differences) between the two recommenders. Other programs find that it is difficult for students to identify two faculty members who know enough about them and their research to write on their behalf. In the end, there is no right or wrong choice.

### **The faculty-identification section**

Some summer research programs use the application to jump-start the process of matching students with faculty mentors. The UCLA application asks students to list five faculty members with whom they would like to work and to briefly explain why. This information ensures that students have taken the time to seriously consider the specific program and ensures that we will select a cohort of students with varied interests. If you choose this option, make sure that the student knows which faculty members on your campus are available to them. This may be done by providing a list of faculty (see, for example, [www.ugresearchsci.ucla.edu/amgenfaculty.htm](http://www.ugresearchsci.ucla.edu/amgenfaculty.htm)) or departments affiliated with disciplines that are in line with your program. By indicating preferred faculty mentors, the students have an additional opportunity to articulate their research preferences. Adding this section to your application can also serve as a selection tool. Students who clearly articulate their interests may prove to be better candidates for your program than those who just list five names and say the faculty seem “interesting.”

## **Develop a format for processing applications**

### **Communicating with students about the application**

When dealing with a large pool of applicants and applications with multiple components, it is critical to keep students up to date on the status of their application. Students want to feel respected. That’s why they often choose either the first school that accepts them or the one that is the most communicative. We recommend that you email students not only when the application is missing items but also when it is complete.

To start, determine if the applicant is eligible for the program and immediately inform any student who is ineligible. In the ASP, the two most common reasons for ineligibility are that the applicant does not have a high enough

GPA or is not in the correct year in school. These two elements can often be gleaned from the first stage of the application, long before the other components arrive. By immediately notifying ineligible students, you reduce the work for everyone.

A final recommendation is to inform students of your ultimate decision as soon as possible. Give students a date by which they should expect to hear a decision, preferably within four to six weeks of their submission deadline and *adhere to your announced deadline*. At UCLA, we let students know if they have been accepted to the program, are being declined, or are being placed on the waitlist around March 1, or one month after the submission deadline.

### **Faculty Review Committee and final selections**

Once all the materials are in, the hard part begins: review and selection. Given the academic nature of summer research programs, we strongly suggest that a committed group of faculty from diverse scientific fields assess your applications. The faculty should reflect the range of fields available in your program. For the ASP, this includes bioengineering, chemistry, physiology, neuroscience, immunology, molecular biology, and genetics. At UCLA, we give the faculty on the committee a small honorarium for their lab research, a gesture that they appreciate in these difficult financial times and that builds loyalty to our program.

Most summer research programs use a two-step review process in which the applications are screened to identify a smaller group for more in-depth review. For example, at UCLA we have two directors, and both review all the eligible applications to choose the strongest 100 (out of more than 650 submitted). For this preliminary review, we judge the match according to our program requirements, the extent of the student's research experience, the strength of the research mentor's letter of recommendation, the student's GPA, and the essays in the student's personal statement, including the section on life challenges.

The strongest 100 applications are then sent out for a detailed review to members of the Faculty Review Committee. All faculty reviewers receive a detailed guide for the evaluation process that includes our programmatic preferences. For example, we have a preference for Ph.D.-oriented rather than M.D.-oriented candidates, and give additional consideration to students from small liberal arts schools who have little opportunity to conduct research. All parts of the application should be considered in the review, and a ranking mechanism should be created to numerically compare the various components of the application for each student (see sidebar "UCLA: Developing a Ranking Mechanism"). Every faculty member receives a personalized Excel spreadsheet that includes each applicant's name, gender, home institution, major, and GPA on which to record his or her evaluations.

Most ASP sites send each application file to two faculty reviewers on the Faculty Review Committee to ensure uniformity in the evaluation. The scoring patterns of individual reviewers should be noted, as those new to the review process may rank all students more harshly or more easily.

#### UCLA: DEVELOPING A RANKING MECHANISM

At UCLA, we first evaluate students using a **grading criteria**. The grading is scored from 1 to 5, with 5 being the highest (best) score, and 1 being the lowest (worst) score. Intervals can be used to evaluate students (e.g., 3.5 for a student between 3 and 4). The three categories being evaluated are the student's letter of recommendation, personal statement, and overall potential. The category of "potential" is based on the student's experience as a researcher, his or her GPA, and the degree of difficulty of coursework taken, while also taking into account the personal statement and letter of recommendation. A perfect score, then, is 15 points.

We then evaluate the grades using a ranking criteria. Once all the scores are received, the two faculty reviewers' scores are summed, the students are sorted by final score, and then all students are rank ordered.

Before making the final decisions, we consider other elements, such as gender matching (for programs with housing that requires roommates) and faculty matching (students should be interested in diverse areas to facilitate lab placement).

Once the review is complete, your institutional budget will determine how many applicants you can accept. At UCLA, we generate two lists: the students to be accepted and an equal number of students to be waitlisted. In this way, we are certain to fill all slots. As mentioned earlier, students apply to multiple programs so a percentage of them are likely to decline your offer.

When making offers, the general rule is to give selected students 7 to 10 days to consider whether or not they will accept the offer. At UCLA, we also ask students who are waitlisted to confirm that they want to remain on the waitlist. Asking for confirmation ensures that only students who are truly interested in your program will remain on the waitlist. As soon as one student declines, you can immediately offer that position to the next student on the waitlist. Occasionally, a student will cancel at the last minute, leaving you suddenly short of a participant. If you have a long waitlist, matched by gender, you can make an offer to fill an available slot even close to the time that the program begins.

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**LESSONS LEARNED****Be consistent and flexible**

As the ASP sites have reviewed many thousands of applications, we can offer you two key lessons learned from dealing with the process:

**If your program is focused on students with a specific career goal (such as attaining a Ph.D.), the application should ask about the student career goals in several sections.** Students sometimes respond with what they think program staff want to hear, and submit that answer to boost their chances of acceptance. So be sure that the discussion of career goals is found in several places: for example, a check box of possible careers in one section, an essay on career goals in a second section, and a summary of extracurricular activities in a third. By comparing the responses in all three sections, the true goal of the student should be apparent.

**Be flexible when it comes to hearing back from students about their acceptance to the program.** Students are often juggling multiple applications and are waiting to hear back from several programs. It is absolutely acceptable for students to ask for an extension in order to wait to hear back from another program. However, it also is acceptable for you to ask if that is why they want the extension. You will always have a waitlist to fall back on if students decide to go elsewhere. Giving them a few extra days will often count in your favor: Students will want to come to your program because they were treated respectfully during the application process.

Developing an application process for a summer research program involves much more than simply designing a student application. It represents the creation of an important data-management file that will be used to record and evaluate student information. Others on your campus who run research programs or handle personnel applications, such as the Graduate Division or Human Resources Office, may be able to advise and assist you. Perhaps they can work with you to create an online portal or, at the least, to advertise your program. Collaboration is critical between staff and faculty to ensure that the quality of participants remains high. However, none of these elements will work if you don't have a clear and secure application process in place.



## Best practices at a glance

### **Design a timeline with your program start and end dates in mind**

- Open the application process early
- Be available to answer students' questions

### **Use an online application if possible**

- Gather demographic information
- Gather information to confirm eligibility
- Design questions that make it easy to determine if the student's career goals fit the program's goals

### **Ask for essays, letters, and other materials that give you insight into the applicant**

- Require a personal statement, a transcript, and letter of recommendation
- Have students describe their preferred research experience

### **Keep an open line of communication with the applicant during the selection process**

- Respond quickly and politely to inquiries
- Keep to dates and deadlines for reporting decisions

### **Create a review mechanism to fairly evaluate the applicants**

- Establish a Faculty Review Committee
- Prescreen applications so only those that are eligible and competitive are reviewed by faculty
- Give the faculty a review guide so that all students are judged in the same manner
- Place the highest-ranking students on both your accept list and waitlist

# Laboratory Matching and Placement

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**A**n effective summer research program provides research training and hands-on laboratory experience to undergraduates. It prepares students for graduate school and careers in science and engineering by exposing them to cutting-edge research in their selected fields. Students benefit from partnering and fully engaging with their faculty mentor and their lab mentor—a postdoctoral fellow or graduate student who serves as the student’s day-to-day supervisor.

The lab experience forms the foundation of any undergraduate summer research program. It ignites students’ passion for learning and science, solidifies their research interests, and spurs intellectual curiosity and discovery.

It also enhances their team-building, communication, and professional-development skills, enabling them to contribute more to the lab itself and, ultimately, to the scientific community at large.

Hence, matching students to the most appropriate lab is a key factor in ensuring student satisfaction as well as a program's long-term success. Indeed, students often report that lab-placement is a major factor in their choice of a summer program. However, the process of matching students to labs varies depending on the structure, goals, and desired outcomes of the summer program as well as its lab training, mentoring, and professional-development requirements.

In making the match, it is important to consider each student's research experience and interests as well as each faculty member's interests, availability, and ability to host and mentor students in the lab. An inappropriate match can compromise the summer research experience for both the student and the lab. Students benefit from a lab experience in numerous ways. For some, the lab experience is an introduction to conducting research, understanding the scientific method, developing hypotheses, and learning lab procedures and protocols. Students with prior research experience can sharpen their lab skills, discover new areas of interest, and enhance their independent-research skills.

This chapter explores the various types of placement strategies the Amgen Scholars Program (ASP) uses in matching students with labs.

### **Identify the best placement process for your program**

Understanding a variety of placement models enables program staff to match summer scholars with the best and most appropriate faculty lab. When determining the best placement process for your summer program, you must consider several factors: the number of faculty mentors available, the range of disciplines that your program may offer, and the overall goals and objectives of your program.

The ASP uses four primary strategies in matching students to labs, as Table 1, on page 47, shows. The information that students provide on their applications—the essay, research or personal statement, research interests, previous research experience and lab skills, and specific lab or faculty preferences—is critical in shaping the decision in each model.

However, the timing varies among ASP sites regarding when students are asked to identify and rank their research areas of interest. At some sites, students are asked on the application to identify the faculty labs they are

interested in working in and to rank their research-interest areas. Others ask for applicants' specific research interests only after they are admitted. Some permit accepted scholars to search for and directly contact faculty with whom they wish to work during the summer. Identifying the best placement process for your students and labs will help ensure the ongoing success of your program.

**ASP MODEL 1: Accepted and matched simultaneously.** In this model, students receive a list of pre-selected faculty labs along with their application materials, and they are admitted to the program and placed in their lab at the same time. They learn about their lab match when they receive their acceptance letters.

**Placement process.** The ASP at the University of Washington (UW) used this model. Each fall, staff at UW compiled a list of previous and new faculty mentors. The final list comprised faculty from a broad range of STEM (science, technology, engineering, and mathematics) disciplines that represented various campus departments. Applicants identified and selected their top three faculty preferences from the pre-selected list and submitted a short essay on why they were interested in each lab. They also selected and ranked additional faculty from the pre-selected list as part of their preference list.

Program staff reviewed and ranked all applications received. The top-ranked applications were sent to the applicant's first and second faculty-lab preferences, and to the third choice as needed. Faculty mentors selected and ranked the applicants they wanted from approximately 10 applications. The program staff reviewed the rankings and matches on a spreadsheet to ensure that the highest-ranking applicants were matched with their top faculty choices.

**Benefits of using this model include:**

- Students are often able to accept an offer more quickly because they know right away that they will be working with their first or second faculty-lab choice.
- Faculty mentors are quickly informed who their lab-team members will be for the summer. In addition, they have a stake in the program and a sense of ownership because they select the participants they want for their labs.
- Faculty mentors have greater choice in determining the types of students who will work in their labs. For instance, one faculty mentor may want a student with little or no research experience, while another faculty mentor may prefer a scholar with more advanced skills and greater research experience.

**ASP MODEL 2: Accepted with match pending.** In this model, students are accepted but not matched with a faculty lab until they agree to participate in the program.

**Placement process.** The ASP sites at Columbia University/Barnard College (Columbia), Harvard University, Washington University in St. Louis (WUSTL), Karolinska Institutet, Massachusetts Institute of Technology (MIT), Stanford University, University of California, Berkeley (Berkeley), University of California, Los Angeles (UCLA), and University of California, San Francisco (UCSF) use this model. Applicants are given access to direct links to the research of faculty from a broad range of fields, disciplines, and departments, and are asked to indicate their top three faculty-lab choices within an online application. The placement itself comes after students accept the offer to participate in the program. Faculty mentors work with program staff to make placements at most ASP sites.

For instance, at Berkeley students receive a guarantee that they will work in their research area of interest and that their faculty preferences will be strongly considered when making a lab placement. In addition, faculty mentors assist in placing students not only in their own labs but also in the labs of other faculty in their discipline. In doing so, they consider various factors including prior research experience, size of the lab, and the lab environment before requesting a prospective faculty mentor to host a student.

The ASP at the National Institutes of Health (NIH) uses a variation on this model. During the application process, the NIH holds a mentor award competition in which faculty mentors/Principal Investigators (PIs) and postdoctoral fellows provide information about their projects, a description of their labs, and other details about their working method. A committee of staff from the Office of International Training and Education (OITE) judge the contributions, and the winning labs are selected as host labs for the summer research program. Once students accept an offer to participate in the ASP at the NIH, they choose their top-five PI/lab choices from those that have received awards. They learn which lab they will work in after they arrive for the summer.

**Benefits of using this model include:**

- Students know that they will conduct research in their desired area of interest. They have the opportunity to rank their top three faculty labs, knowing that their preferences will play a key role in the matching process.
- Students have more choice regarding the faculty they want to work with because lab placements are not contingent on a pre-selected faculty list but generated by the applicant's research interests and faculty preferences.

**ASP MODEL 3: Accepted with opportunity to find your own placement.**

In this model, students are accepted into the summer program and given the opportunity to find their own lab placement.

**Placement Process.** The ASP at the University of California, San Diego (UC San Diego), used this model. Students admitted to the UC San Diego program received lists of faculty mentors, previous faculty mentors, alumni student profiles, and specific UC San Diego departments. They then reviewed several of the faculty labs that matched their research interests, and received guidance and information on contacting faculty to request placement. The program staff set deadlines and monitored the progress of students in finalizing their placements.

**Benefits of using this model include:**

- Students had more flexibility in choosing their lab placement and the unique experience of independently contacting faculty directly.
- Because program staff provided assistance and guidance as needed or if problems arose, students formed relationships with staff and faculty even before the program started.

**ASP MODEL 4: Matched before acceptance.** In this model, students must develop a project with a faculty mentor before they are accepted into the program.

**Placement Process.** The ASP at the California Institute of Technology (Caltech) uses this model. Applicants first identify a potential faculty mentor by a variety of means: faculty members' postings of available summer research projects; access to faculty databases to search faculty labs by area, discipline, or faculty name; booklets with abstracts of previous research projects; and networking with faculty and academic advisers, program directors, and other students who can recommend possible mentors. They discuss and collaboratively develop a research project with that mentor, and then write a project proposal as part of the application process. A faculty committee reviews the proposals and determines which students will receive offers to participate in the program. Students who accept the offer join the lab of the faculty mentor with whom they partnered to develop their project proposal.

**Benefits of using this model include:**

- Applicants have the unique opportunity to collaborate with faculty mentors even before they are accepted into the program. This means that even those students who are not accepted have an invaluable intellectual experience: writing a scientific proposal.

- Faculty determine in advance not only the type of students but also the types of projects they will be accepting into their labs.
- Students form relationships early on with their faculty mentors, academic advisers, program directors, and alumni of the program.

### **Be flexible in developing your own placement model**

Several ASP sites use different placement models from those described on the preceding pages. Some combine elements from various models while others have developed their own process for matching summer students with faculty labs. Examples include:

- Some ASP sites place students with any faculty member who is able to provide a research experience for a student and interested in dedicating his or her time as a mentor. In this option, the research interest area of the student is not as relevant as in other options. It may be particularly attractive to students who are just getting started in research.
- Other sites provide a list of potential faculty but also permit applicants to work with some faculty who are not included on that initial list.
- One ASP site gives students a tentative list of faculty and a description of their research, with the goal of having the student and the faculty member select each other. Accepted students are asked to identify their top four faculty mentor choices. The program sends the students' applications to their faculty choices and those faculty mentors choose the students for their lab. The program staff and faculty directors review the results to ensure that each match is right for both the student and the faculty mentor.
- Another ASP site compiles a list of potential faculty mentors. Accepted students select their top five or six choices. They then write three essays, each focusing on a different theme: 1.) their prior research experience, 2.) their career goals, 3.) their ideal job in 10 years. They include in the essays why they want to work with the faculty mentors they have selected. The chosen faculty mentors review the students' applications and essays and select who will work in their lab. The placement is made when the faculty mentor and the student confirm the choice.

**TABLE 1. ASP LAB PLACEMENT MODELS AND THE MATCHING PROCESS**

| <b>Lab Placement Model</b>              | <b>Faculty Mentor List</b>   | <b>When Placement/ Match Occurs</b>  | <b>Faculty Selection and Contact</b>  |
|---|--|--|---|
| <b>Accepted and Matched</b>             | <p>Pre-selected list is available before applicants apply</p> <p>Faculty list and research areas do not vary</p> | <p>Offer and match occur simultaneously</p> <p>Scholars knows faculty match before accepting an offer</p>  | <p>Program staff contacts faculty for placement</p> <p>Faculty select and rank students</p> <p>Highest-ranked students matched with top choices</p>                                     |
| <b>Accepted and Match Pending</b>       | <p>Students get direct access to faculty links</p> <p>Faculty and research areas vary</p>                        | <p>After student accepts</p> <p>Faculty match is pending</p> <p>Process does not start until offer is accepted</p> <p>Students are informed before or after program starts</p> | <p>Program staff contacts faculty</p> <p>Faculty availability determines placement</p> <p>Faculty/student mutual selection</p> <p>Students' essays, preferences strongly considered</p> |
| <b>Accepted and Find Your Own Match</b> | <p>Students receive various faculty lists</p>  | <p>After student accepts offer</p>   | <p>Student contacts faculty directly with guidance from program staff</p>   |
| <b>Matched Before Accepted</b>          | <p>Students get access to various resources describing faculty</p>   | <p>When a student's proposal is accepted, he/she receives an offer to participate</p>  | <p>Student contacts faculty directly</p>  |

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**LESSONS LEARNED****Prepare faculty backup lists and follow-up processes**

Every summer research program encounters challenges no matter which placement model is used. These include the following:

**Faculty availability will vary and may be more limited than program staff initially expected for various reasons.** For example, a faculty member may commit early to hosting a student, but may no longer be available once the placement process begins. Or faculty on campuses with a number of summer research programs may have their student lab spots filled before your applications are all in. Consider having a backup list of potential faculty mentors to place students with, or see if some available faculty might have the space to take more than one student.

**Sometimes faculty mentors do not respond to a request to host a student in the lab or may respond too late.** Establish a follow-up process with faculty to avoid this. In most cases, the follow-up results in a match, but when it does not, program staff will know early enough to identify another faculty mentor.

**Sometimes the placement process takes longer than anticipated.** Therefore, it is a good idea to have a follow-up process in place to keep the process moving forward. Sending a reminder to the prospective faculty mentors and/or to their administrative assistants can often elicit a response, indicating whether program staff need to identify another faculty lab.

**A placement may not work out.** For example, students may not have the skills necessary for the project, their research interests may not have been clear, or the lab environment might not be a good fit. In such cases, program staff or faculty mentors can suggest other labs for the student.



## Best practices at a glance

### **Identify the best placement process for your program**

- Evaluate options considering available faculty mentors, range of disciplines, and the goals and desired outcomes of your program
- Ascertain how timing will affect your choice

### **Be flexible in developing your own placement model**

- Prepare for challenges such as placements that do not work out or faculty mentors who respond too late to a request
- Prepare faculty backup lists and follow-up processes

### **Evaluate and revise the process based on outcomes**

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**CHAPTER 5**

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# Student Preparation and Orientation

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**T**o get the most out of a summer research program, students should be well prepared. But what type of information should you provide them with? This section will explore the different ways to prepare students.

The preparation period begins as soon as students are informed of their acceptance, continues through the exchange of information in the weeks leading up to the program start date, and culminates with an Orientation as the program commences.

Remember: Your students' success will be your success. Preparing them at the outset for a great experience will lead to a stronger program in the end.

## **Make students feel welcome, define expectations**

When students come to your campus from another institution to embark on research, they will need help transitioning to this new environment. Most important: Make them feel welcome! Simultaneously, share your expectations with them starting with the official acceptance notification via email or a phone call.

In some cases, the summer program may be the first time some students have boarded an airplane or left their hometowns. They may be concerned about campus life or the expectations of their new faculty mentor. Tell them upon acceptance, in writing, that you expect them to participate fully in an 8- to 10-week research program (depending on the length of your program). Let them know that they cannot take additional courses or go on a vacation during that time. You also need to be explicit about the relationship they will have with their faculty mentor and with the graduate student or postdoctoral fellow who will mentor them directly within the lab.

## **Create a sense of belonging**

Helping students prepare for summer research engenders a sense of belonging. To reinforce this sense, invite students who are local or from your home campus to serve as “ambassadors” for your program. Have them reach out via email or Facebook to welcome the students coming from afar. Local ambassadors are particularly useful if your institution is located in a major city where travel is complicated. In addition, in residential programs it is comforting for students coming from a distance to have a local person as a roommate to show them the sights and escort them around campus during the first few days. If all your students are from outside your region, the program staff can fill this role by creating a Facebook page and encouraging students to connect, or by creating buddies (perhaps future roommates) and asking them to get to know one another.

## **Confirm matching, prepare for research**

The first question many students will ask upon acceptance is: “Who will my faculty mentor be?” In many cases, that initial phone call or email will launch the matching process. Other students may have already listed their faculty-mentor interests on the application. What’s most important is that you assure students that their interests are paramount and that you will do your best to ensure that they are placed with the best mentor possible in their field of interest. (See Chapter 6, “Mentoring,” for details on matching students with mentors, as well as Chapter 4, “Laboratory Matching and Placement.”)

Once matching is complete, communication between students and their faculty mentors should begin. At the University of California, Los Angeles (UCLA), we ask faculty mentors to provide a reading list for their mentees well before the program starts as part of this communication. We have found that when students read materials before arriving, they are better prepared to hit the ground running. The reading list also opens the door for discussion of project options. Other programs prefer that the project discussion take place after the student arrives on campus. Choose the approach that works best for you.

How do you start the conversation between students and their mentors? Some programs ask the faculty to initiate communication with students, as students are often too shy to call or email a faculty member they highly respect. Other programs have the students initiate the process so that they understand their role in fostering the relationship. Regardless of how communication begins, faculty members must show that they are invested in the student's project and in his/her contribution to the laboratory's work.

Many ASP sites use this early dialogue as a starting point for developing a brief pre-program proposal. At UCLA we ask faculty mentors to help their students prepare a two-page paper that delineates the project's background, its goals, the methods to be used, and the expected outcomes, along with a reference list that includes the papers provided earlier. This exercise, we have found, focuses students on the project, gets them excited about what they are going to accomplish in the coming weeks, and leads them to read even more, outside the faculty member's reading list. It also gives them a "talking point" when they arrive on campus and their peers ask them to share what they will be doing. This boosts their confidence, as they may be coming from a campus where research is not emphasized.

It is also important to learn from faculty mentors what safety trainings their student scholars need to complete to be ready to work in their lab. Communicate with the Environmental Health and Safety department on your campus to set up any necessary trainings: If your program is large, you may need to ask that sessions be created for your students. These might include sessions on general laboratory safety, chemical fire safety, or the handling of biohazards. For example, on the first day of the ASP at Columbia University/Barnard College (Columbia), the Environmental Health and Safety staff runs a two- to three-hour session instructing students on best practices regarding environmental safety, fire safety, and biological safety. The certification process for working with animals can take upwards of three months and can include both online and lab-practicum components. Such certification is possible if the student is local and can begin the process well before arriving on campus; but if the student is coming from a distance, advise your faculty that they may not be able to offer a project that requires certification for animal use.

## Schedule a structured Orientation

The start of any summer research program includes an Orientation; this can last for anywhere between a day and a week. Make sure you have someone in place to greet students on their first day and to escort them from their residence halls to the campus. Students especially appreciate a professional campus tour. Give students some time to get to know one another before

### EXAMPLE OF ONE-DAY ORIENTATION AT UCLA

#### **Engage students in icebreakers and other team-building activities**

##### **Distribute program calendars**

- Activities calendar: workshops with topics, research seminar series, presentation events or opening/closing events, group photo, socials, and GRE-preparation course information
- Writing calendar: weekly deadlines for drafts, posters, presentations, and research-paper sections

#### **Explain the stipend payment and meal cards**

##### **Describe the logistics of lab entry**

##### **Introduce mentors and the mentor-mentee role**

- Faculty, postdoctoral fellows, graduate students, and program staff

##### **Address methods of networking**

##### **Provide guidelines for attending meetings**

- Introductions
- Dress code

##### **Introduce code of conduct and campus safety**

- Campus rules, housing rules, sexual harassment, and illegal downloading

##### **Orientation to campus—including recreation centers**

##### **Orientation to community**

##### **Introduce safety trainings**

- Arrange in advance with campus officers for students to be trained during their first day on campus
- Cover research ethics and integrity
- Bring in campus officers or use online ethics courses

##### **Orientation to science buildings**

- Escort students to their labs, or have labmates/co-mentors (graduate students, postdoctoral fellows) come to your Orientation lunch and then walk students to the lab

the Orientation begins, as feeling comfortable in a new location takes time and patience.

If you choose a one-day Orientation, create a curriculum to guide students (see sidebar: “Example of one-day Orientation at UCLA”). Be sure to let students know which calendar events are required (such as program-specific activities) and which are optional (such as career workshops of interest to a subset of participants).

If you choose a longer Orientation, say, a weekend or week-long retreat, provide students with at least an overview of the schedule (see sidebar: “Sample of a retreat at Ludwig-Maximilians-Universität München [LMU]”). This second option has the benefit of serving as both an Orientation to the program and a cohort-building activity.

**Introduce the lab and mentorship experience.** The start of the program will be the first day that many students meet their mentors. Some students will have two mentors—an in-lab postdoctoral or graduate student and a faculty mentor, while others will work directly with the faculty mentor. Spend some time during Orientation discussing the best ways for students to connect with their mentors, including the dynamics of the relationships. This is key: It is expected that faculty mentors will write their mentees a recommendation letter at the end of the summer, should they ask. A solid relationship is

| SAMPLE OF A RETREAT AT LMU |   |
|----------------------------|---|
| <b>Thursday</b>            | <ul style="list-style-type: none"> <li>• Arrival in Munich (afternoon)</li> <li>• Travel to retreat location</li> <li>• Reception and dinner</li> </ul> |
| <b>Friday</b>              | <ul style="list-style-type: none"> <li>• Introduction to the LMU ASP</li> <li>• Scientific talks</li> <li>• Mountain excursion</li> </ul>               |
| <b>Saturday</b>            | <ul style="list-style-type: none"> <li>• Scientific talks</li> <li>• Lake excursion</li> <li>• Bioethics lecture and discussion</li> </ul>              |
| <b>Sunday</b>              | <ul style="list-style-type: none"> <li>• Scientific talks</li> <li>• Scientific-writing workshop</li> </ul>   |
| <b>Monday</b>              | <ul style="list-style-type: none"> <li>• Administrative matters</li> <li>• Presentation workshop</li> </ul>   |
| <b>Tuesday</b>             | <ul style="list-style-type: none"> <li>• Travel to Munich (early morning)</li> <li>• Dorm and lab check-in</li> </ul>                                   |



(PHOTO: REED HUTCHINSON, REED HUTCHINSON PHOTOGRAPHICS)

necessary for the letter to be a strong one. If students don't go out of their way to get to know their faculty mentors, this opportunity will be lost. Let students know that if they are having trouble communicating with their in-lab or faculty mentor, they can always discuss the issue with program staff.

**Stress the value of networking.** Another key element to share during Orientation is the importance of networking while on campus. At presentation events, for example, students should know that to get the most out of the event, they should introduce themselves to the speaker and ask questions. Coach students on how to dress for these professional occasions, and how to shake hands. When students meet a respected scientist, a firm handshake will make a strong impression. Have students practice these introductions with their program mates. This will serve as an effective icebreaker, as well as a valuable lesson in professionalism.

**Explain the role of key cards.** Remember to introduce the use of key cards for building access, computer access, and library access. Make sure that the mentors know what time the key cards will be delivered to the lab on the first day of the program. Discuss appropriate lab clothing and planned safety trainings as well.

**Focus on research ethics and integrity.** Most institutions have a written code of conduct, and you should share your school's code with your students during Orientation. If your summer research program has its own code of conduct, introduce students to that as well. The Amgen Foundation, for example, has its own code of conduct for its student scholars, which emphasizes integrity. Other codes important to review with students are those for campus housing, illegal downloading, sexual harassment, and other general topics. Speak with your university ombudsperson or dean of students for more suggestions on how to share the importance of good conduct with your students.

It is also important to spend some time instructing your students on the subject of research integrity and ethics. The instruction should cover plagiarism, as most programs ask students to write a research paper, as well as authorship and the assignation of the order of authors, as most students want to publish their work. A detailed discussion of how to keep a lab notebook is also in order. Some ASP sites use the ethics course offered online by the National Cancer Institute: ([ncifrederick.cancer.gov/Programs/Training/EthicsCourse.aspx](http://ncifrederick.cancer.gov/Programs/Training/EthicsCourse.aspx)). Others use similar ethics courses created by their own institutions.

**Talk about student life.** What many students want to know, however, is: “Where is the gym, and can I use it?” So be prepared to spend some time focusing on campus life. Where are the movie theaters? What are some of the fun events in the area during the summer? Is there a nearby county fair or jazz festival? Compiling a list of these types of activities will make students realize that they don’t have to do research every moment of the summer—there is fun to be had! Often memories of these social events will last long after the summer program ends. (See Chapter 12: “Student Affairs.”)

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## LESSONS LEARNED

### Clarify expectations and rules, create a community

The participants in a summer program are constantly changing as they learn and grow. That means some issues don’t come to light until late in the season. For this reason, we’ve chosen to highlight these three lessons:

**Let students know your program expectations upfront.** Give them ample opportunity to meet with program staff, so that any personal or professional issues can be dealt with right away.

**Inform students of your campus rules and lab safety.** While faculty members are responsible for the safety of the students and staff in their labs, your staff should be proactive. Ask what safety trainings are needed and facilitate the process of enrolling students. By helping faculty members ensure the safety of their students, you will strengthen your relationship with the faculty—as they will trust that you are taking care of them as well as their students.

**Include opportunities for students to connect with one another.** During Orientation, create icebreakers that encourage students to come out of their shells and share a bit about themselves. And, of course, food is a must. If students are well fed, they will be willing to sit through a day full of Orientation and trainings, especially if they know that a welcome reception (with more food!) is waiting for them at the end.



## Best practices at a glance

### **Preparations begin with the acceptance letter or phone call**

- Make your students feel welcome and connect them to the other participants
- Let students know about their new faculty mentors
- Encourage communication between students and faculty
- Ensure that students have appropriate compliance tests before arrival and safety trainings scheduled upon arrival

### **Plan a structured Orientation program**

- Inform students about the expectations of the program
- Introduce the lab and mentorship experience
- Orient your students to their new campus
- Include a discussion of research ethics and integrity

### **Prepare your students for entry into the lab**

- Explain what students can expect from their mentors
- Encourage student-mentor interactions

### **Help students connect to the campus, the region, and one another**

- Share information about ongoing summer events
- Stress the value of networking
- Offer activities that encourage students to bond

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**CHAPTER 6**

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# Mentoring

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**O**ne of the most important aspects of the summer undergraduate research experience is the in-lab mentor. The effectiveness of the mentor-mentee relationship is an indicator of overall program success and the future success of the student scholar. Most students are placed in a lab under a faculty member/Principal Investigator (PI), but are often mentored on a daily basis by a postdoctoral or graduate student (we will refer to them as “co-mentors” in this section) in the lab. Some Amgen Scholars Program (ASP) sites, such as the University of California, Berkeley (Berkeley), also use graduate assistants (GAs) as coaches to facilitate

students' adjustment and progress (see sidebar, "Role of Graduate Assistants at Berkeley"). Mentors support their mentees in a variety of ways. In general, the more support they provide, the higher they are rated.

In this section, we will discuss how summer research programs establish and support mentors—both faculty and postdoctoral or graduate students who serve as day-to-day co-mentors—throughout the summer research experience, using examples from the ASP sites. A positive mentoring environment promotes student and mentor success.

#### ROLE OF GRADUATE ASSISTANTS (GAs) AT BERKELEY

At the ASP at Berkeley, graduate students serve as coaches, or graduate assistants (GAs), rather than co-mentors. As the liaison between the summer scholars and the lab, they assist in all aspects of the program, with particular emphasis on academics.

Before the scholars arrive, the GAs meet with the faculty mentors and co-mentors to reiterate program goals, expectations, and requirements. Once the program begins, they interact weekly with the scholars, meeting with small groups and individuals during alternate weeks. Weekly topics include troubleshooting challenges and providing ways for students to enhance their science-communication skills within the group and individually. Each GA covers roughly the same broad topics, though problem solving, of course, varies among the small groups. They communicate regularly with the co-mentors so they can assist in resolving issues such as conflicts in the lab, concerns about project appropriateness, and dealing with failed experiments.

In the individual meetings, GAs offer advice to scholars on integrating into the lab environment, setting educational and career goals, accessing campus and community resources, and navigating the Bay Area for social activities outside the work environment. They provide students with updates on their progress—incorporating regular feedback from both the faculty mentors and co-mentors—as well as advice on abstracts and presentations.

In addition, the GA team organizes group social activities for the scholars, such as sightseeing and street festivals, and activities for small groups of five to seven students.

## Choose mentors with your program goals in mind

The process of matching students with mentors is covered in Chapter 4, “Laboratory Matching and Placement,” so we will not discuss the details of that topic here. However, in addition to a successful mentor-mentee match, it is important that the mentor be a good match with your overall program goals and expectations. For example, if your program aims to have participants explore careers in industry, then it is crucial to select mentors who are open to having students attend lab tours and networking events with industry professionals. Programs that intend to prepare students for graduate school, as opposed to medical or pharmacy school, may wish to select their mentors from among academic rather than clinical faculty.

In addition, prospective mentors should understand the type of experience that your program seeks to provide, and ensure that the lab has the capacity to provide that type of placement. One of the desired program outcomes, especially for upperclassmen, is to secure a letter of recommendation from a summer mentor for post-graduate applications. If faculty members do not have the time to get to know a visiting summer student well enough to be comfortable writing a recommendation letter (assuming a positive outcome from the summer project), then they may not be a good choice for the program. Even though faculty members do not provide most of the day-to-day mentoring, it is still important that they be available to offer some guidance and oversight of the summer student. This guidance may be provided in a group lab meeting or in discussions that include the co-mentor, as long as the student and the faculty member have some direct communication. Ultimately, a recommendation letter from a graduate student will not be as helpful as a letter from the faculty member, or a joint letter from both.

Mechanisms should be in place that allow the director of your summer program to look at the mentor-mentee relationships experienced by the student participants. These include student and mentor evaluations, personal observations, and consultations with other staff and mentors. Challenges that are identified may be resolved through trouble-shooting and consultation with the mentor and lab personnel. If that approach is not successful, it may indicate that a mentor or lab placement is not well suited to that particular program, and should be removed from consideration in future years.

## Establish good lines of communication with mentors

As with any relationship, communication is key. Communicate the goals and structure of the program with faculty and co-mentors during your first contact. Be sure they understand what they will be asked to do before you make the student placement. At the University of Washington (UW) ASP,

**PROVIDING SUPPORT AND RECOGNITION FOR CO-MENTORS AT UW**

Recognizing the importance of lab co-mentors, the ASP at UW provided orientations, training, and feedback to graduate students, postdoctoral associates, and staff members who served in these roles. While some faculty mentors provided daily training to the undergraduate scholars, most assigned a graduate student, postdoctoral fellow, or research staff member to be the daily “go-to” person for their ASP scholar (and other undergraduate researchers). Some of these co-mentors were experienced in guiding the work of undergraduates, but many were new to the role.

The orientation session for co-mentors was held roughly two weeks before the start of the summer program. At that time, we also provided general advice on mentoring, including how to communicate expectations and goals, and we discussed common issues that can emerge as the mentoring relationship develops.

Partway through the summer program, we held mentoring roundtable discussion, where faculty mentors and co-mentors were invited to share their experiences, troubleshoot any problems that had arisen, and talk about the benefits and challenges of guiding students’ work. At the end of the summer program, we provided a letter of recognition for co-mentors to include in their academic file. Many postdoctoral fellows asked us for assistance in their job searches, particularly those seeking teaching positions at colleges and universities. Successful mentoring experiences are important for developing ideas about how to integrate research and teaching into a coherent teaching philosophy on job applications.

we always sent a written description of goals, student-application materials, and the previous summer’s calendar of activities to all prospective faculty mentors before they agreed to guide the work of a summer scholar. This helped ensure that our mentors fully understood the program expectations at the time that they agreed to mentor a student.

**Mentors are busy, so your communications need to be concise and carefully timed.** Regular communications are vital, but it is best not to communicate too often or people will begin to ignore important messages. A schedule for communicating with mentors will help you control the frequency and length of your messages (see Table 1, “Mentor Communications Timeline,” page 63). Limit all emails to one or two paragraphs or to a set of bullet points. Try not to include too many points in one email message.

**Even with busy people, a face-to-face meeting can be critical for maintaining positive communications.** At UW, we invited faculty and co-mentors

to one-hour orientation sessions to discuss program information and the calendar of events, including the final presentations (see sidebar, “Providing Support and Recognition for Co-Mentors at UW”). The sessions also allowed mentors to meet one another and exchange tips and advice, as people from many different academic departments participated in our program.

**If a face-to-face large group meeting is not possible, consider delivering program information in person to each participating lab.** At Ludwig-Maximilians-Universität München (LMU), for example, the labs are distributed across the city of Munich, so face-to-face meetings are not always possible. In that case, email and phone contacts help program staff get to know the faculty; however, staff must make the effort to engage with each faculty member and lab on occasion to establish important personal contacts for the program. We have found that mentors are much more likely to report problems to the program director if they have met a contact by the beginning of the program.

**A brief web survey of mentors once or twice during the summer session can help identify any problems early enough to resolve them** and rescue a summer experience that might have hit a rough spot. At UW, we sent a simple survey near the end of the second week that consisted of four questions:

- 1) Is your student fully engaged in the project in your lab?
- 2) Is your student (exceeding/meeting/not meeting) your expectations for work at this point in the program? If not, please elaborate.
- 3) Is there anything we can do to help your student be more successful this summer?
- 4) Do you have any other feedback for us?

We learned through experience to keep the questions short—if all was going well, mentors could simply supply one-word answers to the survey questions. If something was not going well, we could address it right away. One year, we had a student whose lab schedule was restricted because she had to use public transportation to get to her work site; her mentor perceived her as not being willing to put in the extended hours needed to complete her experiments. Another year, we found that a student needed some additional computer training to do her project well. Another student was very shy, and was perceived as “uninterested” in the work. We were able to step in each time and work with the mentor and mentee to make adjustments to the schedule, add training, or encourage more interaction to ensure a positive experience for all.

We also learned to send the survey out a maximum of two times over the summer session. The first time is the most critical, to be sure that students and mentors have gotten off to a good start. The second time may help students who start off enthusiastically but get a little discouraged when their experiments fail: they may need some additional encouragement or training. While individual meetings with students during the first two weeks of the summer program ensured that most placements were successful, the mentor survey enabled us to get feedback from both faculty and day-to-day co-mentors early enough in the summer term to address concerns.

**TABLE 1. MENTOR COMMUNICATIONS TIMELINE, FROM LAB PLACEMENTS THROUGH WEEK THREE**

| <b>Date</b>                               | <b>Recipient</b>    | <b>Subject of Communication</b>                  | <b>Mode of Communication</b>                  | <b>Notes</b>   |
|---|---------------------|--|---|--|
| <b>Eight weeks prior to program start</b> | Faculty             | Draft of calendar with important dates           | Email with attachments                        |  |
| <b>Six weeks prior to program start</b>   | Faculty; co-mentors | Program Orientation session dates                | Email with RSVP                               | Follow up with non-responders  |
| <b>Three weeks prior to program start</b> | Faculty; co-mentors | Conduct program Orientation                      | In-person meeting (1 hour) or email materials | Consider dropping off materials for those who can't say hello face-to-face |
| <b>Two weeks prior to program start</b>   | Faculty; co-mentors | Summer calendar update; opening-lunch invitation | Email with attachments; RSVP for lunch        | Follow up with non-responders  |
| <b>Week 1</b>                             | Faculty; co-mentors | Reminder for lunch                               | Email   |  |
| <b>End of Week 1</b>                      | Faculty; co-mentors | Thank you for strong start; invite feedback      | Email   | Send updated calendar if any changes                                       |
| <b>Week 3</b>                             | Faculty; co-mentors | Request to complete short feedback web survey    | Email with link to web survey                 | Four-question survey; follow up with non-responders                        |

In addition to communications that relate directly to mentor-mentee activities, many programs invite both faculty and co-mentors to other program activities. These may include opening events, such as a whole-program retreat or a mentor-mentee lunch; research seminars; and after-hours social events, such as a barbecue, picnic, hike, or closing dinner. Some mentors enjoy socializing with their students; others are less interested in these activities. We have found that all types of mentors can be successful, as long as they develop a clear understanding of expectations and priorities with their mentees, and are working toward common goals.

### Be prepared to deal with common problems

Many great resources focus on building strong mentor-mentee relationships and offer advice on resolving common challenges to those relationships (see sidebar, “Resources,” page 69). Here we discuss some of the challenges that tend to occur in summer undergraduate research programs in the sciences.

#### **The project is too advanced or too simple for the student**

Summer students come from a wide variety of home institutions and have varying background experience; it is often difficult to evaluate their skill level until they start their summer project. Once they get going, students may realize they are either under-prepared to tackle the project they have been assigned, or they may become bored if the project is not sophisticated enough. Either way, the student is going to be unhappy with the situation.

Seasoned mentors will be able to define projects that can be taken to different levels of sophistication, depending on the student’s skills and understanding. If students are not prepared to do the project, it is important that they talk with their mentors right away either to identify additional training that might be available or to develop a different project. If the mentor and mentee communicate openly, this issue can usually be addressed without much trouble. The more difficult problem arises when students hesitate to reveal their lack of understanding until later in the summer. An early advising meeting with the program staff and/or early mentor feedback surveys can often catch this situation while there is still time to adjust the student’s project. Emphasize flexibility and openness with your students—that is the best way to get them to talk with their mentors about any gaps in their training or background.

In some ways, a student with a project that is not challenging enough is a more difficult problem. This student may lose interest and disengage, fearing that to ask for something more sophisticated will be seen as complaining. Co-mentors, especially, may not know how to handle students who need a greater challenge than the project provides; in this case, it is important that

the faculty mentor be brought into a conversation to help develop a project that allows for learning and growth. Sometimes the faculty mentor and co-mentor may offer a compromise that asks the student to complete the easier project first, and then be rewarded with a more engaging and challenging follow-up task. Either way, it is important that the student, faculty mentor, and co-mentor all understand one another's expectations and needs.

Program staff should not get between the mentor and mentee; however, if a student has a difficult time communicating directly with the mentor, a phone call to explain the situation to the mentor can often generate a quick solution. Be careful to remain an impartial mediator in such instances, and always encourage direct communication wherever possible.

### **Communication triangle: Student, mentor, and co-mentor are not on the same page**

The student who is guided by both a faculty mentor and a co-mentor has the great benefit of learning from two individuals whose styles, knowledge, and skill sets may be different and complementary, thereby affording a rich experience for the student. However, faculty mentors and co-mentors occasionally have different perspectives on a project, or give different and conflicting feedback to the student.

In these cases, students may come to the program director either confused about the mixed messages from their mentors, or frustrated to be in the middle of what seems to be an argument about how the work should be done. Sometimes, one of the mentors may criticize the other to the student, exacerbating the feeling of being caught in the middle. It is important for the program director to emphasize to everyone involved that the best way to resolve these types of issues is through open communication. Help the student set up a meeting with the mentors, and coach him or her in writing a post-meeting summary noting important decisions or advice about the research that will be sent to both mentors. If needed, a program director might talk with a mentor privately, especially if the student is frustrated by the situation and is not confident about a potential solution. This may help create more open and clear communication among all parties, or it may result in moving the student to work with a different co-mentor. Either way, it is best to handle this issue quickly; once a relationship is at sea, it is difficult to rescue it during a short and intensive summer session.

Remember that graduate students can become frustrated with their own research, too, and if they are under a good deal of pressure to get their own results, they may not have the time and energy to focus on mentoring an undergraduate. Pay particular attention to graduate students who are in the final stages of writing and defending their dissertations; while they may bring more experience than other graduate students, they are in a stressful



(PHOTO: SAM DEAN, SAM DEAN PHOTOGRAPHY)

place with their own program and may not be able to provide the best mentoring to your students. If that proves true, you may wish to talk with the faculty mentor to decide if the summer scholar might need a different co-mentor assignment.

### **The student is frustrated with failure**

Students who are new to research often begin their summer program with great enthusiasm and energy; they throw themselves into their projects and engage in a lot of hard work. When their experiments start to fail in a few weeks, however, they can experience the opposite feelings, and often blame themselves for their failures, thinking that theirs are the only experiments that are not working. They may become too embarrassed to talk with their fellow students or mentors. This is a problem that you can start to address at the outset of the program.

Beginning with the program Orientation, it is good for students to hear about the failures involved in doing research—from their mentors, program staff, and other students. If they have only experienced “canned” course-based experiments, they may not realize the high rate of failure in research-based experiments. The sooner they learn that failure is an opportunity to learn, the better. This is an important lesson, but it is a hard one to experience the first time it happens. Program staff can prepare students, and be available for coaching when needed. A strong student cohort will be invaluable for support when summer scholars face failures.

**The student loses interest in the project or lab**

Despite your best efforts to select the students most suited to your summer program, to secure placements that build on their backgrounds and interests, and to help them toward their stated goals, students may occasionally find that they do not enjoy the lab environment or the work. The good news for these students is that summer programs are relatively short. It is important to remind them that they made a commitment to complete their summer project. You can help these students identify the skills they are learning that will be relevant to their other interests and goals, and support them as they learn to handle the situation professionally and with personal grace. Regardless of their lack of a longer-term interest in the subject, they can still progress toward their goals and create positive relationships with their peers and mentors.

**The student cannot integrate socially into the lab environment**

It can be challenging for some of your summer students to be comfortable in their research labs. The wonderful variety of backgrounds represented by your students will mean that some of them will be accustomed to a social scene very different from what they experience in the lab. Whether they are from a small rural college or working with professional adults in a high-tech setting for the first time, they may be shy or reluctant to interact authentically with the people in the lab. Students who are first in their families to go to college may be particularly uncomfortable with the social situation in their research group. Over the years, the UW program director heard students say: "I don't know how to talk with adults" or "I think my mentor doesn't like me because she walked right past me in the cafeteria without saying hello" or "I'm afraid to say anything because everyone there has a Ph.D.!" In our Orientation session for summer scholars, we made sure to address social issues directly by exploring what the students expected from their mentors and colleagues in the lab, what situations they were likely to encounter, and how they could begin to understand their new lab culture. Some groups are just friendlier than others, and that is a reality the students will need to accept.

At UW, our Amgen Scholars' first homework assignment was to interview a faculty or staff member in their lab. We suggested they request 20 minutes and offer to buy their colleague coffee. We supplied suggested questions: ask them about their career, what work they are most proud of, and what advice they have for students as they begin their summer projects. It broke the ice for the students with at least one person in the work environment, and helped them figure out how to get to know their colleagues and peers.

In most cases, when students feel unsure of themselves socially they simply need some encouragement and coaching. Again, communication is key to

making sure that this discomfort does not persist throughout the summer, and interfere with the student's ability to properly conduct his or her research project.

### **Involve mentors in final presentations and celebrations**

We recommend that your summer research students be required to present their work in either a poster or an oral-presentation session, or both. This is a chance for them to experience being the “teacher”—to reflect on how far they have come in understanding their topic since the program began—and for their mentors to hear what the students have learned. Although students often find the thought of presenting their work orally to their mentors daunting, they are empowered once they do it. At UW, summer Amgen Scholars presented in concurrent oral sessions on the final afternoon of the program, and all the faculty mentors, co-mentors, labmates, and occasionally parents and families attended. It was a profoundly transformative experience for them. The mentors enjoyed it, too, as they had a chance to see the impact of their weeks of training and guidance in the students' self-confidence and new knowledge.

Sometime during the final days of the program, try to arrange exit interviews for students with their faculty mentor and/or co-mentor to discuss the next steps in their careers and receive feedback on their overall performance in the program. This will give your students an opportunity to ask questions about the educational choices they will be making in the final terms of their undergraduate program and to explore opportunities for graduate-school preparation or gap-year programs with their mentors. Invite faculty mentors and co-mentors to final program celebrations, whether it be a lunch, picnic, or more formal dinner or reception, so they can wish their students well as they return to their home institutions or regular schedules.

In addition to recognizing your summer students' achievements, we recommend that you recognize the faculty mentors and co-mentors at your final event. Mentors do appreciate being thanked; students may also want to write something for their mentors, and/or present a collective thank you to them. Be creative, and express your gratitude—you will find mentors even more willing to come back in subsequent years!

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**LESSONS LEARNED****Solicit post-program feedback**

**Take time to elicit and review post-program feedback soon after the program ends.** Despite everything you have done to gather feedback along the way, there may still be some surprises. Having put good planning and communications with mentors and co-mentors in place ahead of time will help you deal with any unforeseen issues as they arise. Keep in mind that you will never be completely “done” tweaking your program; there is always room for clarification and improvement.

**At UW, we sent out final feedback surveys using a common web-based tool to all faculty mentors and co-mentors a week after the program ended each summer.** This feedback, along with student surveys, helped us make adjustments to the program for the next cycle. Adhering to a continuous improvement model will allow you to refine your practice and adjust to the changing needs of students, mentors, institutions, and funders.

**Best practices at a glance****Choose mentors and co-mentors with your program goals in mind**

- Ensure that lab placements match desired outcomes, such as faculty knowing students well enough to write letters of recommendation and graduate students having the time and energy to focus on mentoring undergraduates
- Establish mechanisms that allow the program director to evaluate the mentor-mentee relationships
- Address challenges through trouble-shooting and consultation with mentors, co-mentors, and lab personnel

**Establish good lines of communication with mentors**

- Communicate the program’s goals and structure with mentors during your first contact with them
- Keep communications short and carefully timed
- Hold a face-to-face group meeting with mentors if possible; if not, deliver program information in person to participating labs
- Conduct a brief web survey of mentors once or twice during the summer to identify problems early on
- Invite both faculty mentors and co-mentors to other program activities, such as a whole-program retreat, research seminars, or social events

*Continues, next page*

*Best practices continued...***Be prepared to deal with common problems**

- Hold early advising meetings with mentors and program staff and/or conduct early mentor feedback surveys to ensure projects are at an appropriate level for each student
- Emphasize flexibility and openness with students to help them approach mentors about gaps in their training
- Let students know program staff are available to help if differing perspectives among students, mentors, and co-mentors cause conflicts
- At Orientation, tell students about the high rate of failure in research-based experiments so they see failure as an opportunity to learn
- Teach students to deal professionally with disappointment in their lab work
- Address social issues directly in Orientation by exploring students' expectations

**Involve mentors in final presentations and celebrations**

- Arrange for your students to have an exit interview with their faculty mentor or co-mentor to get advice and feedback
- Recognize your mentors and co-mentors at your final event

**Solicit feedback from participants during and after your program ends**

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**CHAPTER 7**

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# The Laboratory Experience

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**A** hallmark of the Amgen Scholars Program (ASP) is that students conduct full-time hands-on scientific research. Doing research allows students to apply their classroom knowledge to real-world problems. In addition, exposure to the lab environment gives them insight into research as a career. Many ASP participants have reported that this summer experience helps them select their future career path.

Because the lab experience is the central component of any summer research program, the students' assigned projects as well as the lab environment must be considered before the program begins. The research experience should boost students' confidence in their ability to work independently, increase their exposure to lab techniques, and contribute to the lab's goals. Tangible results in students' research projects enable faculty to write stronger recommendation letters for them, which will ultimately make them more competitive candidates for graduate or professional school.

This chapter examines both the components of a successful undergraduate research project and what students should be able to gain from working in a lab. In addition, it looks at the various ways in which research projects and labs may be organized by providing some specific examples of organizational structures.

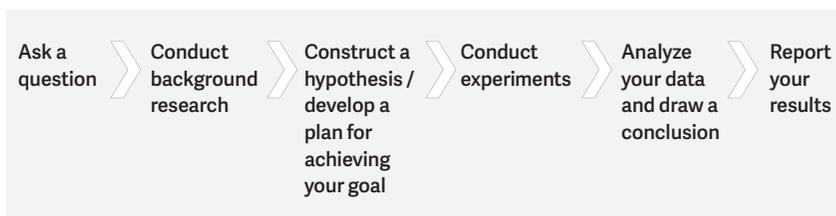
Overall, remember this: The best way to design all aspects of a summer research program—including the research project/lab experience—is by preserving the unique culture and organizational structure of your own institution.

## Lay the fundamentals

For a typical 8- to 10-week summer program, the students' research projects will vary widely depending on the discipline. Successful summer research projects, however, should have a similar framework with the goal of generating results that can be shared. The research project should be an original scientific endeavor that, at its core, follows the scientific method, as shown in Figure 1.

**FIGURE 1**

**The scientific method as applied to a summer research project.**



The project should be structured with the length of the program in mind. This generally means that a student will be working on one part of a larger ongoing project. The student's portion of the project should be challenging, but also feasible in scope and skill level. With proper training, the student should be able to learn new skills and execute the necessary steps to carry out the project and make meaningful contributions by the program's end.

## Clearly state goals and expected outcomes

From the outset, the faculty mentor/Principal Investigator (PI) should clearly state the goals and outcomes of the research project. These vary from program to program and lab to lab, but always include a final deliverable. For example, at the ASP at the Massachusetts Institute of Technology (MIT) and the University of California, Los Angeles (UCLA), students are required to present a scientific poster on their research at the end of the program, but individual faculty may also require their students to present in lab meetings and/or submit a final report at summer's end. While requirements and expectations will vary, it is an important part of the scientific process for students to report their progress and results in some format.

This keeps students continually challenged and accountable, whether they are conducting research for the first time, learning or mastering lab techniques, obtaining unexpected results, starting over from a failed experiment, or articulating their research for the first time. It is through the trials and tribulations inherent in scientific research that students learn, achieve their program goals, and strengthen their research expertise.

Some ASP sites have established a set of student-learning outcomes for undergraduate research participation. For example, at the California Institute of Technology (Caltech), students should be able to accomplish the following by project's end:

- Develop a research question, problem, or design
- Apply basic scientific principles and knowledge found in the literature related to the research question
- Develop a research proposal to address or resolve a specific question or problem
- Apply and evaluate methodology throughout the project
- Collect, interpret, and critique data in order to resolve a research question or evaluate a design
- Communicate research findings
- Appreciate what the process of scientific research entails

Caltech communicates these outcomes in a number of ways, including outlining them in communications to faculty, who are invited to post announcements of summer research opportunities available in their labs, and in training materials for co-mentors (graduate students and postdoctoral fellows), and in the ASP pre-application and acceptance materials.

At their core, the seven outcomes illustrate a basic understanding of and appreciation for the scientific method. They serve as an excellent guide for what all students, regardless of their program or institution, should be able to achieve by the end of a summer research program.

### **Determine lab placement and project**

A critical responsibility of directors of summer research programs is the placement of students in faculty members' laboratories. There are a number of ways that you can place a student. ASP sites such as Columbia University/Barnard College (Columbia) and Caltech have a set list of pre-approved faculty/projects that students select in the application process, while other

schools—such as MIT, Stanford University (Stanford), Karolinska Institutet (KI), and University of California, Berkeley (Berkeley)—place students based on their stated research interests and preferred faculty supervisors. UCLA and MIT wait to make the actual lab placement: they do so only after students have accepted an offer of admission. Choosing a process that works for you, your faculty, and your program requires careful deliberation (see Chapter 4, “Laboratory Matching and Placement,” for more information on this crucial step).

**Once a lab has been selected, students should be assigned to one specific project that fits their research interests and experience.** The project should challenge students and teach them new skills. We strongly caution against students working on multiple projects during a summer research program. Balancing multiple projects can be difficult, particularly during a brief summer program. Dividing students’ attention not only limits the intellectual gains and scientific contributions that students can make to a research project; it also makes it difficult for them to present a poster or write a research paper. At Berkeley, staff members work diligently to ensure that student scholars are given their own distinct project that contributes to the lab’s goals. At UCLA, students begin developing a research proposal based on their project before they arrive. This ensures that they are familiar with the research area and background reading before they start in the laboratory. We highly recommend that your program require faculty mentors to assign readings and other materials to review before students arrive on campus. The project should not be a surprise that students unwrap on the first day.

**While many students will be new to their research project, some may continue a project at a lab in which they are already established.** For example, within each ASP cohort, some students are from the home institution, while others are admitted from other schools and institutions. The home-institution students may have the option as summer scholars to continue a project on which they have already been working. Indeed, many students who continue on an existing project find that, because they can focus on research instead of classwork, they can make extraordinary advances in their projects. Whether continuing research established through other programming or starting afresh, participants across all ASP sites show considerable gains in knowledge and proficiency.

**So what defines the perfect project?** It is a project where any result, positive or negative, is a reportable result; where the student gets to see an experiment from assembly to data analysis; and where there is a visual manifestation of their work productivity. This may mean teaching students how to use a specific suite of graphics software or helping them learn how to do statistical analysis. It is also a project where, even if students do not finish, they make a contribution that is appreciated by the lab. Students can

take pride in knowing that the project will be continued when they depart. The benefits of the lab experience cannot be underestimated: for example, 62 percent of 2014 scholars said research skills was one of the top five areas where they gained the most knowledge and experience during the summer.

### **Prepare for laboratory research**

As part of preparation for the arrival of a summer research student, be sure to let the lab supervisor(s) know that a designated bench space must be ready. Because the student has so little time, the lab should also be willing to have critical materials and supplies on hand, if possible. Advance preparation and planning allows students to jump into their projects rather than spend a week making reagents or waiting for cells to grow.

Another crucial program element to consider is lab safety. Students may be able to complete safety trainings and other requirements online in advance of their arrival. Many participants in the ASP at MIT are able to do this. It not only helps to prepare students but also reduces the training time typically allotted for the first week of the program. (See Chapter 5: “Student Preparation and Orientation,” for more specifics.)

### **Engage students in lab culture**

There are many important aspects to the lab experience beyond the research project itself. For instance, students should be fully immersed in the lab's culture. They should participate in weekly lab meetings, present their findings to the group, and take part in the lab's journal club to familiarize themselves with the literature in their field. Invitations to lab events and social activities will enable students to take advantage of greater networking, mentoring, and learning opportunities.

Students also must realize that it is their job to actively engage with all members of the lab, especially the faculty mentor. This person will write the letters of recommendation for graduate school or for a job. Because the connection and relationship with the faculty mentor can vary widely, students must take the lead in ensuring that they meet several times (if not weekly) with him or her.

However, such regular meetings are not always possible due to the faculty mentor's schedule and commitments outside the lab. In those cases, students should stay in close touch with the lab co-mentor. This individual will be asked to report to the faculty mentor on the student's progress, thereby helping the student to maintain indirect communication with the faculty mentor.

The lab environment is rich with people who have a similar science background and thus are a great resource. Students should reach out to all lab members, including other students (both undergraduate and graduate), postdocs, and lab technicians. This will enable them to expand their network and learn about the diverse projects, education, and career paths of other individuals.

If possible, students should also extend their reach to other labs on campus. Participating in a summer program gives students the unique opportunity to have an informational interview with the lab that they might consider for their Ph.D. work. Summer program directors should be prepared to help students set up and navigate these all-important networking meetings.



(PHOTO: JOE K., ABBOTT IMAGING)

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**LESSONS LEARNED****Five crucial traits of the best projects/lab experiences**

As we have seen, no two undergraduate research programs are exactly the same, but those that succeed do share important traits. The best research projects/lab experiences are:

**Feasible** – appropriate for an 8- to 10-week summer program

**Original** – offer novel scientific research executing the scientific method

**Challenging** – provide a new and rewarding learning experience for students

**Appropriate** – challenging yet reasonable for an undergraduate

**Organized** – permit students to begin immediately with clearly stated goals

Beyond including these key components in a research project, faculty mentors and co-mentors are encouraged to do the following:

**Engage students** by fully involving them in all aspects of the lab—professionally, academically, and socially.

**Provide students with opportunities to network** with all lab members and those outside the lab, too.

**Mentor students** by advising and counseling them on academics, graduate school, and their career path.



## Best practices at a glance

### **Lay the fundamentals**

- Ensure the research projects follow the scientific method
- Structure the project with the length of the program in mind: Be sure it's feasible in scope and skill level

### **Clearly state goals and expected outcomes to students, faculty mentors, and co-mentors**

- Provide opportunities for students to report their progress
- Include a final deliverable, whether a poster, presentation, or research article

### **Determine lab placement and project based on the needs and resources of your institution**

- Assign students to one specific project or portion of an ongoing project
- Consider assigning students from your home institution to a lab/project they are already working on
- Select projects in which the result—positive or negative—s reportable, where students can see an experiment from assembly to data analysis, and where there is a visual manifestation of their work productivity, for example, graphics or statistical analysis

### **Prepare the lab for your students**

- Have designated bench space and critical materials and supplies ready when students arrive
- Work to have students complete lab safety trainings before they arrive

### **Engage students in lab culture**

- Require participation in weekly lab meetings
- Offer a lab journal club
- Invite students to lab events and social activities, and encourage them to actively engage with all lab members, especially their faculty mentor
- Suggest students engage with members of other labs on campus as they begin to think about their Ph.D. work

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**CHAPTER 8**

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# Communicating Science

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**S**ummer research programs aim to help students develop their research skills and gain a deeper understanding of the work they perform in the lab. This chapter describes the weekly science research meetings held at many sites. These weekly small-group meetings usually start a few weeks into the program, after the students have become acquainted with their research projects. They ensure that students fully comprehend their research topic or the question they are exploring by helping them effectively communicate what they've learned, both orally and in writing, to individuals with varied science backgrounds—people with minimal science knowledge, undergraduates like themselves, or other scientists in their lab. A weekly meeting is an ideal setting for such instruction.

A number of factors need to be considered when planning the weekly meetings such as size and timing. The number of students that meet weekly to discuss their work ideally ranges anywhere from six at the University

of California, Berkeley (Berkeley) to 12 at the University of California, Los Angeles (UCLA) and Columbia University/Barnard College (Columbia). The group size allows each student ample time to participate. Groups arranged according to research topic, student grant support, or the lab location all seem to work relatively well. Weekly meetings should be held at either the beginning of the day (starting around 9:30 a.m.) or at the end of the day so that they don't disrupt lab schedules. Columbia schedules weekly meetings on different week days, enabling students to attend a different section, if necessary.

In this section, we focus on strategies for teaching students the oral-presentation and writing skills necessary to effectively communicate their scientific research to others, using best practices from the Amgen Scholars Program (ASP) as examples.

### Oral presentations: Cover both informal and formal approaches

Oral presentations are important for communicating research, and students who pursue a research position at any institution will be required to give them. At many ASP sites, students frequently give both informal and formal oral presentations. Informal oral presentations frequently are presented to two different audiences: members of the weekly meetings and an imagined influential person in an elevator who must be convinced in 60 seconds to support their research (“elevator pitch”). For the formal presentations, they are asked to present their research to fellow lab members and other undergraduate researchers.

#### **Informal presentations**

Two common types of informal presentations are reciprocal peer introductions and the elevator-pitch exercise.

**Reciprocal peer introductions** during the weekly lab meetings pair up students, give them time to discuss their research, and then have each student introduce his or her partner's research. There are three major advantages to this technique. First, most of the scientific jargon will be eliminated since the person presenting the research did not perform it. Second, the person who performed the research gets to hear what information is excluded from the presentation, enabling him or her to better understand which elements are crucial to understanding the project. Third, it enables all students in the weekly meeting to hear what others in the group are doing, without getting too technical. This exercise works best if you mention the advantages before beginning.

This exercise is frequently performed a few weeks into the program so that students have a chance to familiarize themselves with their research projects.

***The elevator-pitch exercise*** gives each student 60 seconds to persuade an influential person on a grant committee to support his or her research (for example, a member of Congress who is not a scientist but allocates tax dollars for research). This requires that students consider the broader significance of their research. This exercise is most successful if the weekly meeting leader first demonstrates an elevator pitch with his or her own research and if students are given 5 minutes to write down their pitch.

At the beginning of this exercise, students receive two index cards, each representing \$1 million. Students select the best pitches, and “give” \$1 million to two students or \$2 million to one student by writing the name of the student(s) on the index card(s). At the end of the session, the meeting leader (a graduate student, post-doc or faculty member, depending on the ASP site) collects and tallies the index cards, and then discusses with the students what was good about the three or four elevator pitches that received the most grant money. This fosters discussion about the important components to include in a good elevator pitch. It is interesting to see how the elevator pitches improve over time as students gain an understanding of what works and what doesn't.

The elevator pitch is frequently performed a number of weeks after the reciprocal peer introductions.

### **Formal presentations**

During formal presentations, the students present to either members of their lab or other undergraduates.

***Presenting to fellow lab members.*** Students are encouraged to present their research during lab meetings in the lab where they are performing their research (The ASP sites at Berkeley and Columbia do this). Presenting during lab time has advantages: It permits lab members both to advise students on their technique and to discuss the specifics of future research experiments. Students can include much more technical detail, since the members of the lab are highly trained in the student's area of research. Students should be encouraged to attend the other lab meetings held by their lab each week to hear what other lab members are doing but also to get a feel for the lab environment and what is expected during their presentation in this forum.

One way to promote student presentations in the lab is to include the activity in the mentors' contract that each student receives, as the ASP at Columbia does.

**Presenting to fellow undergraduate researchers.** The ASP sites use a variety of approaches for oral presentations to other undergraduates. They are described below:

**Symposium roundtables.** A key component of the ASP is the Symposium, at which students from all the U.S. ASP sites meet at UCLA, students from all the European ASP sites meet at Cambridge, and the students in Japan meet at one of the two Japanese host institutions. There, each student gets a chance to introduce his or her research for two to three minutes to eight other students and a faculty member. This brief talk should be general enough to interest undergraduates in other fields of scientific research. It is especially important that the students begin with a sentence that puts their research in a broader context. The specifics of this activity are explained to the students before the Symposium. Depending on when the Symposium is held, the students may need more or less preparation for this exercise. We recommend performing the reciprocal peer introductions before the Symposium. A mock round-table event is useful beforehand as well to expose students to the format. Giving students a chance to practice before they actually present their research publicly is crucial.

**Formal oral presentations during the weekly meetings.** At Columbia, students give a 10- to 15-minute oral presentation during the last few weeks of the program. The order of these presentations is drawn randomly from a hat, since multiple students give their talks each day. Due to the nature of the audience, which is primarily undergraduates performing science research, the presenter should spend about half the time introducing the topic to the audience and explaining the significance of the research; the second half of the talk should focus on the results and conclusions. The biggest mistake undergraduates make during these presentations is to spend too much time on the specifics of their project and not enough time on their work's broader implications or on explaining their findings. Since a picture is worth a thousand words, we recommend that any student with results end the talk with a slide illustrating the conclusions.

**Competitions.** The ASP at the California Institute of Technology (Caltech) has turned the oral presentations into a competition with a substantial financial award in order to promote the students' ability to communicate orally. All students who perform summer research present orally during a "conference" with multiple concurrent sessions. A judge at each of these sessions picks the best speaker to continue in the competition. Two additional rounds of talks by those who win their sessions are used to pick the first-, second-, and third-place winners.



(PHOTO: BENJAMIN GOLDWATER AND DAVIS GOODNIGHT)

**Preparing the students.** Different sites use different methods to help their students prepare for the formal oral presentations, some of which are listed below:

The weekly meeting leader provides slides, ranging from clear to unintelligible, that cover titles, an introduction, methods, results, and a conclusion/model. Students form groups and compare the slides within each category. Each group then presents their thoughts regarding the quality of each of the slides within one of the categories, for example, regarding the quality of each of the results slides.

The weekly meeting leader gives a “bad” presentation that conforms to the time limits for the students’ oral presentations. The students are told ahead of time that the presentation is bad in order to promote discussion afterward of “what not to do during presentations.” Undergraduates, in general, seem reluctant to criticize another presenter. However, it is amazing how willing they are to dissect the good and bad elements of a presentation once they know that it is intentionally bad. This is followed by discussion of the elements of a “good” presentation.

Before students present they meet with the three to four other students that are presenting during the same week (Columbia) and do a dry run of their presentation. Students then receive feedback from everyone in the audience based on a rubric that they fill out covering specific ways to improve the talk and make the slides easier to understand.

Students in the audience should be encouraged to ask questions to learn the importance of doing so at scientific presentations. At Columbia, where the talks extend over three weeks, all students are required to ask a question each day. Most presenters enjoy fielding questions as a way of interacting with their peers. We find that undergraduates who have

spent the summer working in a research lab love talking about their experience. However, many undergraduates are hesitant to ask questions during these presentations for fear that their peers will not be prepared to answer. Requiring questions removes this hesitancy.

## Written materials: Proposals, posters, and articles

Writing is the most important medium for communicating scientific research because written accounts—articles in scientific journals, for example—can reach the entire research community, rather than just a slice of it. Faculty positions are frequently determined by the impact of the journal in which research appears, and that, in turn, depends on how well the writers communicate their research first to the journal editors and reviewers and eventually to the readers. To be published, articles must describe not only the details of the research but also its significance—that is, why the study matters both scientifically and practically. Most ASP sites require a proposal from students at the start of the program and either a poster and/or an original research article at the end of the program.

### Proposals

Having students write a proposal and submit it a few weeks into the summer research program helps ensure that in the lab, they will have an in-depth understanding of their project. (Students from external institutions may be given more time to turn in the proposal than internal students.) The specifics vary between ASP sites, but most require that students speak to the researchers in the lab before beginning the summer research to learn about papers and other resources relevant to their research topic. By reading these materials, students improve their ability to develop, in consultation with the faculty mentor /Principal Investigator (PI), a research question and an approach to address this question. The ASP at Columbia requires that students email a list of five such references to the program administration one month before the program begins.

Each student's proposal should include the significance of the research, an introduction to the topic, the research question, and the approaches that he or she will implement to address the question; the length should be one to two single-spaced pages. In addition, three (at UCLA) to five (at Columbia) references should be used—and cited—in the proposal.

Students submit the proposal to the weekly meeting leader. The students are reminded that the proposal's target audience is the meeting leader, and the proposal should be written accordingly. The meeting leader reviews the proposals and returns them with comments. Final proposals are due a week later.

**Poster presentations**

Poster presentations usually contain both oral and written components, since the author of the poster is frequently available for explanations during the poster session. As a result, not everything that needs to be communicated must be written on the poster. The ASP at the Karolinska Institute (KI), in Sweden, emphasizes poster presentations.

During the first week of the program, KI sets aside half a day to work on communication techniques, both oral and written. This half-day interactive session, led by a lecturer trained in facilitating student science-communication skills (frequently someone other than the weekly meeting leader), outlines best practices regarding scientific presentations. The portion that covers poster presentations includes: poster layout, poster content, construction of figures and tables, the proper balance between text and figures and tables, and shaping the poster content for the proper audience. The lecturer presents a common template, but explains that it can be modified according to the specifics of each student's research. The template provides a framework for the students and makes the poster session more uniform, putting the focus on the research. Students construct their posters at the end of the program with feedback from the lecturer.

At many ASP sites, the students present a poster in a formal setting, either during the summer (UCLA, Berkeley, and KI) or during the following academic year (Columbia). Berkeley sets aside one morning during the last week of the program for all students to present their posters. Each student stands next to his or her poster half the time, and views other students' posters the remainder of the time. At the end of the poster session at KI, each poster is assigned to three students, who tell the author the aspects of the poster that work and suggest improvements. The lecturer who led the initial session at the beginning of the program is also present to give feedback to the students.

KI's summer scholars also participate in a multisite poster session where different ASP sites in Europe present posters. Consecutive poster sessions enable the students to both present their work and view other students' posters. This second poster session enables the students to incorporate the suggestions from the first part of their poster presentation into the poster they present at this multisite session; this also helps students hone their poster-presentation skills. Students use the poster session to network, get constructive feedback from peers and faculty, and practice their short descriptions of the research depicted in their poster.

The ASP at Columbia, on the other hand, holds its poster session during the academic year, and includes the posters of students in other summer science research programs at Columbia University. To increase undergraduates'

exposure to science research, Columbia students in the introductory biology class are given extra credit if they summarize two of the posters. This enables the students in the summer research programs to explain their research numerous times to interested undergraduates. They prepare a three-minute explanation of their poster to accompany the poster itself, gearing both the poster and the talk to undergraduates.

Some ASP sites (Caltech, Columbia, and KI) offer awards (monetary or chocolate) for the best poster. The competition either has specific judges (Caltech and KI) or each attendee at the session casts one vote to determine the winner (Columbia). Caltech judges use the following criteria to evaluate the poster session: [www.surf.caltech.edu/fellows/Poster\\_Contest\\_Judging\\_Criteria.pdf](http://www.surf.caltech.edu/fellows/Poster_Contest_Judging_Criteria.pdf)

The poster abstracts can be collected in an abstract book that is distributed at the poster session and posted online.

### **Articles**

An original research article is the most common vehicle scientists use to describe their research to the world. The ASP recommends that a number of sessions be dedicated to helping the students understand the components of each section of an article and the norms for writing research articles for a professional journal. These norms are then customized for the summer research program. For example, in the introduction, students are told they must include any additional background that other undergraduates in the program may require to comprehend the research.

The ASP sites assign at least one original research article to students to read to illustrate the specific guidelines of the different research article sections. The article should be on a topic of interest to most students. Articles on appetite, the effects of respiration on tumor-cell growth, and how “Brainbow,” or fluorescent proteins, can help scientists see millions of individual neurons in the brain have all been used. In general, articles from *Science* and *Nature* are not used because they do not contain the conventional article sections.

Before the paper is assigned to the students, the weekly meeting leader spends time introducing some of the more confusing aspects of journal articles, including unfamiliar methods in the article. Many undergraduates have not been exposed to a wide variety of methods and will need clarification. After the introductory explanation, the students are asked to read the article for the next session and to be prepared to introduce any figure in the paper.

At the next session, the students are broken into the same number of groups as there are figures. Each group is told which figure it is responsible for and that all members of the group must present part of the figure. Then they are given 10 to 15 minutes to discuss the figure. This allows students to clear up any discrepancies they may have found while reading the paper. Each group then stands at the front of the class and presents a figure.

The students then discuss the article to understand its sections. The meeting leader provides a handout describing what goes into each section for students to reference when analyzing the article and writing their own articles. Some meeting leaders create this list through student discussion.

Students often have difficulty determining what information belongs in which section of an article (for example, what belongs in a Discussion section versus a Results section). One way to clarify this is to break the students into groups and hand out sentences that they must assign to a particular section. Each group discusses the sentences and then presents where each sentence should be placed in the article, and why. It should be obvious to seasoned scientists where some of the sentences belong, but two or three sentences should be less clear-cut to provoke discussion.

***The article assignment.*** Students do not submit the entire article at once. As the research progresses, sections of the article are submitted for peer or meeting leader review and returned with comments. The Methods and Introduction can be submitted a few weeks before the end of the program by all students. However, depending on the progress of the research, other components of the article may be more difficult to submit before the last week of the program. A week before the students begin submitting sections of the article, meeting leaders distribute a list of questions to help them both write their articles and to aid peer reviewers.

The faculty mentors review, edit, and sign off on the final version of the research article before it is submitted to the administration in PDF format. Often multiple revisions of the article are required, and students should anticipate this as part of the process.

## Overview of weekly meeting schedule

Table 1, on the next page, outlines a sample schedule of the small-group weekly meetings at Columbia. This table does not include the scientific or social events that occur outside of these science-communication meetings, which are held from the 4th week until the 10th week of the program. (See Chapter 9, "Meetings, Seminars, and Workshops," for a discussion of the scientific and social events.)

**TABLE 1. SCHEDULE OF WEEKLY LAB-MEETING EVENTS AT COLUMBIA**

| <b>Week</b>          | <b>Day</b>            | <b>Assignment</b>   |
|----------------------|-----------------------|---|
| <b>1 Month Prior</b> | Set by Administration | Students submit references to the ASP administration to ensure that they are familiar with the lab's area of research   |
| <b>Week 1</b>        | Friday                | Students submit proposal to meeting leader (deadline is extended for participants from outside institutions)  |
| <b>Week 2</b>        | Tuesday               | Meeting leader returns proposal to students with comments   |
|                      | Friday                | Students submit revised proposal to meeting leader (who submits final version to administration)  |
| <b>Week 4</b>        | During Weekly Meeting | Reciprocal peer introductions<br>Introduce journal article topic and figures  |
| <b>Week 5</b>        | During Weekly Meeting | Discuss assigned article – subgroups present each figure<br>Introduce the type of information in each article section   |
| <b>Week 6</b>        | During Weekly Meeting | Discuss good and bad components of oral-presentation slides<br>Discuss sentence placement within sections of an article<br>Methods submitted and assigned to peer reviewers                             |
| <b>Week 7</b>        | During Weekly Meeting | Bad oral presentation + discussion of good and bad components<br>Elevator pitch<br>Method edits returned; Introduction and 10 references submitted  |
| <b>Week 8</b>        | During Weekly Meeting | Oral presentations and questions<br>Introductions returned  |
| <b>Week 9</b>        | During Weekly Meeting | Oral presentations and questions  |
| <b>Week 10</b>       | During Weekly Meeting | Oral presentations and questions; students submit complete article to meeting leader and faculty mentor<br><i>(Note: Other ASP host institutions stage poster presentations during the final week).</i> |
| <b>10 Days Later</b> |                       | Article returned with comments by meeting leader and faculty mentor; multiple revisions may be required   |
| <b>1 Month After</b> |                       | Submit final article in PDF format to administration<br>Article must be signed by faculty mentor  |

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**LESSONS LEARNED****Focus on specific topics, encourage hands-on learning**

At the start, many ASP sites try to cover everything—oral presentations, posters, and research articles. However, they soon learn that students benefit from focusing on a few topics in depth rather than trying to cover everything superficially. For example, Columbia works extensively on oral and written communication; Caltech emphasizes oral presentations and posters; and UCLA works extensively on the writing of the research article.

**Hold small-group meetings.** Weekly meetings to improve science communication skills should be structured as small discussion groups to encourage as much student interaction as possible. That way students become engaged and learn from one another.

**Select the skills to highlight.** An important part of any summer research program is developing students' skills in explaining—and along the way understanding—the work they perform in the lab. The communications skills you choose to highlight will influence which activities you incorporate into your program. No matter which topics you choose to expand upon, students will come away from your program with a better grasp of the research they performed and with a deeper understanding of the significance of their work.



(PHOTO: BENJAMIN GOLDWATER AND DAVIS GOODNIGHT)



## Best practices at a glance

### **Cover both informal and formal approaches to oral presentations**

- Informal: Students pair up and present the research of their partners (reciprocal peer introductions)
- Informal: Students persuade a funder to support their research in 60 seconds (elevator-pitch)
- Formal: Students present their research to fellow lab members
- Formal: Students present their research to fellow undergraduate researchers in a variety of settings: two- to three-minute talks to a small group at the Symposium at the end of program, 10- to 15-minute presentation with slides toward the end of the program
- Consider turning the oral presentations into a competition with a substantial financial reward

### **Prepare students for formal presentations using a variety of methods**

- Break students into groups and have them discuss what works and what doesn't in slides on various sections (Introduction, Results, etc.)
- Have them critique a "bad" and "good" presentation given by the weekly meeting leader

### **Require a research proposal at the start of the program and a poster and/or original research article at the end of the program**

- For the proposal, require references and conversations with the faculty mentor
- Early in the program, hold a half-day interactive session led by a lecturer specializing in science-communication skills to cover poster layout, content, construction of figures, balance between text and graphics, and tailoring the poster for the audience
- Have students present a poster in a formal setting during the summer or the academic year that provides time for them to view and comment on other students' posters
- Consider inviting students in the introductory biology class at your institution to the poster session
- Discuss at least one original research article to illustrate the components of an article and have students discuss figures in groups, with each group subsequently presenting a figure
- Discuss the components of each section of a research article; have students discuss what kind of information goes in each article section by having students discuss where within an article it is appropriate to place different types of sentences
- For the original research article, have students submit sections of their articles for peer or meeting leader review one at a time, and allow ample time for revisions

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**CHAPTER 9**

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# Meetings, Seminars, Workshops

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**Tama Hasson, Ph.D.**

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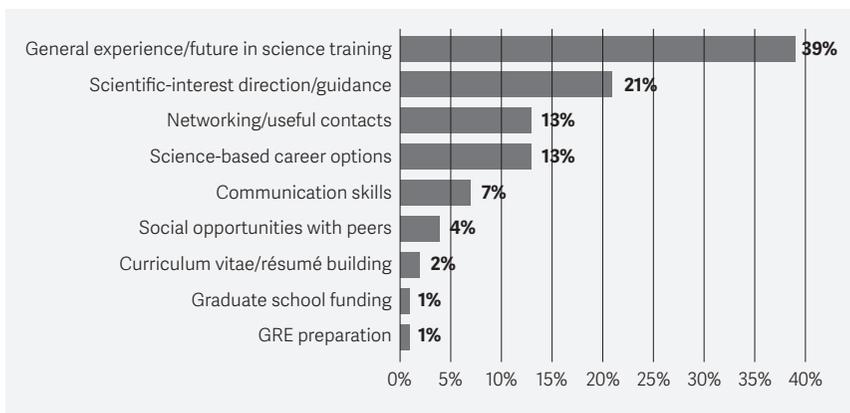
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**S**eminars, meetings, and workshops round out the training experience at a summer science research program. Such activities should address topics that are directly related to scientific research, including methods, resources, technology, résumé writing, achieving research objectives, presenting at conferences, and ethics in research practice. Stress management is another important topic, as is preparing for the future, including exploring careers and studying for the Graduate Record Examination (GRE). Basing some seminars or workshops around a theme that helps students view their projects in a broader context provides an interdisciplinary perspective. For an example, see Stefan Grimberg and colleagues' paper describing their seminar on environmental sustainability for summer researchers in the January 2008 issue of the *Journal of Engineering Education*.

In this chapter, we share the philosophy behind the seminars, meetings, and workshops offered as part of the Amgen Scholars Program (ASP) as well as our best practices. From a survey we conducted at the 13 2014 ASP sites, three focus areas emerged: Meetings that helped students connect their projects to ongoing campus research, those that enabled them to see themselves as potential graduate students, and those that helped them explore careers that matched their interests. Indeed, when asked to identify their favorite ASP seminars and workshops, the scholars themselves pointed to those that helped guide them toward a career in science, as shown in Figure 1, below,

**FIGURE 1**

**Amgen scholars prefer workshops that help guide them toward careers.**



Below we expand on these three focus areas. We recommend selecting a few practices from each category to provide a well-rounded experience for your summer science research students.

### Connect to campus research via faculty research presentations

Students want to learn about the diverse areas of research on campus but don't know where to start. Presenting dynamic and engaging faculty speakers is one way to showcase the breadth of research on your campus. Engaging the best speakers may require initiating contact several months in advance, however, as the most respected and well-known faculty have busy travel schedules. The ASP sites use a variety of approaches to select speakers and ensure that both students and faculty benefit from the presentations.

**Have the students select the faculty they want to meet.** This may mean polling your students before they arrive on campus. At the University of

California, Los Angeles (UCLA), we invite the UCLA students who will be attending the summer program to meet a few months before the program begins to select a few of the summer speakers. Because of their experience with the faculty who teach their courses, they are often better placed to nominate good speakers than the visiting students are. Student scholars may suggest that their own mentor would be a good speaker, which is totally acceptable. Of the many ways to select a speaker, letting students make the choice pleases them most, as they feel involved in the decision-making process. To underline the connection, we recommend that the student who nominated the speaker do the introduction.

**Invite faculty who mentored students in previous years.** This approach is particularly successful because the faculty will often reflect on how much their previous students contributed during the summer, showing the incoming students that their work will be appreciated. And, perhaps most important, faculty who previously mentored students tend to say “yes” to the invitation, as a way of thanking you for assigning them a student the year before.

**Select speakers based on your participants’ areas of research.** If you want to arrange speakers well in advance without involving students, carefully consider the disciplines in which your incoming cohort will be working. The University of California, Berkeley (Berkeley), uses this approach, identifying the best faculty in the relevant disciplines to be speakers. For example, if you have students in four disciplines (say, chemistry, neuroscience, bioengineering, and physiology), then select well-known faculty (faculty known to give good talks!) in those disciplines. This approach is often successful because you know that the speakers will present a good story that connects to the audience. Sometimes students will select the most famous faculty members, but they may not be as effective in addressing the audience of a particular summer research program.

**Ask graduate students to suggest good faculty speakers.** In some programs, graduate students work as ASP staff assistants and know firsthand who the best faculty lecturers on campus are. If you don’t have graduate-student staff, you could poll the graduate students (or postdoctoral fellows) who have been matched to co-mentor your students in the summer. Usually, those matches are in place several months before the program begins—and those individuals will have a good sense of the best faculty to invite in related disciplines.

**Once a faculty speaker is selected, prepare the students for a great talk.** It is important to give the students required reading before the talk so that they can familiarize themselves with the topic. This will also prepare them to ask questions afterward if they so choose. Annual reviews may be too dense, so

ask the faculty to suggest one or two general reviews from journals with titles such as “Current Opinions in...” or “Current Topics in ...”

**Help the faculty by informing them about the audience.** Ask the faculty to give a generalist talk that any student could understand, rather than a typical talk they might give to other faculty members or at a conference. Inform the speaker of the students’ backgrounds in advance—include each student’s year, major, and area of study. It is also helpful to have the faculty give a “journey” talk—how they became involved in science and how their program at your institution has grown over the years. This type of talk is much more accessible for a naïve audience and serves the additional purpose of helping students to see themselves as future scientists.

**Offer feedback to the faculty.** Many ASP sites use faculty research talks as a way to teach students how to give a good talk. They ask students to evaluate the talk on-site. This is not a deep dissection of the talk, but rather a simple questionnaire in which students describe briefly what they learned from the talk. It is also an opportunity to provide immediate feedback to the speakers. Many faculty find this illuminating, if not rewarding. Moreover, the process ensures that students stay engaged during the entire talk.

**Have faculty share the ins and outs of publishing.** Many ASP sites hold one session in which a faculty member discusses his or her experience in getting articles published in top journals, such as *Science*, *Nature*, and *Cell*. The speaker illustrates the process using copies of actual papers that include reviewers’ and editors’ comments, and leads a discussion on the experience. Topics of discussion include but are not limited to: the difference between editors and reviewers, how reviewers are picked, how journals deal with the sheer volume of article submissions, and how to decide which journal is most appropriate for a particular article. At the ASP at Columbia University/Barnard College (Columbia), the following points have been discussed in past meetings:

- An article may be submitted to only one journal at a time for review
- Most articles are edited 20 to 50 times, from first draft to final publication
- Some articles are rejected by the editor without review
- How “hot” the topic is can affect acceptance
- Authors are not required to change everything the reviewers criticize

**Consider a faculty-student lunch with no agenda.** Sometimes it is better to focus on connecting students directly with a faculty member rather than impose a science-specific talk or set of discussion points. These types of

meetings often start as journey talks, but can evolve into interesting discussions of philosophy or politics. Such meetings can be more memorable than formal options and also better connect students to faculty on campus.

### Help students to see themselves as potential graduate students

While it may not be explicitly stated on your website or in your brochures, a summer program is a form of outreach. Bringing students to your campus is always an effective way to inform them about returning as graduate students—and students want this information. Many summer programs are administered by the university's Graduate Division for this very reason. In fact, many students choose a summer research program because they are interested in going to that graduate school. The ASP exposes summer research students to graduate school opportunities in two primary ways:

**By exploring the admissions process.** The best way to let students know how your campus selects graduate students is to invite members of the Graduate Admissions Committee to sit on a panel to discuss the application process. Often representatives from your Graduate Division can share policies that apply to the university as a whole; but if the policies vary too widely across disciplines, you may need to gear the presentation to your summer cohort's area of study. On the other hand, if your summer program serves a wide range of disciplines, you might host a campus fair where representatives from all major departments sit at tables and speak individually with your summer students. Students always want to know what schools are looking for, whether there is a certain GRE cutoff, or if a certain amount of research experience is required. If you bring in someone who is willing to provide specific answers, your students will be very grateful!

**By revealing a day in the life of a graduate student.** Working full time in the lab gives your students a taste of graduate-student life, but the lab is not the whole story. Inviting graduate students to sit on a panel to discuss their lives as students is an informative and popular option. This panel can be moderated so that the participants can share information about their personal experience with the application process. They also can reflect on why they chose that particular school and how they went about selecting their thesis lab. Another approach is to invite graduate students from the major departments to give short talks or present posters of their research. In this way, summer students can learn about research on campus and also talk informally with graduate students about their lives. At UCLA, we often invite alumni from our own summer programs to serve on these panels. Alumni remember the important role that the summer program played in helping them to choose their current career—and they are excited to give back to the school!

## Help students explore careers that match their interests

As you can see from Figure 1, on page 93, students want guidance. They like research, but don't know how to apply a B.S., M.S., or Ph.D. in the sciences to their futures. Therefore, some of the most popular seminars you can offer are those that help your summer students see themselves in various careers. It is important for students to realize that most people follow a career trajectory rather than a direct path to their future. There will be career twists and turns as they make choices based on evolving interests and family situations.

**Provide a sampling of nonacademic careers.** We have found that moderated panels are an easy way to showcase the variety of careers within the sciences. Students can help select the options: In week one of your program, ask what careers interest them, have them vote on the top three they most want to learn about, and then identify professionals who can come speak on a panel hosted toward the end of your program. If you cannot find local speakers, use Skype to bring in people from across the nation whom you can project on a screen. Table 1 lists possible careers pursued by individuals with B.S. degrees in science. Note that some of them require advanced degrees in other fields. Speak with your Alumni Office to find graduates of your institution in those fields.

During the careers panel, the moderator should allow each panelist to share his or her career trajectory as well as “a day in the life” to make the experience real. It is important to note that the panelists do not have to be far

**TABLE 1. A PANEL OF INDIVIDUALS WITH B.S. DEGREES IN SCIENCE WHO REPRESENT DIVERSE CAREERS**

|   |   |
|---|---|
| <p><b>Patent lawyer</b></p> <p>•</p> <p><b>Science writer</b></p> <p>•</p> <p><b>Biotech executive</b><br/><i>(established or startup)</i></p> <p>•</p> <p><b>Pharmaceutical-industry employee</b></p> <p>•</p> <p><b>Government employee</b><br/><i>(for example, from the National Aeronautics and Space Administration, National Institutes of Health, or Centers for Disease Control)</i></p> | <p><b>Public health/epidemiology worker</b></p> <p>•</p> <p><b>Green energy advocate</b></p> <p>•</p> <p><b>County coroner/Crime Scene Investigation-division employee</b><br/><i>(only a community college degree is required for this position)</i></p> |
|---|---|

**ADDITIONAL MEETING, SEMINAR, AND WORKSHOP IDEAS**

One-on-one or small group meetings with graduate students, postdocs, or faculty to work on individual content can go a long way toward helping students feel comfortable with the research process. Some areas where such meetings would be particularly helpful are:

- To improve writing skills
- To practice short presentations
- To follow up other meetings, seminars, or workshops so students can integrate, and further investigate, what they've learned

Workshops are also good places for students to practice their technical skills. Various ASP sites have had success in addressing these topics:

- Using the library and university databases
- Learning about reference-management software
- Analyzing scientific papers and posters to understand how to communicate research through both text and graphic design
- Navigating a research conference to get the most out of it

along in their careers. A panel that shows people at different stages of their careers allows students to visualize their own career path. Seeing young people just starting out enables your summer students to put themselves in their shoes.

**Portray the path to an academic life.** What is it like to be a professor, and what does it take to get there? In addition to the graduate-student panel mentioned above, we recommend offering two panels that together track the entire trajectory from graduate student to faculty member. For the first, convene a panel of postdoctoral fellows. We recommend that you select postdoctoral fellows who attended schools that are similar in size and focus to those attended by the students in your program so your students can better identify with them. For the second, convene a panel of faculty at various levels from many institutions, such as research universities, community colleges, state schools, and liberal-arts colleges. Such a panel lets students see that there is great diversity in academic careers. Once again, what the students are most interested in are the faculty members' career paths—how did they get to where they are now? Why did they choose to teach or do research at that type of school? And how do they balance having a family with their career? One word of warning: Make sure you invite happy faculty and postdoctoral fellows. A panelist who is displeased with his or her life could turn off your students to a career in academia and spoil the entire event.

## Strike a balance regarding attendance

With so many programming possibilities, you have to decide what is mandatory and what is optional for students to attend. Consider the goals and desired student outcomes of your program. If, for example, you are expected to help students successfully transition to relevant Ph.D. programs, then the seminars and workshops that will help them do that will be more critical than those that focus on the far future or side interests. Here are some guidelines for setting priorities:

**Frontload the critical workshops.** Students get progressively busier as they delve into their research projects. To avoid overloading your students, we recommend offering the bulk of meetings, seminars, and workshops at the start of the program. These might be the ones that help students get into graduate school, for example, if this is something they will do immediately after completing your summer program. Later on, you can offer research talks and less information-intensive activities that students can sit in on and enjoy.

**Consider making career-related seminars and workshops optional.** We have found that students may complain if they are required to attend a workshop that is outside their career interest. In addition, many students are not ready to ponder their careers, because they see them as being far into the future.

### RESOURCES

You may find these sources useful in setting up meetings, seminars, and workshops to accompany your summer science research program:

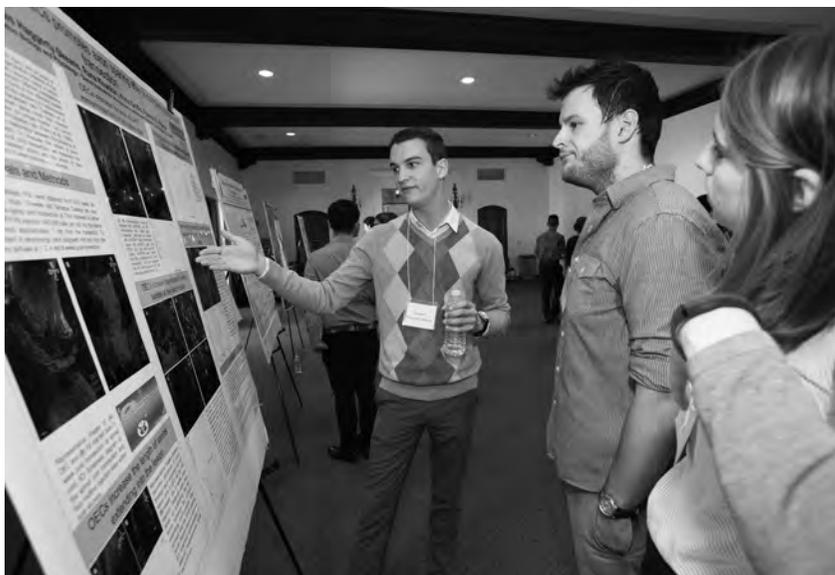
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Frantz, K.J., DeHaan, R.L., Demetrikopoulos, M.K., and Carruth, L.L. (2006). Routes to research for novice undergraduate neuroscientists. *CBE-Life Sciences Education*, 5, 175–187.

Grimberg, S.J., Langen, T. A., Compeau, L.D., and Powers, S.E. (2008). A theme-based seminar on environmental sustainability improves participant satisfaction in an undergraduate summer research program. *Journal of Engineering Education*, 97, 95–103.

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Page, M.C., Abramson, C.I., and Jacobs-Lawson, J.M. (2004). The National Science Foundation research experiences for undergraduate programs: Experiences and recommendations. *Teaching of Psychology*, 31, 241–246.



(PHOTO: REED HUTCHINSON, REED HUTCHINSON PHOTOGRAPHICS)

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#### LESSONS LEARNED

### Limit extras, provide choices

Don't be surprised if you hit a few bumps while offering seminars, meetings, and workshops for your summer students. Here are two crucial lessons we've learned from running ASP sites:

**Students want to do research but not much else!** While it is exciting to offer a dense curriculum of workshops and seminars to accompany your research program, the truth is that too many activities can create problems. Students want to work in the lab, and they may resent having to leave the lab to sit through too many additional activities. At the most, we recommend one required seminar or workshop and one optional one.

**Students will never be 100 percent happy.** We assess our programs, and use this information to decide what does and doesn't work. Often, there is no one seminar that students like best. Instead, a seminar some students find superlative others find boring. If a topic is not relevant to students, they will rank it poorly or not attend. If the invited speaker is outside their research area, they will be unwilling to read the materials and get little out of the presentation. For these reasons, it is wise to offer a wide variety of seminars and workshops to your students. That way, everyone can find a meeting that will engage and excite them about a career in science.



## Best practices at a glance

### **Connect students to research on the campus through faculty research talks**

- Have your students select the speakers
- Select the best speakers in relevant disciplines
- Make sure the faculty know their audience and offer feedback
- Help the faculty connect to your students

### **Help students see themselves as potential graduate students**

- Explore the admissions process
- Let them learn what it is like to be a graduate student

### **Offer career-focused workshops**

- Sample from a variety of possible careers
- Share the life story of an academic

### **Don't make all workshops mandatory**

- Offer critical workshops first
- Let your students choose career-related options

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CHAPTER 10

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# Preparing Students for Graduate School

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**I**n addition to the research project and mentor-student relationships, summer research programs provide students with important information about preparing for graduate school. One of the most common measures of success for science-based undergraduate research programs is how many program alumni enter science-based graduate programs

The Amgen Scholars Program (ASP) considers that measure key in determining whether the overall program and the individual sites are meeting their two primary goals: to increase the learning and networking opportunities for students who are already committed to pursuing a career in science

or engineering, and to spark the interest and broaden the perspective of students who may be considering a scientific career. The numbers have been confirming: As of June 2014, over 90% of Amgen Scholar alumni who had completed their undergraduate work were pursuing an advanced degree or career in a scientific field.

This chapter will focus on the enrichment activities that occur outside of the lab/research experience that support students' successful application and matriculation to graduate school.

### **Develop workshops, seminars, and panels**

Most ASP sites offer workshops, seminars, and panels on a variety of topics to help undergraduates prepare for the graduate-school application, selection, and matriculation process. Before developing your own graduate-school preparation program, review what activities are already available on campus and consider coordinating efforts to expand your areas of expertise.

The most common topics these activities cover are:

- The graduate-school application process
- How to choose a graduate program and school
- Letters of recommendation
- Mastering interviews and visits
- Preparing a curriculum vitae (CV)
- Writing an effective essay or personal statement
- How graduate-school funding works
- Selecting an adviser
- Transitioning to graduate school, life as a graduate student, and school-life balance

At the California Institute of Technology (Caltech), we offer two such series for our summer researchers: the William Whitney Workshops on Academic and Professional Development and weekly Amgen Fridays.

The goal of the Whitney Workshops is to help students make short-term academic and career decisions in the context of their long-term goals. These sessions permit students not only to learn important information about the graduate-school application process but also to reflect on how best to achieve their personal goals. Additionally, we aim to provide information that is relevant across the students' academic careers. For example, when presenting

about letters of recommendation, we may focus on how to establish and cultivate academic relationships as early as possible in your undergraduate career and how to determine what information to give your letter writers so they are prepared to write a strong letter.

We rely on the expertise of our campus colleagues and alumni to make these programs a success. It is important to collaborate with offices such as career development, fellowships, and the graduate dean. We have found it equally important to invite faculty and current graduate students to share their experiences and advice. One of the most popular sessions in the series is entitled “Decisions, Decisions, Decisions,” in which a panel of graduate students speak about their own decision-making process regarding whether or not to attend graduate school and in selecting a program and a school. Another popular session focuses on faculty talking about what they look for in an applicant and how the process generally works once an application is submitted.

Our Amgen Friday sessions provide our student scholars with a more focused opportunity to explore these issues. Faculty in disciplines of interest to our students come in to give a “journey” talk, during which they discuss their academic and professional paths. ASP alumni may attend to share how current scholars can make the best use of their summer in order to prepare for graduate school.

The ASP at the University of California, Los Angeles (UCLA), also hosts a series of workshops and panels throughout the summer. In addition to a graduate-student panel and an introductory workshop on the graduate-school application process, students participate in a CV-writing workshop. The presenters discuss what should, and should not, be included in a professional CV. Students bring in their own CVs and invite staff, graduate-student mentors, and academic administrators to provide real-time feedback on the presentation of their research experience. Putting that experience in writing is not only the most important part of the CV, it is also the part that students struggle with the most. At the University of Washington (UW) ASP, the workshop series also included a session on finding and applying for fellowships to fund graduate school.

Most of the ASP sites also offer specific workshops on M.D./Ph.D. programs, including information on the admissions process. At the ASP at the University of California, Berkeley (Berkeley), for instance, faculty and students discuss the Medical Scientist Training Program (MSTP) at the University of California, San Francisco (UCSF), which combines the graduate and medical curricula and leads to both the M.D. and Ph.D. degrees. At Caltech, students hear from a panel of current M.D./Ph.D. students, who share their experiences and advice. Faculty representatives also discuss their academic and professional journeys.



(PHOTO: BOB PAZ)

## Hold how-to sessions

Many ASP sites provide additional offerings to help students prepare for graduate school. These are among them:

**Introduction to graduate-student life.** At the University of Cambridge (Cambridge), students live in graduate-student housing over the summer. This provides them with a “taste” of graduate student life: they cook, do their own laundry, and have the opportunity to interact with current graduate students.

**Graduate Record Examination (GRE) test preparation.** Many ASP sites provide GRE test-preparation opportunities for their students. At Caltech, we partner with a national provider. Our students have the chance to take evening on-campus classes or online classes, both offered at a substantial discount. Other ASP sites use on-campus resources to provide the training and/or fully subsidize the cost.

**Meeting with Graduate Student Program Assistants (GAs).** At the Berkeley ASP, scholars meet weekly with graduate-student program assistants. During these individual or small-group meetings, GAs lead discussions on graduate-school admissions and talk with students about their specific experiences and academic interests.

**Faculty-student meetings.** Several ASPs encourage, if not require, that students meet with a set number of faculty over the course of the summer to learn about the faculty members’ research and career paths, and to discuss their own research interests and future plans, including graduate school. During the first week on the Caltech campus, we ask students to identify

three faculty members (other than their mentor) whom they would like to meet. Typically, there is overlap, so we then try to arrange for a small lunch with the professor and several students. If a one-on-one lunch or meeting is more appropriate, we work with students to make the arrangements.

**Conference travel support.** Going to regional or national conferences is one way for students to begin to establish a professional network that can influence their graduate-school decisions. Many ASP sites provide subsidies for students to present at such conferences.

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#### LESSONS LEARNED

### Review and refine

**Continuous refinement is important!** Each year, the workshops, seminars, and other activities devoted to graduate-school preparation must be reviewed and refined. Key components to evaluate include the effectiveness of speakers, the relevance of the topics, and the timing of activities within the summer schedule. Collect feedback from students, faculty, and graduate-student co-mentors to ensure a thorough evaluative process.

**Don't overdo it.** Students' research projects are their primary focus at any undergraduate summer research program. Providing information about preparing for graduate school is important, but should not interfere with students' work in the lab. Consider the overall goals of your program when developing non-research activities, and budget the time accordingly.

**Scaffold the information.** Information needs to be pertinent to both rising sophomores and graduating seniors, to students from large schools and small schools, and to those from liberal-arts colleges as well as research universities. It is important not to assume that all students need the same knowledge about and preparation for graduate school.

**Address the anxiety as well as the topic.** When presenting certain topics, such as strategies for getting a good letter of recommendation, remember to be sensitive to students' concerns. For some students, just thinking about interacting with faculty around this topic may generate great anxiety. This is true for many of the components and strategies for getting into graduate school.



## Best practices at a glance

### **Develop workshops, seminars, and panels that address topics about graduate school**

- Take time to select the most relevant topics, including the application process, choosing a program and school, fellowships, preparing a CV, and getting letters of recommendation
- Include discussion of career as well as academic goals
- Collaborate with campus offices such as career development, fellowships, and the graduate dean to provide the best information
- Invite current graduate students and faculty from a variety of programs to share their own decision-making process

### **Hold how-to sessions to make the process real**

- Provide GRE test-preparation opportunities
- Arrange individual or small-group meetings for students and graduate-school co-mentors and students and faculty
- Subsidize travel to regional or national conferences to help students begin to establish a professional network

### **Review and refine the activities at the end of each summer**

- Collect feedback from students, faculty and graduate-student co-mentors on the usefulness of the events
- Be sensitive to students' time commitments and concerns: Research projects come first, address the anxiety as well as the topic

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**CHAPTER 11**

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# Networking

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**S**ome undergraduates view networking as a competition: Who can trade the most business cards or other contact information? So your first step in teaching the students in your summer research program about the practice is to redefine the term. “Networking” means building relationships to establish an ever-expanding community that will endure beyond the summer program and prove profitable for the students as well as their current and future associates. This commitment means that students must have a genuine interest in the projects and careers of others, look for opportunities to give or receive assistance, and share information with others, even if they do not personally benefit.

In this chapter, we will discuss how to establish networking practices in a summer research program and prepare students to use them to mutual advantage.



(PHOTO: IMAGE GROUP LA)

### Put networking plans in place well before your program starts

During the eight years the University of California, San Diego (UC San Diego) was a host institution for the Amgen Scholars Program (ASP), we learned that creating the buy-in for a positive approach to networking begins well before the students meet one another and their mentors. Leading up to the program's start, the staff must achieve a number of clear goals. It must:

- Assemble a group of stakeholders from the program and university community who are willing to meet with students individually or collectively. These advisers should be able to provide guidance to students about matters of professional, academic, or personal advancement.
- Select a cohort of summer scholars who are not only accomplished academically but also differ sufficiently in background, experience, and interests. This diversity will stimulate the students to talk to one another in both structured and informal environments.
- Arrange multiple opportunities for students to practice their networking skills in a supervised situation. At these events, students should have a chance to meet professors, professional researchers, key administrators, graduate- and professional-school personnel, and other possible mentors or useful contacts.
- Establish a way to follow up with students after the program ends. This review should include evaluating the students' community-building methods and offering suggestions when appropriate.

## **Assemble a group of stakeholders**

The ASP at UC San Diego was housed within a unit in Student Affairs. However, the program staff worked hard to establish year-round support for the program across administrations in numerous departments and with organizational units, including the Division of Biological Sciences, the Office of Research Affairs, the Jacobs School of Engineering, the Career Services Center, and the Graduate Division. Affiliated institutions, including the Salk Institute, the Stanford Burnham Institute, the Scripps Institute of Oceanography, and others also provided support. The ASP sites in general follow this model of stakeholder support.

Such partners contribute to the success of the ASP community in ways that go far beyond supplying mentors for summer scholars. At UC San Diego, for instance, the Division of Biological Sciences and the Jacobs School of Engineering both hosted receptions for ASP and other summer-program participants who were interested in pursuing graduate study at UC San Diego. The dean of the Graduate Division spoke to these students during the first week of the summer programs. The Career Services Center hosted a networking exercise during the program, where students received tips on how to introduce themselves, practice active listening, dress appropriately, and present themselves as knowledgeable in their area of study without appearing arrogant or unprofessional. Faculty members in the stakeholder community also served as special lecturers or as moderators for the Summer Research Conference (SRC), held at UC San Diego every year, where more than 200 undergraduates conducting research in San Diego gather to present their research and to network.

All of these activities were important networking opportunities; in fact, from Orientation onward, the program staff instilled in summer research students the belief that every event was a networking opportunity and that all university units were potential sources of support.

## **Select a cohort of students who differ in background, experience, and interests**

In accordance with the ASP's mission, the UC San Diego program staff always sought to have a cohort of students representing a wide range of backgrounds, interests, and experiences. Once the cohort was finalized, we began emphasizing to its members that they could create multi-year and even lifelong connections through this program. Given the talent and ambitions of their peers, they immediately became members of what might be their best professional network.

Concretely, the program staff oversaw the creation of a Facebook page for each cohort. They encouraged the student scholars to use it before the start of the program, to share information about travel to San Diego, housing, finding mentors, parking, getting to know the campus, and other matters. More specifically, the program staff met with the UC San Diego undergraduates who would be participating in the ASP—typically half of the cohort. They stressed the importance of reaching out to summer scholars coming from other schools and helping to ease their adjustment to a new campus. The directive led to various activities, including UC San Diego students meeting visiting students at the airport and driving them to campus, or organizing trips to stores where they could find kitchen and other household supplies.

Amgen Scholars made up about one-third of the students in UC San Diego's summer research programs. Although the summer programs as a whole provided valuable community-building opportunities, the ASP staff also worked to reinforce the Amgen link through ASP-only events. The first was an ASP dinner the night before the official start of the summer research program. The meeting was casual and designed to put the students, especially the recent arrivals, at ease. However, it also gave the staff a chance to emphasize maintaining an atmosphere of respect and mutual support in order to create a close-knit community of scholars. Equally important, the dinner prevented the students from feeling lost during the official Orientation session the next day.

Other ASP-only activities included a hike through the Torrey Pines State Reserve on the first Saturday of the program. This hike gave students a common experience that strengthened their attachment to the program. ASP-specific contacts continued throughout the summer as well. These included regular meetings with staff, during which students were encouraged to discuss their work with one another and compare their research and program experiences. These meetings gave staff an opportunity to gauge the quality of the students' research experiences, and allowed the students not only to become more comfortable with one another but also to see themselves as capable of providing advice and encouragement to their fellow scholars.

### **Arrange networking opportunities**

We considered every program activity, structured or informal, to be a networking event, and program staff did their best to prepare students to make a favorable impression. At UC San Diego, we held three major networking events and many smaller ones.

**The first major networking event, which occurred very early in the summer, was the address from the UC San Diego Dean of the Graduate Division.** To prepare students who were interested in graduate study at UC San Diego, program staff spent time at the welcome dinner giving advice on how to approach the dean confidently and respectfully, request her business card, and follow up with a professionally written email and a request for further information or contact. Again, we emphasized that connecting with the dean was neither a competition nor a chance to overshadow other students. Rather, it was a chance to show the dean that they had listened to her talk and were now more interested in graduate study because of the information she had shared with them.

**The second major networking event was the “Mocktail Party,” which ASP program staff coordinated with the Career Services Center.** This was held before the Amgen Symposium—an event at the end of the summer where all the U.S. scholars come together at The University of California, Los Angeles (UCLA), and all the European scholars come together at The University of Cambridge (Cambridge). The Mocktail Party was a two-part rehearsal: During part one, a member of the Career Services Center staff who specialized in external relations offered the students tips on how to introduce themselves to distinguished faculty members and other professionals in a social situation. During part two, the students acted on these suggestions in meetings with UC San Diego faculty members, many of whom served as faculty mentors in the program. At the conclusion of the “party,” Career Services Center staff helped the students evaluate how well they had done in the exercise and where they could improve.

**The third major networking event was a reception hosted by the Division of Biological Sciences for prospective graduate students.** Biological Sciences includes many graduate programs of interest to Amgen Scholars, and the reception offered them a chance to talk to administrators, professors, and graduate students in small-group settings. Before the event, program staff met with the students and advised them how to make a favorable impression and get the information they needed to make an informed decision concerning graduate education at UC San Diego or elsewhere. One point we stressed was to leave with every important question asked and answered.

Because attendance at the reception was not mandatory, we also asked those who participated to share the knowledge they gained with other summer students, especially those who couldn't attend. Whether this sharing took place as part of a group meeting, in a personal conversation, or via social media, it added to the students' conviction that the cohort was a valuable source of knowledge for making decisions or fleshing out plans and for socializing as a group.

## AMGEN SCHOLARS SYMPOSIUM

A signature component of the summer program is the symposium where students hear firsthand from leading scientists working in industry and academia. Over the course of the symposium, Scholars have the chance to share their summer research projects with their peers and deepen their understanding of drug discovery and development.

Amgen Scholars from across the U.S. meet in California, Amgen Scholars from across Europe convene in England, and Amgen Scholars across Japan meet in either Tokyo or Kyoto. The three symposia provide undergraduates with a valuable opportunity to network with other Amgen Scholars as well as interact with top industry and academic scientists.

## Networking at the Amgen Scholars Symposium

No element of the ASP excites the summer scholars more than the Amgen Scholars Symposium for several reasons:

- They are genuinely grateful for the opportunity to be Amgen Scholars and want to express that gratitude to members of the company and the Amgen Foundation that they may meet at the Symposium.
- They want to take advantage of the opportunity to ask the speakers and the scientists they may meet at the roundtables well-considered and well-expressed questions.
- They hope to find out information about graduate study and other research programs from representatives of other ASP sites.
- They want to meet, glean information from, and possibly develop relationships with their peers from other programs.

Two weeks before the Symposium, UC San Diego program staff held a meeting dedicated to helping students get the most out of the experience, reinforcing this theme: Every moment of the Symposium is a potential opportunity not only to make useful connections but also to represent the ASP, the Amgen Foundation, and UC San Diego. Therefore, we reminded students that they had to:

- Dress “neat business casual” for the lectures and other information sessions
- Treat everyone—from the Amgen Foundation president to other students—with respect

- Attend all sessions for which they had signed up
- Understand that their behavior during downtime or at parties would affect whether others decided to initiate contact with them

We also encouraged students to be proactive about approaching others at the Symposium, as long as they did so professionally. We helped students print business cards to distribute at the Symposium and provided them with samples of follow-up emails.

### Networking at the Summer Research Conference

Next to the Symposium, the SRC was the most highly rated program activity among UC San Diego Amgen Scholars. The possibility at the SRC for successful networking—with faculty, fellow students, and others—was one of the main attractions of this event. The ASP at UC San Diego required all of its scholars to present their findings at the conference. During the question-and-answer period following the presentations, students received feedback on their work from the moderator, other faculty members in the audience, their labmates, and fellow ASP Scholars. These discussions led to new research partnerships or invitations to apply for new research opportunities or support.

UC San Diego program staff required all Amgen Scholars to attend a workshop before the conference on effective oral presentations, where we again stressed the importance of proper appearance, quiet confidence, displaying a willingness to listen as well as speak, and the sharing, rather than guarding, of information.



(PHOTO:JOE K., ABBOTT IMAGING)

## LESSONS LEARNED

**Be patient, remain open-minded**

**Establishing connections takes time.** It is important to stress to students that some very useful connections may take months or years to develop into professional collaborations. Patience is an essential part of building a strong network. Over time, students may find that certain beneficial connections may not have developed because they decided too early that the connection was not useful to them.

**Best practices at a glance****Put networking plans in place well before your program starts**

- Assemble a group of stakeholders from the program and campus community who are willing to meet with students
- Select a cohort of summer scholars who differ in background, experience, and interests
- Arrange opportunities for students to practice their networking skills in a supervised setting
- Establish a way to follow up with students after the program ends to evaluate their community-building skills

**Prepare students for networking events**

- Emphasize that networking is not a competition but an opportunity to let others know you are interested in their work
- Provide advice on how to approach speakers confidently and respectfully, request a business card, and follow up with a professionally written email
- Collaborate with Career Services to hold a “Mocktail Party” where students can get tips on how to introduce themselves to faculty and other professionals in a social setting and then practice in an arranged “party” with faculty
- Collaborate with the Graduate Division of your university to hold a reception where students can talk to administrators, professors, and graduate students in small-group settings, and advise students not to leave before they have every important question about graduate programs they are interested in asked and answered

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**CHAPTER 12**

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# Student Affairs

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**U**ndergraduate summer research programs can make a big impact on students in a short 8–10 week time span. While in the program, students are expected to minimize outside commitments and immerse themselves in intensive research. Although the majority of students' time is spent in the laboratory working on their individual projects, additional nonacademic activities are important to round out the summer experience.

What are some of these aspects of student life? Social activities, recreational outings, and cohort rapport among summer students and with program staff have a significant impact on the overall quality of the summer experience for students.

The Amgen Scholars Program (ASP) recruits students from a variety of backgrounds and, from both host institutions and other national institutions, including many students from small four-year schools who may lack exposure to sophisticated research experiences. This diversity means that students come to campus with a variety of individual needs and issues. To address them, program staff must consider the “whole student,” not just the student researcher.

In this chapter, we describe some of the nonacademic activities that various ASP sites have implemented to strengthen student development and success.

### Start student-affairs programming early

Plans for student-affairs programming should ideally start during fall term, before the application process opens, and continue throughout the academic year as you develop the program components. Questions for program staff to consider in the planning stages include: What are the expectations around student conduct? How can students, staff, and other campus administrators work together to ensure a healthy, safe, and productive summer experience for all students? What types of extra-curricular activities will enhance their experience?

### Introduce campus policies, rules, and regulations at orientation

Clear discussions about campus policies, rules, and regulations at the start of the program go a long way toward safeguarding student health and safety over the course of the summer. Orientation is a good time to introduce these topics (see Chapter 5, “Student Preparation and Orientation”). Moreover, such discussions send a strong message to students: The community they are joining is one of mutual support and respect where, for the good of all, violations of policies, rules, and regulations will not be tolerated.

**Recognize differences from state to state and country to country.** Those policies, rules, and regulations vary from state to state, country to country, and campus to campus, so they must be spelled out clearly for all students, including those who attend the host institution. Moreover, it is important to recognize that they apply differently to students based on their age. In the United States, for example, the legal drinking age is 21, whereas in Europe it is 18. Some of your students may be legal minors, that is, under the age of 18, if they were admitted to college early. Program staff must work with campus representatives to plan how to respond to this diversity. At the University of Washington (UW), for example, minors were not permitted to live

unchaperoned in campus housing during the summer and required parental permission to comply with lab-safety measures appropriate to their age. At the University of Cambridge (Cambridge), U.K. laws make it far too complex for the ASP to admit any student under the age of 18.

**Introduce the conduct codes for both the summer program and the host institution during the Orientation.** At UW, program staff and staff from the office of Community Standards and Student Conduct reviewed campus conduct and ASP conduct codes with scholars and facilitated discussions around expectations students had of one another and the program. The UW ASP then brought in residence hall staff to clarify conduct and safety policies related to housing. Bringing in campus staff who are well versed in these student-affairs areas both helps program staff and ensures that important details will not be left out. Campus residence-life staff are often available to provide a housing overview for students, and university-standards and -conduct personnel can help cover student rights and responsibilities on campus.

At Cambridge, staff emphasize the expectation that Amgen Scholars will act in accordance with the student conduct code and health and safety policies. Students also participate in a two-hour health-and safety talk with student-life staff.

At the California Institute of Technology (Caltech), in addition to a general orientation held for all students, program staff conduct a special two-hour orientation for non-Caltech summer students, including the visiting Amgen Scholars. During this visiting scholar orientation, the undergraduate dean provides a brief overview of important campus policies, including use of alcohol, sexual harassment, and sexual assault.

They discuss resources that students can use if they encounter any issues. Caltech students discuss the campus honor code and how it relates to the academic and nonacademic aspects of life. The residential-life team talks about the specifics of living in campus housing. Campus Security talks about campus and community safety issues and resources. And various campus representatives, from offices such as Athletics and the Library, are on hand to introduce themselves and their services. Program staff then follow up the next day by sending all the policies to the students via email.

Washington University in St. Louis (WUSTL) ASP students are cautioned that they must adhere not only to the rules and guidelines for WUSTL and the ASP, but also to those of their home institution. This has an impact on students, because they know that program staff can potentially report poor conduct back to their home institution. Program staff also discuss the visitors' policy: students can have visitors for three days and two nights in their suites, provided that they get permission from their other suite members.

**House summer undergraduate researchers together on campus, whenever possible.** Living on campus is more than an essential component of the summer experience; it also encourages social cohesion of the cohort. At the UW ASP, students were typically housed in single-sex suites that included seven students in single and double rooms and a common lounge area. Past participants have noted that the camaraderie they experienced in the residence halls and lounges enabled them to connect with one another on a deeper level. Many said that their conversations in the halls were some of the most significant and stimulating aspects of their summer experience. Several shared that they were able to engage with their fellow students there in a way that was not possible during the academic year or on their home campuses, and extolled the benefits of being able to “geek out on the science.”

At Cambridge, students are housed in single en-suite rooms with communal kitchen/lounge areas. Suites are mixed gender, and undergraduates also share housing with recent graduates who remain on campus during the summer. At Cambridge, staff emphasize the expectation that Amgen Scholars will act in accordance with the student conduct code and health and safety policies. Students also participate in a two-hour health-and safety talk with student-life staff.

While Amgen Scholars at Caltech are not housed together, they live in residence halls that contain a vibrant community of hundreds of students, both domestic and international, who are spending the summer conducting undergraduate research.

The WUSTL ASP houses the Amgen Scholars together with scholars from the Biomedical Research Apprenticeship Program, another summer-research program on campus. Students live in single-sex suites, and each student has his or her own room. Each suite comprises one kitchen and one to two shared bathrooms. All summer program students attend a residence-hall Orientation featuring talks by Campus Security, Dining, Housing, and the Office of Undergraduate Research. Washington University in St. Louis (WUSTL) ASP students are cautioned that they must adhere not only to the rules and guidelines for WUSTL and the ASP, but also to those of their home institution. This has an impact on students, because they know that program staff can potentially report poor conduct back to their home institution. Program staff also discuss the visitors' policy: students can have visitors for three days and two nights in their suites, provided that they get permission from their other suite members.

## Attend to students with special circumstances or needs

Amgen Scholars have many attributes in common. They hail from four-year campuses all over the world, and are high-achieving rising juniors and seniors who possess the intellectual drive, curiosity, and academic preparation necessary to engage in a high-caliber summer-research experience. However, within this high-achieving group, there are a number of subtle distinctions and broadly defined special circumstances or needs that program administrators must address. Among these are physical and learning disabilities, medical concerns, dietary restrictions, younger scholars (those under 18 years of age), and marital/family status. Students may note these special circumstances during the application process, but most do so only after they are accepted into the program. Program staff must become aware of and address these unique student issues by asking questions, responding to inquiries from students, and making accommodations with the help of campus staff wherever possible.

In the past, ASP accommodations at the UW included the following: providing electronic and large-print handouts for a student with a visual disability; providing exceptions to the campus housing requirement for a student who was bringing his spouse for the summer; and an on-campus housing exception for a younger (under 18) student. Single-room accommodations were also made for students who, for various reasons, were not comfortable sharing a room. In other instances, specific accommodations were not necessary, but program staff checked up on the health and well-being of a student with special medical conditions.

At times, program staff encounter issues of serious concern that students may choose to hide or have not yet acknowledged themselves. For example, more than one ASP site reported instances of students with eating disorders and accompanying social-interaction challenges. This, in turn, affected other students and people in the labs. Program staff had to make sure that the students were aware of all the avenues of support, including university physicians and mental-health counselors.

Mental health-related issues may come to the fore during a summer-research experience for several reasons. Changes in circumstances can highlight issues that students may have otherwise hidden or disguised through their daily routines. Moreover, students may “shelve” issues that lead to depression or anxiety during the academic year. When they finally have a chance to relax a bit in the summer, they may begin to address these issues. In such cases, it is critical to have strong support networks that can advise both students and staff. Several ASP sites use weekly meetings and track adherence to requirements to learn how students are doing. Usually, the first sign that students

are facing challenges is when they neglect to show up at the lab, answer emails, or turn in an assignment. It is important to note that, while program staff are key in supporting students throughout the summer, they must not take on the role of a medical professional or mental-health counselor. Staff must connect with campus professionals for advice and direct students to appropriate services.

### Plan recreational activities

While students are on campus, their main focus is the research experience itself; they are working hard to develop their individual projects in the lab and to enhance their scientific skill sets. However, fun is also an important element of a well-run summer research experience.

Recreational activities are key in helping students connect to the institution and the surroundings. Planned activities at the ASP sites include welcome barbecues, campus tours, hiking excursions, art walks, and outings to professional sports events. While students are getting acclimated to the program and campus, program-hosted activities help them to feel at home in a new setting. As the summer progresses, planning will shift to the students, who will organize these outings and events themselves with program staff acting as advisers by, say, emailing notices about events going on around town over the weekend and encouraging students to use the summer-program's websites and listservs to organize activities. Local students in the program are a valuable resource regarding events and activities. Program staff at many ASP sites encourage them to take the lead in organizing events; they can be excellent tour guides for visiting students.



(PHOTO: MARTIN BOND, MARTIN BOND PHOTOGRAPHY)

During the first week of the ASP at UW, students participated in a number of community-building and informational activities. On the morning of day two of the program, for example, Amgen Scholars took part in a campus tour—a critical activity for visiting students to get their bearings on campus. Directly after orientation, the program staff hosted a student-mentor luncheon where most faculty mentors, co-mentors (graduate student and postdoctoral mentors), and lab groups met their student scholars for the first time and then took them back to the lab. Providing lunch for busy research faculty, grad students, postdocs, and staff is always appreciated and serves as a nice way to “break the ice” with their summer researchers.

Many campuses host a variety of undergraduate research programs during the summer, opening the door for shared programming. Collaborating with campus colleagues on a few key events draws a larger community of summer researchers to activities and fosters a welcoming and fun campus climate. Added benefits of shared programming include pooling resources for costs such as venue rentals, sharing the “sweat-equity” required to organize events, and providing a brighter spotlight on summer-research experiences: Collaborative events create a larger buzz, attracting more attention both on and off the campus.

During the first week at UW, several summer programs joined together for a Summer Research Program welcome barbecue, where a few hundred students and staff gathered at a local park. Research mentors and lab groups were welcome and frequently joined in this family-friendly event. In fact, it was not uncommon to find world-renowned researchers flipping burgers on the grill. What better way to send a message that summer researchers are part of a campus community that is supportive and fun?

The ASP at WUSTL provides a tour of St. Louis for its scholars; two welcome dinners, one on campus and one at the home of a faculty member; and a midsummer brunch at the home of the administrative director. The Student Activities Committee for the Division of Biology and Biomedical Sciences hosts a get-together where summer faculty co-mentors serve food and drinks to the summer students. The care that everyone puts into the gathering makes the summer students feel welcome and a part of the campus community. Throughout the summer, the Office of Undergraduate Research holds other events, including a trip to the movies, the City Museum, and various barbecues and swimming parties. St. Louis-related events are placed on a shared drive that is easily accessible by the summer students.

Midway through the program, all Amgen Scholars at Cambridge are taken on a road trip. Program staff find it's a good way to ensure that students

get a day away from the lab and unwind. They take a coach there and back, which enables them to engage in light conversation, play a few games, and then, when they get to the park, enjoy themselves on the rides.

Throughout the summer, a critical challenge for all program administrators is to strike a balance between providing program-initiated events and activities and allowing students to organize their own time. Attention to the program calendar is key in this planning process. By frontloading activities during the first half of the summer experience, program staff can ensure that students will be able to engage in events that won't conflict with the busier latter half of the summer research experience. Time flies in any summer research program, but it seems to markedly accelerate during the second half of the program, when students are advancing their research engagement and preparing their final presentations.

To deal with those challenges, each summer the ASP at Caltech hires a program coordinator who is responsible for planning and executing summer events. Los Angeles is a recreational hotspot, allowing for trips to the beach, Hollywood, and various museums. Staff plan simple events like ice-cream socials and movie nights. They start off the summer with a campus scavenger hunt and pair up Caltech and non-Caltech students. The Caltech students are thrilled to show off their campus, and the non-Caltech students learn a lot about the campus and the community.

### Arrange industry tours

In addition to gaining an awareness of academe, Amgen Scholars exit the program with an understanding of the larger pharmaceutical and biotechnology industry in which Amgen plays an important role. Many students will find themselves working in industry research positions in the future, or they may simply need to understand the porous boundaries between academic and industry research. ASP staff at each site work with local biotech-industry contacts to arrange tours of labs and provide opportunities for scholars to interact with industry professionals. The ASP at UW used to provide two or three such tours each summer in the biotech industry as well as with organizations such as the Seattle Biomedical Research Institute and the Institute for Systems Biology.

### Schedule advising sessions

Given the brevity of summer research programs, students may be derailed in their progress if they hit a snag (self-perceived or actual) that goes unaddressed. One-on-one advising sessions at regular intervals are a good way

to ensure that students continue to move forward. Many ASP sites choose to divide the student cohort among staff and schedule 30-minute individual check-in sessions. The sessions address academic components, such as students' research progress and mentor support, as well as student life issues. These include whether students feel compatible with their roommate and suite placement; are physically and mentally in good health; are getting enough sleep and exercise and making time for meals; and are otherwise able to engage positively in the summer experience. It is the responsibility of program staff to help students open up about issues related to health and well-being to ensure that they are "research ready." In some cases, staff may refer students to appropriate campus resources such as a student counseling center. ASP staff also help students set networking goals while they're on campus. This is particularly helpful for students who come to the program from other institutions. Visiting students are encouraged to meet with the faculty and investigate programs they might be interested in pursuing for graduate study (see Chapter 11, "Networking").

At the UW ASP, staff scheduled individual appointments with scholars over the first three weeks of the program and encouraged them to check in frequently. While scholars at all ASP sites form relationships with all program staff, generally they bond a bit more with their advising contact. To ensure that program staff were all on the same page regarding advising, the staff created a one-sheet checklist that included common program components and issues to cover in advising sessions. In subsequent meetings, staff used the checklist to report about their advisees, discuss how the cohort was adjusting to the summer research experience, address any issues, and share resources that might be helpful to the students.

The ASP at Caltech holds regular weekly get-togethers called Amgen Fridays where one focuses on how to make the most of the summer. Students participate in an exercise where they identify their research and non-research goals for the summer, and then discuss how they can meet them. Program staff also ask students to identify three faculty members, other than their faculty mentor, with whom they wish to meet. They then work to schedule group lunches or one-on-one meetings for the students with those faculty members. In addition, if non-Caltech students are interested in learning about graduate school at Caltech, staff arrange one-on-one appointments for them with the graduate dean. The ASP at Caltech also hosts several student/co-mentor coffee hours over the summer. Co-mentors are the graduate students, postdoctoral candidates, or research scientists who serve as day-to-day mentors to the students in the lab (see Chapter 6, "Mentoring"). During the coffee hours, the co-mentors discuss with students how their projects are progressing and offer advice on graduate school and other non-research aspects of student life.

## Prepare for emergencies

One rule of thumb in running a summer research program is to plan for the best but always expect the unexpected. When emergencies occur, and they will, administrators need to spring into action. Sometimes this requires meeting students at emergency rooms and interacting with medical personnel. In all cases, it is critical to have emergency-contact information at hand, including a list of the student's family contacts and insurance documentation. During orientation, be sure to provide students with quick-reference emergency phone numbers (police, ambulance, crisis phone line) and after-hours cell-phone numbers for staff.

Students at UW were given a brightly colored wallet-sized card that included telephone numbers of emergency services and staff cell-phone numbers. Emergency contact forms were copied and scanned onto a shared computer drive to enable access to this information during off-hours. In addition, students were housed in a dormitory that staffed a 24-hour reception desk.

At WUSTL, students receive a list of emergency contacts, along with the cell-phone and office-phone numbers of five staff members. Staff also provide students with campus-security telephone numbers for both the undergraduate campus and the medical-school campus. Emergency information is also available on a shared drive that students can easily access.

Students should know that in the case of an emergency, they must first call appropriate emergency personnel and then contact program staff to apprise them of the situation. It's also worth encouraging them to watch out for and support each other. It's very easy for students who are sick or in trouble to become isolated when they are away from home. An ASP administrator shared an instance where students intervened to help another student through a medical emergency:

We had a boy with appendicitis who sat in his room in pain for hours before he eventually knocked on someone's door to ask for pain relief. It was only at that point that the person he spoke to suggested that he should go to the hospital. They then woke another student and all three went together. A lot of our students "don't want to make a fuss." Often it's the other students they live with who may notice something is wrong. I got notified about 7:30 a.m. that the three students were at the hospital and was then able to complete needed administrative details. We interacted with the hospital administration and insurance, collected information to relay to the student's parents, and made sure that all the paperwork was signed appropriately so the hospital was able to perform the surgery.

Other examples of emergencies are non-medical, such as a death in a student's family. Program staff may need to help students make critical decisions, such as whether to go home for the service or whether they will be able to complete the summer experience. In some cases, program staff will want to consult with student-affairs professionals, such as the staff in a campus counseling center, who can provide mental-health and grief-support services. These personnel can help program staff respond appropriately to student crises and refer students to services where appropriate.

### **Celebrate program completion!**

The ASP, like many other summer research experiences, culminates with student poster and oral-project presentations and writing assignments. It is important to mark these academic achievements with social events, such as a celebratory dinner. To commemorate the experience, some summer programs present students with gifts, such as a group photo, a program T-shirt, or other awards. The Amgen Scholars U.S./Global Program Office provides Certificates of Completion for Amgen Scholars, and many ASP sites distribute them during closing celebrations.

UW ASP scholars—along with mentors and lab staff—attended a celebratory catered buffet dinner hosted at their campus residence hall. In addition to celebratory remarks, program staff gave scholars reminders regarding checkout, travel procedures, and completion of program evaluations. The dinner followed the final oral presentations and ended by 7:30 p.m., giving students ample time to embark on their own social activities directly afterward.

The ASP at Cambridge concludes just prior to the start of the Amgen Symposium, which is also held at Cambridge. There, students from all three Amgen European sites convene. Before the students from the other sites arrive, Cambridge hosts “formal hall” for their students to say goodbye to one another.

On the final Friday of the Caltech ASP, students are treated to lunch at the Athenaeum, Caltech's faculty club. The program coordinator usually compiles a slide show of the summer, and students are presented with their Certificates of Completion. Students from all the U.S. ASP sites discuss their summer work at the U.S. Amgen Symposium, which is held at the University of California, Los Angeles (UCLA), on the following day.

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**LESSONS LEARNED****Simplify and collaborate**

**Bring in existing student-affairs resources wherever possible.** You don't need to be an expert on all aspects of student life. Bring in campus professionals to help you orient students and troubleshoot issues as they arise.

**Require scholars to live together in campus housing if possible.** Shared campus housing is a significant part of the summer-research experience and most students cite it as critical to their cohort engagement. Shared meals are also encouraged, since they provide regular opportunities for scholars to interact.

**Don't go activity crazy.** Too many program-hosted events will exhaust staff and resources and lead to lower scholar participation. Over the first few weeks, arrange a few key activities or events with the ASP cohort and some with other summer research programs on campus; that way you will avoid conflicts during key work periods later in the summer. As the weeks progress, students will arrange their own activities around their schedules.

**Schedule individual advising sessions with students.** One-on-one student-advising sessions can alert program staff to challenges students are facing, which in turn enables staff to provide help in a timely manner. Schedule these early and set expectations for ongoing student check-ins throughout the summer.

**Expect the unexpected.** Realize that no amount of pre-planning will prevent emergencies from occurring. Have procedures in place for students to contact emergency personnel and program staff, and have students' emergency-contact paperwork and insurance information in order.



## Best practices at a glance

### **Start student-affairs programming early**

#### **Be explicit about campus policies, rules, and regulations with students**

- Introduce the subject at Orientation
- Recognize differences from state to state, campus to campus
- Bring in expert colleagues when possible

#### **Attend to students with special circumstances or needs**

- Ask questions and respond to student inquiries to learn of special needs
- Make accommodations with the help of campus staff
- Be sure students are aware of all avenues of support, including physicians and mental-health counselors

#### **Strike a balance between staff-planned recreational activities, such as barbecues and road trips, and student-initiated activities**

- Share programming with staff running other undergraduate summer programs
- Involve mentors and lab groups to attend program-organized events
- Frontload social activities during the first half of the summer
- Encourage local students to take the lead in student-organized events

#### **Schedule one-on-one advising sessions at regular intervals**

- Address student-life as well as academic issues so students are “research ready”
- Assist students in setting summer research and networking goals that help them to make connections and explore programs for graduate study

#### **Prepare for emergencies**

- At orientation, provide students with quick reference emergency phone numbers and after-hours staff cell-phone numbers
- Explain the program’s emergency procedures: For example, to call emergency personnel prior to contacting staff
- Be prepared to help students make critical decisions regarding family emergencies

#### **Celebrate program completion!**

- Plan a celebratory dinner or lunch
- Consider presenting students with small gifts, such as a group photo, program T-shirt, or a Certificate of Completion

# Year-Round Maintenance

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**W**hile most summer undergraduate research programs run for only 8 to 10 weeks, they require a good deal of attention throughout the year to ensure success. Each year at the program's end, staff must reflect on the summer activities and evaluation findings to make necessary improvements to the program. Networking during the year with faculty on your campus and other campuses will help increase the visibility of the program and the participation of faculty as mentors, application reviewers, and speakers during the summer. Websites and online application systems need to be updated, and students need to be recruited. In addition, most of the logistical preparations, including lab placements and housing, need to occur before the students arrive on campus.

At the Amgen Scholars Program (ASP) at the California Institute of Technology (Caltech), we find that, except for a brief reprieve during the month of December, we need to work the entire year to make plans for running the program and prepare for our new summer cohort. It is equally important to keep in touch with the program's alumni to support their continued academic and professional success.

This chapter will explore several components of this year-round maintenance and provide a calendar overview of how to proceed throughout the year (see Figure 1, "A Sample Maintenance Calendar for Caltech," page 134).

### Identify the commitments underlying your program's goals

As a first step, identify the commitments that underlie the goals and desired outcomes of your summer research program. These commitments will guide much of the work needed to establish, grow, and refine the program. Here are the three commitments that guide the ASP:

- Since its inception, the ASP has been committed to continuous improvement at all levels of the program—from the Amgen Foundation itself to the Global/U.S. and European Program Offices, to each of the corresponding program sites. An independent external evaluator leads this effort by collecting student data through applications, pre/post program surveys, site visits, and focus groups as well as collecting mentor and administration data through site visits, interviews, and surveys. The results of these evaluations are shared with the program directors through reports and at annual leadership meetings. Program directors are expected to use this feedback, along with data from local assessment efforts, to reflect upon their practices and refine their programs.
- In addition, the ASP is dedicated to bringing research opportunities to students who might not otherwise have access to such resources. In the United States, this means working to increase visibility of the program across various regions, institution types, and student populations. It is important that site directors take a creative and active role in marketing and recruitment efforts.
- Finally, the ASP continues to provide support to its alumni worldwide. This has resulted in travel grant programs in the US and Europe that provide partial support for alumni to attend national and international academic conferences and meetings. The ASP sites themselves stay connected to their own alumni to help them seek out other summer research programs, apply for graduate school or fellowships, and look for new mentorship opportunities.

## Identify key maintenance categories

With the commitments of your program firmly in mind, consider the big-picture areas that you need to maintain throughout the year. At Caltech, we have broken them into six general categories: visibility and marketing; faculty involvement; student recruitment; technology review; application, review, and award process; and alumni relations.

In general, we break down these areas over the seasons this way:

The fall is a good time to update your application process and websites, ensure rooms are available for all students, establish the awards process, and begin planning summer events. That is the schedule we follow at Caltech.

We also begin our assessment and evaluation process in the fall. This entails sending reports from the completed summer to the Amgen Foundation, reviewing reports we have solicited from the external evaluator to better understand our program's strengths and weaknesses, and holding debriefing and planning meetings with key collaborators.

Consider bringing an external evaluator into your evaluation process who can design and conduct in-depth evaluations specific to your organization, and provide reports outlining program effectiveness and strategic feedback.

Then, during the winter and spring at Caltech, we hold kickoff meetings with our key collaborators, confirm all summer events, prepare for Orientation, and manage all student travel.

Discussion of each of the categories follows:

**Visibility and marketing.** Each ASP site markets its program in a variety of ways, including advertising in student publications. Faculty and alumni, including the most recent cohort of scholars, write articles for print media, blog and tweet on social media, send emails and flyers to alumni and colleagues, speak at conferences and symposiums, and display posters on campus and in the local community.

**Faculty involvement.** Faculty from a variety of disciplines play a crucial role in the success of any undergraduate summer research program.

At Caltech, we take several measures throughout the year to ensure faculty involvement. Every fall, we meet with new faculty members to introduce them to the ASP. During these meetings, we talk about Caltech's commitment to undergraduate research, provide a general overview of the ASP, and share important dates for the upcoming year. We share post-summer

assessment data from reports prepared by the external evaluator, which highlight how students have grown in various skills and learning outcomes by participating in the program. This outreach helps us to expedite the search process later in the year when we begin to look for faculty mentors, application reviewers, and summer speakers.

Faculty are also critical in helping to maintain the quality and diversity of the research experience at each ASP. At Caltech, this includes their posting Announcements of Opportunity (AOs) on Caltech's ASP website to help prospective students identify a suitable project and/or mentor. Recent AOs posted by faculty/mentors include projects researching laser sensors for nitrogenase enzyme bioassays and quality control of mitochondria. Other ways that faculty ensure a quality experience for students are by serving on award committees, helping review applications, and speaking about their research during the summer. We begin planning speakers' schedules early to ensure that faculty will be available.

**Student recruitment.** At Caltech, faculty actively help to recruit students by holding information sessions, displaying posters on campus, using listservs like the Council on Undergraduate Research (CUR) to generate emails, attending regional and national conferences such as the Annual Biomedical Research Conference for Minority Students (ABRCMS), and spreading the word to alumni and colleagues via personal emails, letters, and phone calls.

**Technology review.** Before the program begins, we ensure that our technology systems are up and running properly. This includes reviewing and updating all of our website content and the electronic application-submission process. Enlisting your campus's information technology services in the spring to help with any necessary technical upgrades reduces delays and frustration later.

**Application, review, and award process.** For the 2015 U.S., European and Japan ASP sites, the application deadline was February 2, except for the Caltech ASP, which was February 14. While some students will begin looking for summer research opportunities in the fall, the process really picks up in January. The ASP sites receive many questions from potential applicants and mentors (both faculty and graduate students/postdoctoral fellows), so it is important to be prepared to answer all queries throughout the year in a timely manner. At Caltech, during the winter and spring, we recruit the Faculty Review Committee, review applications, make awards, and process acceptance materials. Aside from the summer itself, this is perhaps the busiest time of the year.

**Alumni relations.** Reaching out to alumni is an essential part of student recruitment. The University of California, Berkeley (Berkeley) uses external evaluator reports and an internal assessment process to update the information it shares with alumni about program components and practices. At Caltech, we focus on building campus relationships through debriefing and planning meetings with key collaborators, which include alumni. During the winter and spring, we check in with alumni who are juniors in college to see what their plans are for summer and how we might help and with seniors to follow and support their graduate-school application process.

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#### LESSONS LEARNED

### Continually refine and improve!

**Post-program, we stress the importance of:**

- Continuing to evaluate and improve all aspects of the program
- Ensuring that all technology is up to date and running properly
- Maintaining productive relationships with our key constituents

**FIGURE 1: A SAMPLE MAINTENANCE CALENDAR FOR CALTECH****FALL****Tactical Preparations, Assessment, and Evaluation**

- Update application processes and websites, ensure room availability, establish the awards process, begin planning summer events
- Send ASP site reports to the Amgen Foundation
- Review external evaluator reports
- Hold debriefing and planning meetings with key collaborators

**Visibility and Marketing**

- Send thank-yous to campuses for their support
- Advertise in student publications
- Have faculty, current scholars, and alumni write articles for print media, blog and tweet on social media, speak at conferences and symposiums, and display posters on campus and in the local community

**Faculty Involvement**

- Introduce new faculty to the program
- Share data from ASP program evaluations and reports
- Solicit faculty mentors

**Student Recruitment**

- Hold information sessions, display posters on campus, use listservs
- Spread the word to alumni and colleagues
- Attend national/regional conferences

**Technology**

- Review and update website content
- Review and update application-submission process

**Application, Review, and Award Process**

- Be prepared to answer all queries

*Continues, next page*

FIGURE 1: A SAMPLE MAINTENANCE CALENDAR FOR CALTECH, CONT'D.

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Alumni Relations

Assessment and Evaluation

Visibility and Marketing

Faculty Involvement

Student Recruitment

- Hold information sessions

Technology

Application, Review, and Award Process

- Recruit Faculty Review Committee
- Review applications and make awards
- Process acceptance materials

Tactical Preparations

- Hold kickoff meetings with key collaborators
- Confirm summer events
- Prepare for Orientation day
- Manage student travel

Alumni Relations

- Check in with alumni who are juniors to see what their plans are for summer
- Check in with alumni who are seniors to follow and support their graduate-school application process

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Run the program!



## Best practices at a glance

### **Identify the commitments that underlie your program's goals and desired outcomes**

- Conduct electronic evaluations with students, alumni, and mentors; consider using an outside evaluator to eliminate bias
- Provide support to alumni worldwide

### **Determine your program's key maintenance areas and sketch out a timeline for each**

- Plan marketing efforts, including advertisements, articles by faculty and alumni, posters, flyers, emails, and social media outlets
- Consider establishing a global online community, building on a platform they already use.
- Reach out to faculty through meetings to share assessment data and eliciting Announcements of Opportunity
- Recruit students through information sessions, listservs like CUR, attending regional and national conferences, and alumni involvement
- Upgrade technology systems, including the website content and application-submission process
- Set the application process in motion

# Evaluation: Ensuring That Your Undergraduate Research Program Is Successful

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2007–present*

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**U**ndergraduate research is becoming the norm for undergraduate STEM (science, technology, engineering, math) majors, with summer undergraduate research programs being one way students get this experience. These summer programs are known to have many positive outcomes for students, such as bolstered confidence, retention in STEM majors with continuation into science graduate programs and careers, and socialization into the science-research culture. To better understand those outcomes, it is important to evaluate the activities and programs that lead to them.

Evaluation is a necessary part of a successful undergraduate research program and should not be viewed as an afterthought. It is a process that determines the value or merit of a program or project, and reveals the extent to which it is successfully serving the participating students.

Along with measuring program outcomes, evaluation helps ensure from the outset and over the program lifespan that the program achieves maximum effectiveness, continuously improves performance, and ensures accountability to funders and stakeholders. It also helps administrators conceptualize goals, plan improvements, and maximize accountability among staff.

The Amgen Scholars Program (ASP) relies heavily on its evaluation process. Over the last eight years, the evaluation has helped pinpoint practices that have been effective as well as those that have not led to desired outcomes; it has helped inform decision-making at the host institutions, the program office, and the Amgen Foundation itself, which funds the program. It has also provided the data and analysis to better understand the impact the ASP has had on current scholars and alumni of the program.

In this chapter, we discuss the thinking behind the establishment of the ASP evaluation process as well as a description of the process itself.

#### REASONS TO DEVELOP AN EVALUATION PROCESS FOR YOUR PROGRAM

- To understand why parts of the activity or the whole program does or does not work
- To improve the program
- To identify the program's strengths and weaknesses
- To determine if the program is operating as originally planned
- To create a new plan or process for your program
- To determine if the community and/or participant needs are being met
- To measure if the program has met its objectives
- To show others (funders – future and current) how the program benefited the participants and stakeholders (students, alumni, faculty, department, university, employers)

## Plan an evaluation strategy

Program evaluation can help an organization understand the impact of its products or services. However, *a clear plan for using the information from the evaluation must be in place to maximize results*. The most important questions to ask in developing the plan are: What do we want to discover? Who will use this information?

It is essential to create a culture of evaluation at the onset of the program. All aspects of the program must be evaluated for both program improvement (process) as well as program success (summative).

Program directors and staff often view an evaluation as a negative process. They are afraid it will take too much time and money and will be a judgment of their own work. To the contrary, an evaluation can be a very positive experience for directors and staff, helping to eliminate problems the organization might encounter without being intrusive or time consuming. By providing data-based recommendations on what new parts or adjustments may be needed, an evaluation can ensure that the program continues to reach its potential.

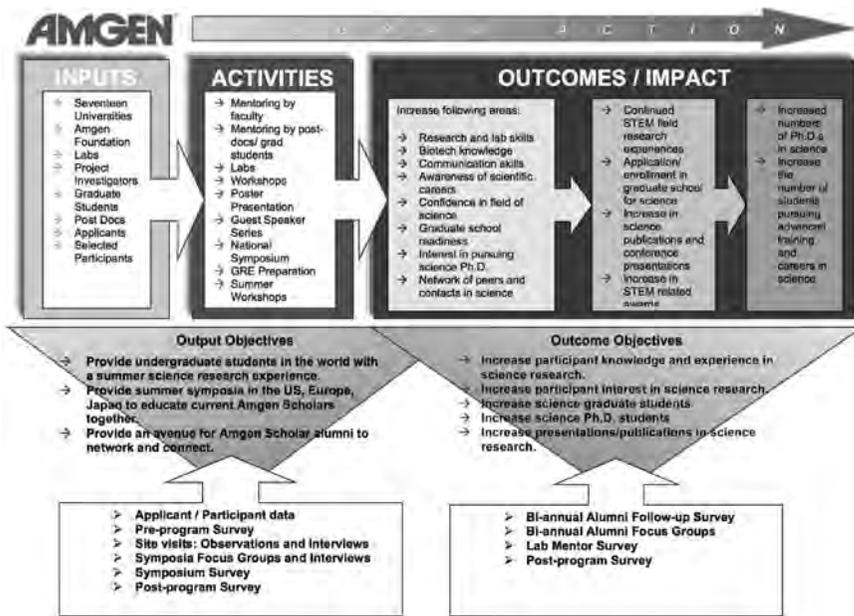
## Determine what to evaluate for your particular program

The development of the ASP evaluation plan helped shape the program itself, and participation in the process is expected of all host institutions. It was built in close collaboration with the Amgen Foundation before the launch of the program. This ensured that the evaluation and associated deliverables would provide the information and recommendations that the Foundation needed to inform the program, make ongoing decisions, and capture the outcomes at the very core of the ASP mission.

To determine what to evaluate for your program, you must first understand the program's mission, its components, and its expected outcomes. *One of the first steps we undertook in designing the ASP evaluation process was to create a logic model for the program*. A logic model provides a visualization of the parts of a program or organization, the desired outcomes or impacts, and the connections between the parts and the outcomes/impacts. A program's funding sources and participants provide significant input to the model. The program's activities—its services, materials, and actions—comprise the core elements of the evaluation. These vary depending on the specific program being evaluated. Short-term impacts and long-term outcomes show the results of the activities and the broader, more enduring effect of the program as a whole. With these aspects mapped out, we were able to develop questions that we wanted answered through the evaluation.

The logic model developed for the ASP is below. This logic model also depicts the evaluation tools used to measure the process and outcomes of the ASP.

**Amgen Scholars Program Logic Model and Evaluation Plan**



(SOURCE: CENTER FOR EVALUATION AND EDUCATION POLICY)

During the first two phases (eight years) of the ASP, we employed both a process and an outcome evaluation. These required both quantitative and qualitative data to successfully accomplish the following: (1) provide the types of process feedback needed for program improvement and decision-making to each host institution, each national/ coordinating office, and the Amgen Foundation; and (2) produce the types of data and reports necessary to show the overall impact of the program. The evaluation also considered the context and individuality of each host institution within and across each continent (the U.S. and Europe; the Japan sites were added later). This consideration allowed for a more comprehensive picture of the process, the programs, and the outcomes. In other words, the evaluation helped to address not only the extent to which the program worked, but for whom the program worked, in what contexts, and why.

**Conduct a process evaluation**

A *process evaluation* is a critical aspect of any evaluative process. It ensures that the program is delivering and implementing the services in a beneficial

and efficient manner that is satisfactory to its stakeholders as well as effective in its delivery and outcomes. The process evaluation allows for critical feedback needed for purposes of program improvement on an ongoing basis.

The ASP evaluation team worked closely and collaboratively with key stakeholders at the Amgen Foundation and the host institutions to learn about the activities and experiences at each site and to ensure the questions and focus of the data collection were tied to program delivery. We shared the evaluation data and emerging trends on a regular basis with the Amgen Foundation and Amgen Scholars Global/U.S. Program Office and the European Coordinating Centre to help them better serve the host sites by coordinating conversations, preparing summer Symposia, marketing the program, and maintaining overall program development and success.

For example, the evaluation examined the implementation and effectiveness of various common activities across the sites, such as:

- The scholar recruitment process
- The application process
- The applicant pool
- The selected students
- The 8-10 week summer research experience
- The Symposium for Amgen Scholars
- Peer relationships/community among the scholars at each respective institution

The process evaluation questions included:

- *Who applies to the ASP? Do the applicant and participant pools reflect the types of students a host institution wants to attract to the program?*
- *What do the participants look like in terms of demographics, research experience, home school, and education/career plans?*
- *What are scholars' experiences during the ASP both in and out of the lab?*
- *What workshops, programming, and experiences resonate most with scholars and why?*

Program directors at each site received customized reports regarding their programs throughout the summer and at the end of the program. These

reports included data on their participants and program activities along with recommendations for improvement. The evaluation also identified promising practices for the ASP as a whole. Additionally, these best practices were regularly used as a basis of conversation for the Program Director Meeting initially held annually and then every other year. Finally, the information and data collected and analyzed were communicated back to the GPO, the European Coordinating Centre and the Amgen Foundation in a manner that provided not only feedback for immediate program improvement but also for future program and policy decisions.

### Conduct an outcome evaluation

*Although process feedback for program improvement was regularly provided to key stakeholders, the ultimate purpose of the evaluation was to determine the impact and outcomes of the ASP as a whole.* Therefore the evaluation plan included collecting both quantitative and qualitative data from students starting with the application process and continuing through program completion, as well as each year afterward. The aim was to provide a comprehensive picture of not just what was happening to students but also why it was happening, and what types of experiences most impacted each student's education and career post-ASP. The Outcome Objectives are listed in the logic model, on page 140.

The key questions guiding the short-term outcome evaluation were:

- *To what extent, and in what ways, does the ASP influence participants' decisions regarding future career and educational plans?*
- *Do participants' plans change after participation?*

The key question guiding the long-term outcome evaluation was:

- *To what extent does the ASP impact a student's future goals, education, contribution to the field of science through presentations and publications, and ultimate career?*

In order to answer these overriding questions, it was essential to first understand the students who participated in the program. The evaluation collected data from students' applications regarding their experiences prior to the ASP, such as research interests, disciplinary major, grades, and home-institution type, as well as demographic data, including their nationality, race-ethnicity, and gender. The goal was to assess questions like the following over time: To what extent does the ASP serve undergraduate students who are already committed to an academic and/or career path in a STEM

discipline versus undergraduate students who are less certain about their educational and career plans?

Given that the ASP takes place in multiple universities across multiple countries, it was important to establish common measures and definitions for key variables of interest to enable evaluative comparisons. Hence, there was an effort to collect similar types of data across all ASP sites. All data-collection instruments were approved by the program leadership at each site as well as native speakers from the countries represented to ensure that they were sensitive to any cultural or linguistic differences.

The evaluation comprehensively addressed the potential benefits of the ASP and examined any differential effects based on participant or institutional characteristics related to each of the following 10 areas:

- **Interaction and communication skills** (e.g., skill at oral, visual, and written communication; leadership; becoming part of a learning community; working independently; ability to collaborate with other researchers; changes in attitudes toward learning and working as a researcher)
- **Data collection and interpretation skills** (e.g., ability to collect data according to a plan; ability to analyze data; skill in interpretation of results; lab techniques; ability to solve technical or procedural problems)
- **Professional development** (e.g., clarification, confirmation and refinement of career/education paths; understanding professional behavior in your discipline; understanding personal demands of a career in your discipline; understanding the research practices in your field; understanding how professionals work on real problems)
- **Personal development** (e.g., sense of accomplishment; tolerance for obstacles; self-confidence; interest in a discipline)
- **Design and hypothesis skills** (e.g., ability to employ appropriate design methods; ability to integrate theory and practice; critical evaluation of hypotheses and methods in the literature)
- **Professional advancement** (e.g., enhanced career/graduate school preparation; opportunities for publication; sense of contributing to a body of knowledge; opportunities for networking; enhancement of your professional or academic credentials; developing a continuing relationship with a faculty member)
- **Information literacy skills** (e.g., ability to read and understand primary literature; ability to locate and identify the relevant literature; ability to see connections to your college coursework)

- **Responsibility** (e.g., learning safety techniques; learning the ethical standards in your field)
- **Knowledge synthesis** (e.g., learning a topic in depth; understanding how current research ideas build upon previous studies; thinking and working like a scientist)
- **Intellectual development** (e.g., epistemological reflection and development; critical thinking skills)

In examining how participation in the ASP impacted students' academic and career paths, the evaluation analyzed data related to the following: (1) students' educational and career plans (e.g., pre- and post-surveys of students' education and career plans, and self-perceptions regarding impact of the program on their decisions related to future career and educational plans), and (2) the education and career paths the student was pursuing or had pursued.

### Determine the best types of data to collect

The type of data you collect will depend on the particular goals and activities of your program. The chart below shows the types of data the ASP collected to inform both the process and the outcome evaluations. An explanation of each follows the chart.

| Process Evaluation         | Outcome Evaluation                    |
|----------------------------|---------------------------------------|
| Applicant/Participant Data |                                       |
| Pre-Program Survey         |                                       |
| Site Visits                |                                       |
| Symposium Focus Groups     |                                       |
| Symposium Survey           |                                       |
| Post-Program Survey        | Post-Program Survey                   |
| Lab Mentor Survey          | Lab Mentor Survey                     |
|                            | Bi-Annual Alumni Followup Survey      |
|                            | Bi-Annual Alumni Focus Groups         |
|                            | Longitudinal Database Tracking System |

**Applicant/Participant Data.** A set of 10 to 20 common application questions were asked of all applicants every year across all programs. Common application questions included demographic data (e.g., gender, nationality, race, age); academic data (e.g., GPA, major GPA); and marketing data (e.g., how did you hear about the program?). The responses were uploaded by each of the ASP sites onto a secure database created and maintained by the evaluation team. The data were then examined site by site, as well as across the two programs (U.S. and Europe at the time), and as they related to the program overall.

Once the Amgen Scholars are selected, they are marked as “participants” within the application database; their responses then formed the baseline data for the summer cohort. The data were also compared to data from previous years within a site as well as within the ASP overall.

**Site Visits.** Site visits were conducted during each summer at selected ASP sites, including all new sites, sites with new leadership, and sites with a particular need. One to two additional sites were visited annually based on the research emphasis for the year. For example, one year focused on mentor impact, so sites with a well-established, successful mentor program were visited to gather data on successes and best practices. Another year the focus shifted to out-of-lab experiences, so only schools with highly rated out-of-lab experiences were visited. The qualitative data collected during site visits provide a better understanding of the factors that contribute to, and detract from, the successful implementation of a program. They also provide rich, descriptive data regarding the ways in which the ASP has impacted the host institutions, participating students, and other STEM initiatives on each respective campus, revealing commonalities and differences across the sites.

**Web-based Pre- and Post-Program Surveys of Participants.** All scholars participating in the ASP must take a pre- and post-program web-based survey. The purpose of the pre-survey, which students take before arriving at their host institutions, is to collect information related to research knowledge/comfort, program expectations, and future goals. It includes questions regarding participants’ majors, graduate-degree objectives, and current level of knowledge/experience with various research skills, such as laboratory and scientific-writing skills. Students complete a comparable web-based survey in the final week of the program. Pre- and post-survey data are analyzed to determine the extent to which there are measurable changes in participants’ knowledge, skills and abilities, and/or attitudes. Given the intensity and short duration of the ASP, and the fact that most students don’t simultaneously participate in any other courses or programs, it is reasonable to attribute any changes to the program. In addition, the web-based surveys provide process data for program improvement.

**Symposium Focus Groups.** Focus groups of 8-10 students from various ASP sites and backgrounds are held during the U.S. and the European Symposia in the summer. The groups provide an opportunity to observe how the students interact and reflect on the impact of the ASP, their educational and career goals, and the value-add of the Symposium itself.

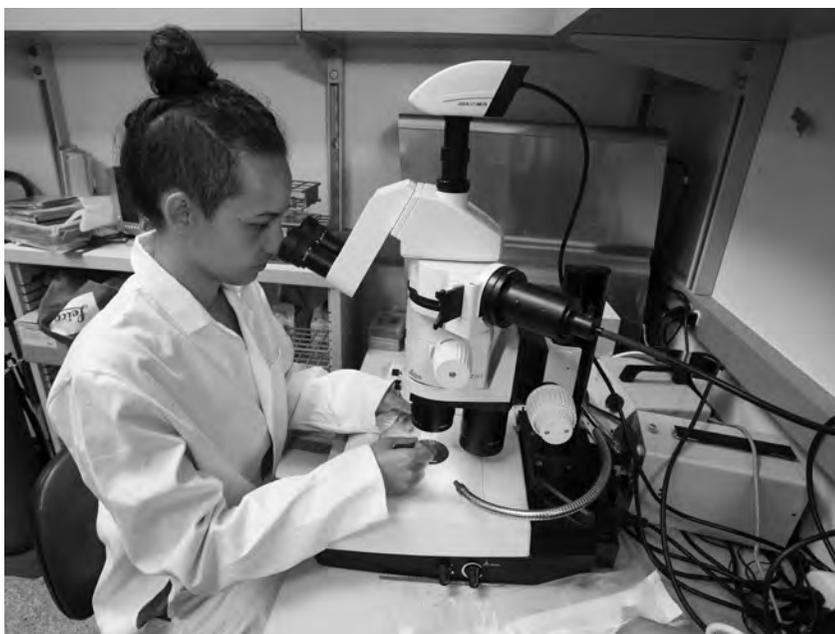
**Symposium Survey.** Following each Symposium, Amgen Scholars complete a brief survey on the elements and value-add of the Symposium to the ASP. The data collected are used for future Symposium planning as well as to determine the impact of the Symposium on the students' ASP experience and future plans..

**Bi-annual Alumni Survey.** To determine the long-term impact of the ASP, each spring all alumni are asked to complete a follow-up web-based survey. The surveys focus on academic impact, career impact, and any presentations or publications that have resulted from research done while an Amgen Scholar or as a result of further education and experience. The data collected from the alumni surveys are the primary avenue for determining impact of the ASP overall. In addition, all alumni are asked to take a shorter survey in the fall to update contact information or follow up with scholars who graduated in the previous spring and were unsure of their plans.

**Longitudinal Database Tracking System.** To maintain all the data a comprehensive evaluation requires, you need an extensive longitudinal database tracking system. Our system includes data from 2,835 ASP participants from the first nine years and from tens of thousands of applicants. It provides reliable and valid data on the long-term impact of the program, emphasizing key transition points in the STEM pipeline (e.g., baccalaureate completion, graduate- or professional-school enrollment, graduate- or professional-degree completion). All of these data serve as a resource not only for the outcome evaluation but also for each ASP site, National Program Office, and the Amgen Foundation.

In addition to providing critical data related to the long-term impact of the ASP, the database tracking system also provides the types of data needed to ultimately examine possible differential effects by institution, or by various key program characteristics or elements (e.g., Do those programs with strong mentoring programs appear to have a greater impact?).

We are committed in all data collection to minimizing respondent burden (e.g., using extant data whenever possible, working with the Global/U.S. Program Office and the European Coordinating Centre and participating institutions to minimize any duplication of efforts) and protecting the rights of human subjects (e.g., ensuring confidentiality and protection of sensitive information).



(PHOTO: REED HUTCHINSON, REED HUTCHINSON PHOTOGRAPHICS)

As mentioned above, much of the data gathered has been collected via applications and surveys, but data are also gathered via regular web searches as well as updates from program directors, and from alumni themselves. The evaluation team maintains a good relationship with all program directors and communicates often with all sites in order to share and exchange information.

Alumni response rate has been quite high: 80%. To ensure maximum retention of participants in the database, several techniques are used. Given that many persons in the academic arena change institutions/jobs/locations starting in the summer, all alums are contacted in the spring and again in the fall to ask if the most current contact information is accurate, and whether they anticipate this information changing in the next six months. The most current e-mail address is used for initial contact, and if there is no response, we follow up with a phone call or letter via mail address. We also request the name and contact information for a person who will always know how to locate alumni (e.g., a parent) and adequate background information (secured and protected) to locate hard-to-find students at a later point in time.

## Generate regular reports

Providing stakeholders with year-round reports is crucial to understanding, and thus continually improving, the applicant process, the programming, the Symposium, and the outcomes of the program.

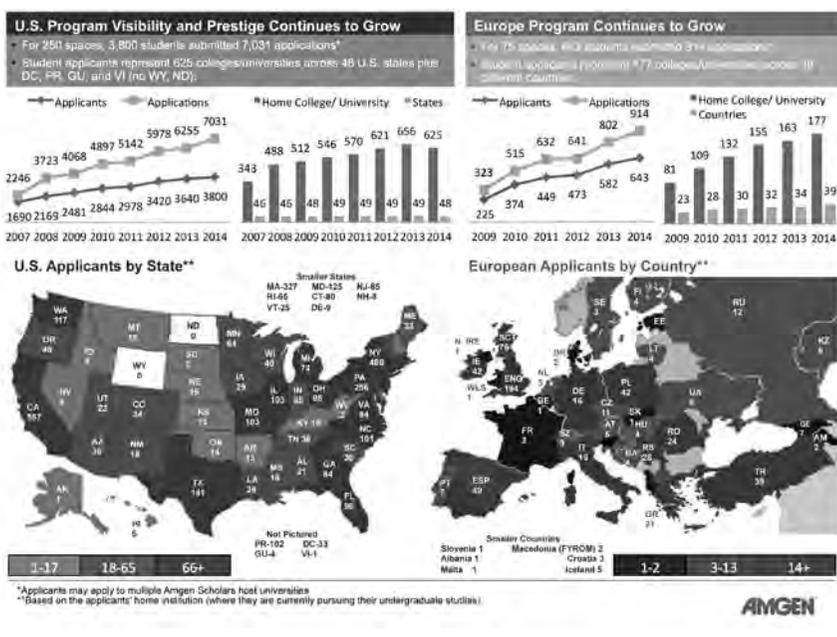
The chart below illustrates the reports generated by the ASP evaluation as well as a timeline for the delivery of those reports.

|                     | Foundation/Program Offices   | Individual Institutions                                    |
|---------------------|--|--|
| Applicant           | Aggregate Applicant Report (March)   | Applicant Snapshots (March)                                |
| Participant         | Aggregate Participant Report (April)   |  |
| Pre-Program Survey  |  | Pre-Program Survey Reports (June-July)                     |
| Symposium           | Individual Symposium Reports (August-September)  |  |
| Post-Program Survey | Final Aggregate Report (October)<br>U.S. Aggregate Report (September)<br>Europe Aggregate Report (October) | Post-Program Survey Reports and Snapshots (August-October) |
| Alumni              | Aggregate Alumni Report (May)  | Annual Alumni Reports (May)                                |

**Applicant Reports** comprise applicant data that have been analyzed for each of the host sites, for each larger program (U.S. and Europe, and, in the future, Japan), and then across the ASP as a whole. This report demonstrates the wide spectrum of applicant profiles, and illuminates any significant trends with regard to applicant characteristics within or among host institutions. This report also provides a Snapshot to universities, the Program Offices, and the Amgen Foundation of the types of students applying, why they are applying, and how they heard about the program.

In our Snapshots we report on the change in applicants and applications over time as well as the location of the applicants. For example, 4,443 students applied to be in the 2014 combined ASP, 3,800 in the U.S. and 643 in Europe. This was a growth from 2007, the initial year in the U.S., from 1,690 applicants, and from 2009, the initial year in Europe, from 225 applicants. Please see the figure below, “Snapshot of the 2014 Amgen Scholar’s Program 4,443 Applicants.”

### Snapshot of the 2014 Amgen Scholars Program’s 4,443 Applicants



(SOURCE: CENTER FOR EVALUATION AND EDUCATION POLICY)

**Participant Reports** comprise analysis of data on those who have been admitted to and attend the ASP. These are sent to the two Program Offices and to the Amgen Foundation. These reports provide the initial baseline data on participants. The Snapshot provides demographic and future plans for the current participants. For example, the U.S. program participants in 2014 represented 132 colleges and universities across 40 states, Washington, D.C., and Puerto Rico. The 80 European participants represented 45 colleges and universities across 21 countries.

Based on the analysis of pre-survey data, the **Pre-Program Survey Report** includes participant demographic data (similar to that found in the Participant Report) and all data points from the pre-program survey. These



(PHOTO: IMAGE GROUP LA)

data are related to program and future goals prior to the beginning of the program. The report serves to inform staff at the host sites about their incoming students and those students' expectations. In some instances it can help with summer planning. The Pre-Survey Report also provides a point of reference for the Post-Program Survey Report. These data are compared and aggregated across programs in the final Post-Program Survey Report.

Data from the each of the Symposium Surveys (U.S. and Europe) are compiled, analyzed, and reported in aggregate form. Each of these reports assesses the impact of the Symposium, as well as scholars' overall satisfaction levels and other Symposium-related feedback. Since each symposium is so different, each report stands on its own with no cross-symposium comparison.

Post-program survey data are analyzed separately and in comparison with the pre-survey data in the **Post-Program Survey Report** to determine the extent to which measurable changes have occurred in participants' knowledge, skills, and abilities, based on the 10 outcome areas described earlier in this chapter in the "Conduct an outcome evaluation" section. These data are also compared and aggregated across host sites within each program (i.e., U.S. and Europe, and in the future, Japan) as well as across all the ASP sites.

These reports provide recommendations for improvement as well as short-term outcomes of the ASP.

Some data points we have learned over the first eight years of the program from survey analyses:

- More than 99% of scholars indicated on the Post-Program Survey that they would recommend the ASP
- 92% value the Symposia
- 94% would attend the same host site
- Students most valued the in-lab learning experience
- The biggest take-aways from the ASP include gaining research skills/experience, laboratory skills/experience, scientific-interest/guidance, communication skills, and networking

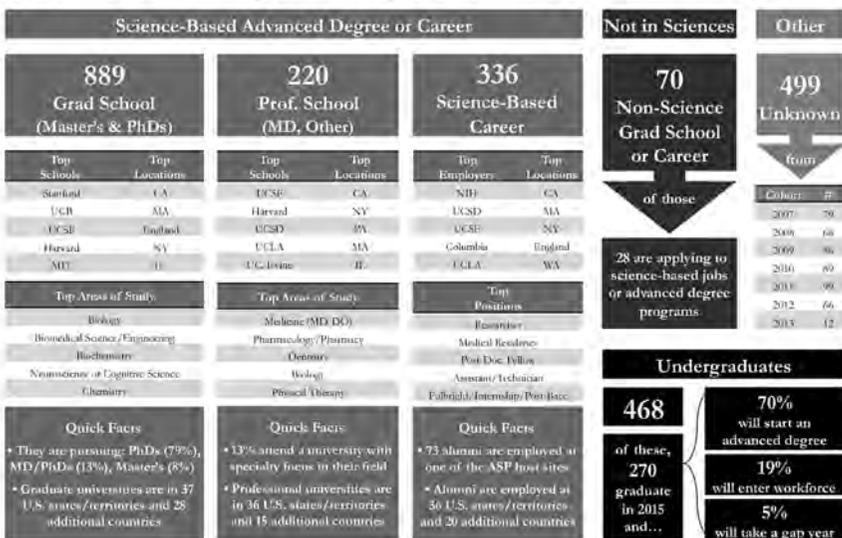
The **Alumni Report** comprises data collected and maintained in the Longitudinal Database Tracking System collected from the annual surveys, webscans, and program-director updates. The report includes short- and long-term outcomes of the ASP including the 10 outcome areas of the program as well as the long-term outcomes such as education, career, and presentations/publications/awards received since program completion. The data collected from this survey are the primary avenue for determining long-term impact of the program on participants. Data are analyzed by separate institutions, each national program, and aggregated across all sites.

Some alumni highlights from the 2,482 Amgen Scholars from the 2007-2014 participating years:

- 1,025 have received an award. There is a positive correlation between those who increased their knowledge of funding opportunities during the ASP and those with awards.
- 1,017 have presented their research at a conference. There is a positive correlation between those who gained presentation skills during the ASP and those making conference presentations.
- 877 have published. The ratings of the gains in knowledge in scientific writing have increased since 2007.
- 95% of those who have completed their undergraduate studies are pursuing a scientific advanced degree or career

## Program Impact: Alumni & Advanced Degrees and Careers

2,482 Alumni • 95% Pursuing Advanced Degree or Scientific Career\*



\*Out of alumni who have completed their undergraduate and who have remained contact.



(SOURCE: CENTER FOR EVALUATION AND EDUCATION POLICY)

### LESSONS LEARNED

#### Bring in the funder, nurture relationships with host sites

An evaluation should be an integral part of any program. It provides useful information throughout the program to make data-driven decisions, and can help program administrators understand how to better achieve the outcomes they are most interested in. The most effective evaluations have buy-in from the top to the bottom, answer the questions that are most important to the funding agent, and provide a value-add to those involved in all aspects of the program design and delivery.

*Some points to remember:*

**Have the buy-in and cooperation of the funder.** The Amgen Foundation values the evaluation and demonstrates that in everything it does. The evaluation data and reports are used and highlighted in every program director meeting and also discussed with the Amgen Foundation Board of Directors.

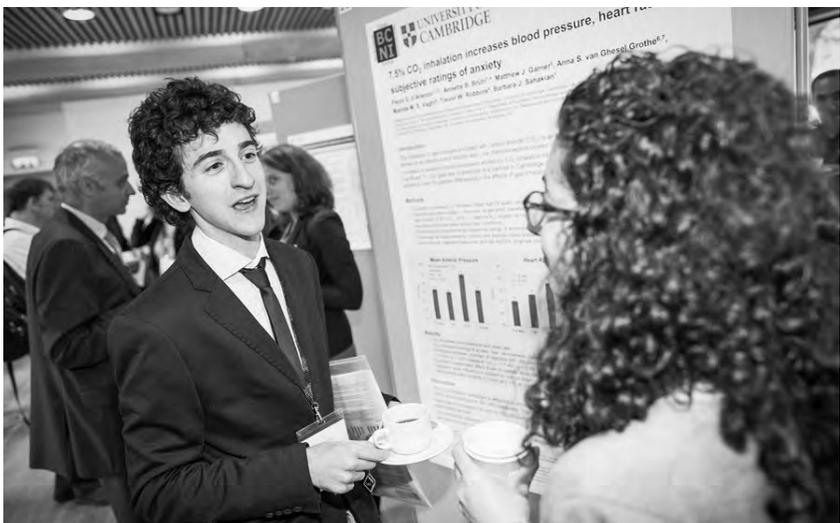
**Develop relationships with the host site directors.** Explain the purpose and results of the evaluation to them, and why you chose the data you did.

Provide a value-add for their participation. The ASP evaluation allows each site to add site-specific questions to the Pre- and Post- Program Surveys and then provides site-specific reports back to each site so they can use the data to make programmatic decisions and see the outcomes of their programming on their scholars.

**Clarify evaluation expectations to host sites.** The Amgen Foundation has made it clear to all host sites that the evaluation data is very important and they should make every effort to provide all information and data to the evaluator in a timely manner. In addition, each site tells all of their scholars that they are expected to complete all surveys received both during the program and in the years that follow.

**Send out the Pre-Program Survey to students before they arrive on campus for the summer program.** The Pre-Program Survey is meant to gather information on the knowledge and expectations of the students. If they don't receive the survey until after they have arrived, they are likely to respond differently as they have already been influenced. To increase response rates, Post-Program Survey should be administered in the last week of the program. If you wait until the last day or two of the program, many will not complete the survey.

Gather a non-“edu” email address from students while they are in the program. The email that students have when they are scholars is generally attached to their undergraduate institution. As soon as they graduate it becomes almost impossible to track them down. Require all students to provide a non-“edu” email address and use this one to contact them annually.



(PHOTO: MARTIN BOND, MARTIN BOND PHOTOGRAPHY)



## Best practices at a glance

### **Plan an evaluation strategy**

- Ask: What do we want to discover from the evaluation?
- Ask: Who will use this information?

### **Determine what to evaluate for your particular program**

- Create a logic model to visualize the parts of your program, the desired outcomes, and the connections between the parts and the outcomes
- Get input for the model from funding sources and participants

### **Conduct a process evaluation**

- Work with key stakeholders to learn about the activities and experiences at each host institution
- Ensure that the focus of the data collection is tied to program delivery

### **Conduct an outcome evaluation**

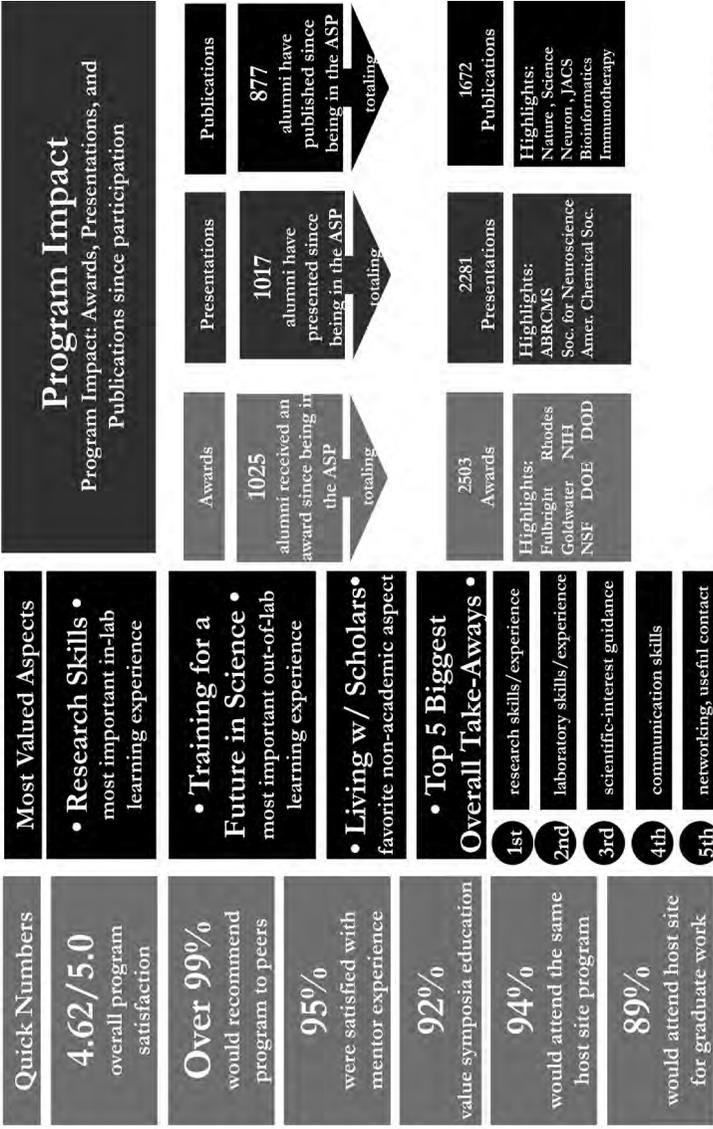
- Collect both quantitative and qualitative data from students starting with the application process and continuing through program completion and each year afterward
- Establish common measures and definitions for key variables of interest to enable evaluative comparisons across sites
- Compile a set list of benefits you want to evaluate, for example, data collection and interpretation skills, professional development, and knowledge synthesis, and relate them to how participation in the program affected participants' academic and career paths

### **Determine the best types of data to collect, for example, Applicant/ Participant Data, Pre- and Post-Program Surveys, Site Visits, and Lab-Mentor Surveys**

### **Institute a Longitudinal Database Tracking System to maintain all the comprehensive data an evaluation requires**

### **Generate regular year-round reports to stakeholders**

Summer Program Outcomes – 2007–2014



\*Based on the participants' home institution (where they are currently pursuing their undergraduate studies).  
 \*\*Data only available for cohorts 2008-2014.





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## CONTRIBUTORS

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