

# Designing Virtual Internships in STEM Fields

Innovations and Lessons Learned from Summer 2020



# Summer 2020: Unprecedented Opportunity to Study Virtual Internships



## Thousands of internships were canceled in summer 2020.

- Nearly 4 in 10 students (38%) reported cancellations (Beschloss, 2020).
- Employers also delayed programs and made them shorter (Blumenstyk, 2020).

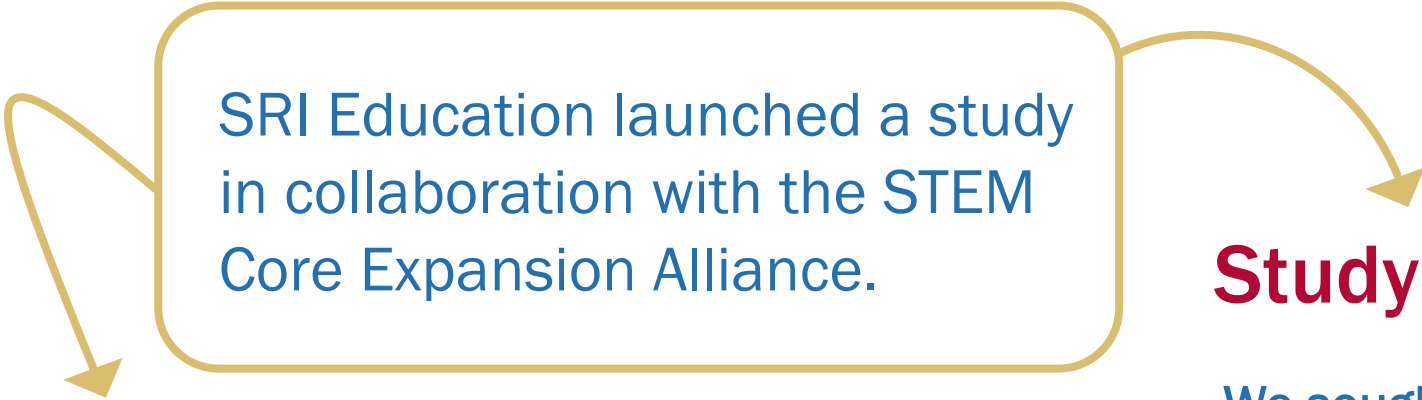


## A small fraction of internships converted to virtual formats.

- Five in 6 National Science Foundation (NSF) Research Experiences for Undergraduates (REUs) in chemistry and engineering were canceled; the remainder converted to virtual internships (Parry, 2020).



## This small fraction still made for a dramatic rise in virtual internships.



SRI Education launched a study in collaboration with the STEM Core Expansion Alliance.

## Study Assumptions

Summer 2020 virtual internships designed by necessity could...

- transform internships long-term
- generate lessons learned and innovations useful in the future
- hold promise for broadening participation in STEM.

## Study Goals

We sought to understand...

- how well virtual internships met, or could meet, employers' and students' goals
- employer and student successes and challenges
- the potential for virtual internships to expand opportunities for students in groups underrepresented in STEM.

Here's what we learned.



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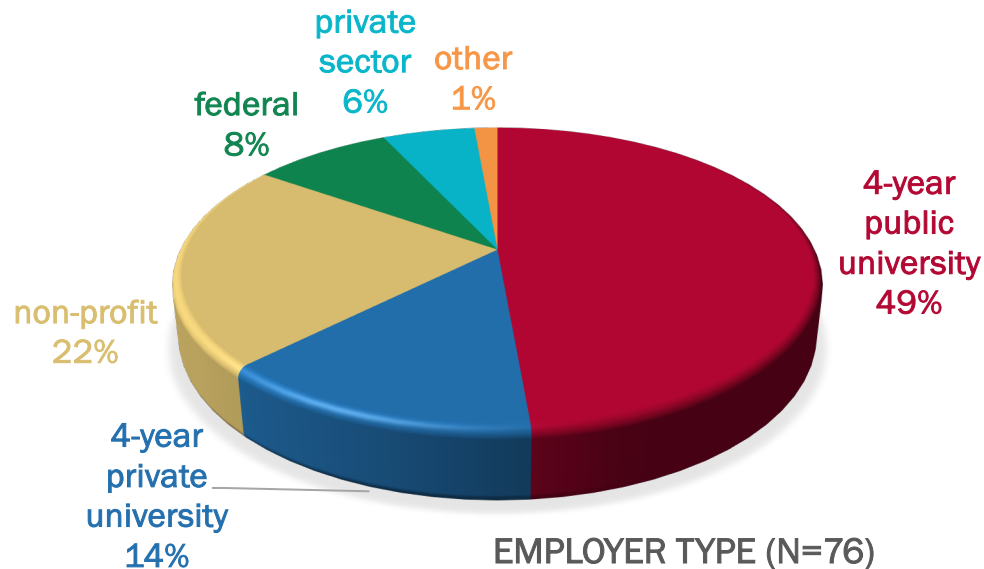
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# Study Participants

84

employers surveyed offered virtual internships.

- 125 employers responded to the survey; 81 completed it.
- We then interviewed 9 employers who had submitted surveys.



The large proportion of academic employers resulted from our having contacted all grantees of NSF's Research Experiences for Undergraduate program, in addition to advertising the survey online and via social media.



75

# Study Participants

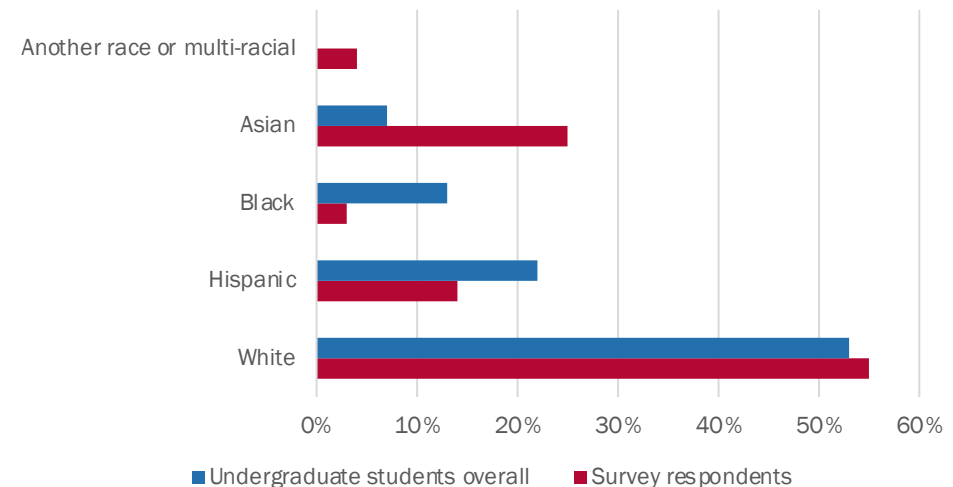
students surveyed had STEM virtual internships.

- 137 students responded to the survey; 106 completed it.
- We then interviewed 18 students who had submitted surveys.

## About the students

- Computer science, material science, and biomedical engineering were remote interns' most common majors.
- More than half (56%) were students at 19 public, 4-year schools; 34% of students attended private 4-year schools; 8% attended community colleges.
- Over half (55%) identified as White, with smaller proportions identifying as Asian (25%), Hispanic (14%), Black (3%), or as of another race or multi-racial (4%).

Over- and under-representation of students by race and ethnicity in survey data



Source: NCES postsecondary data on U.S. resident college students, 2019

# Interviews with Survey Respondents

16

students interviewed

These 16 students attended:

- public 4-year colleges (9)
- private 4-year colleges (5)
- community colleges (2)

Their internships were:

- REUs (9)
- in the private sector (3)
- with federal employers (2)
- with non-profits (2)

9

employers interviewed

These 9 employers were with:

- university research labs (4)
- private companies (2)
- a non-profit research institute
- an industry workforce development group
- a national lab



# Study Findings and Recommendations





**STEM virtual  
internships are  
here to stay.**

## Employers were surprised by the success of virtual internships.

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- All (100%) said remote interns met expectations.
- Just under half (49%) identified no way interns could have performed better.
- Nearly half (44%) planned to offer virtual internships again or weren't sure. None ruled them out.

## Employers said virtual internships...

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- can broaden recruiting pools, reduce costs, and expand student options
- provide a glimpse of the future of work
- provide valuable preparation for later onsite work.



**STEM virtual  
internships are  
here to stay.**

## Students had positive experiences...

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- Nearly all (98%) would recommend their internship to a friend with similar career goals.

## ...although they didn't choose virtual internships.

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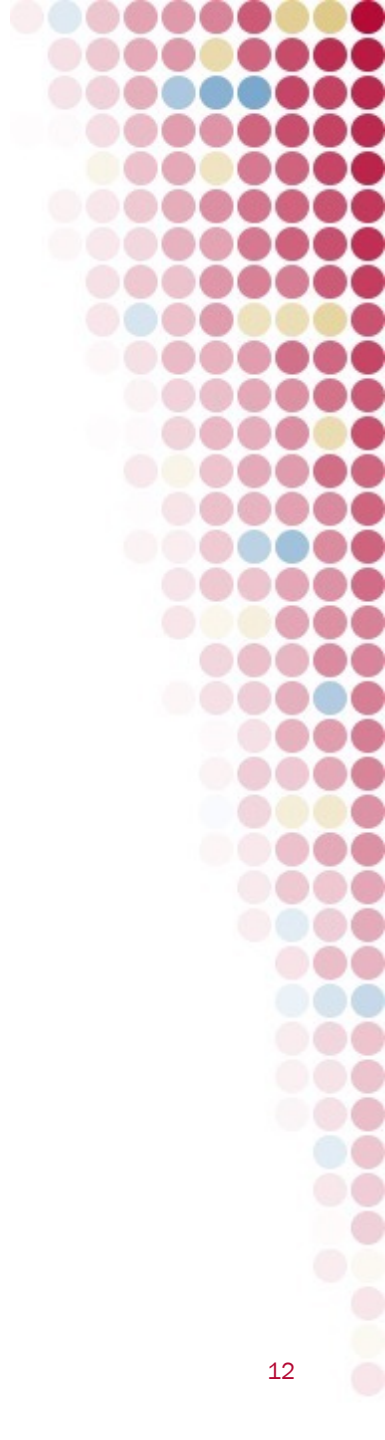
- Virtual internships were the only option for 61% of students.
- Planned, in-person internships changed to virtual for 59%.



*“We didn't lose an awful lot. So much of the work is online anyway. My team is in five cities.” –Employer*

*“Going forward, like many companies, we are going to shrink our footprint, and more people are going to be able to work from home permanently.” –Employer*

*“With innovative thinking, a lot of goals that may have initially seemed not possible in a virtual environment actually were.” –Employer*



*“The barriers to doing things remotely are low. They are things like ‘how do you build a community?’, and ‘how do you get people interested in each other?’...The big picture question for us is, ‘how can we bring experiments into the mix?’ That’s going to involve automation. There are some signals that some automated experiments may become possible in the not-too-distant future.” –Employer*

*“The use of captioning, description, accessible software—without question all the telework software and hardware is an issue that companies are just becoming aware of. Personalization features—how to make experience more human—is a great area of study for years to come. [...] We did pretty well using what we have, but there is no doubt there will be a lot of improvements. You can sort of shape how the world sees you. [...] There is an interesting aspect of being stuck online that is ripe for innovation.” –Employer*

# Clarifying Goals for Virtual Internship Programs Post-Pandemic

Expanding recruiting pools and raising their organization's profile are top goals, employers said.

Employers also want to use intern programs to improve diversity, equity, and inclusion, but program criteria and other factors present challenges.



## Can a virtual internship program expand your recruiting pool?

- Recruiting was the top goal among employers we interviewed.
- More than half of surveyed employers (54%) identified recruiting as a goal, whereas only a quarter (26%) of students completed a virtual internship because they hoped to later work where they interned.

### Benefits of recruiting remote interns

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- Develop new partnerships with community colleges, workforce boards, and industry groups far from your physical office.
- Attract talented students who lack transportation, cannot easily relocate for the summer, live far from your offices, or already have needed accommodations at home.

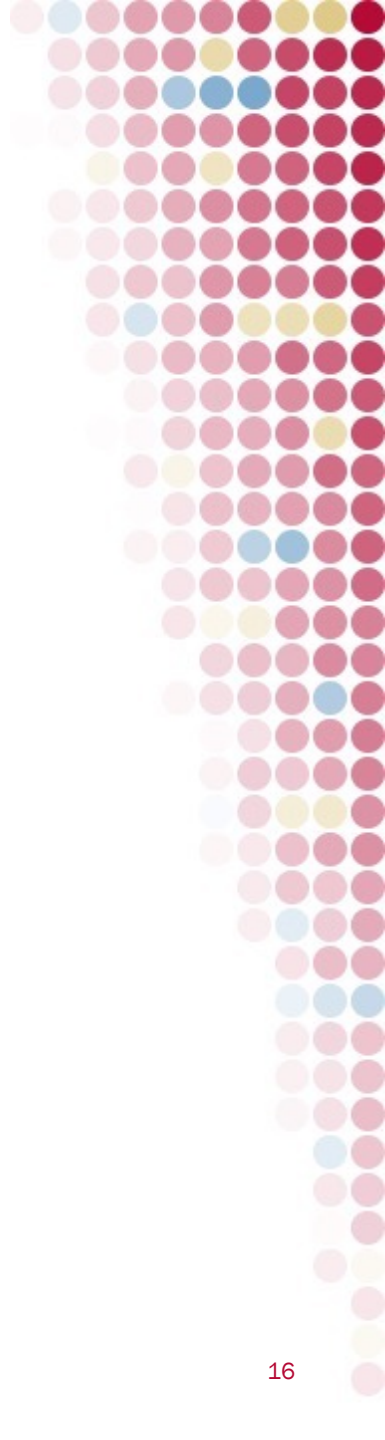
## Meeting goals for diversity, equity, and inclusion.

- Improving DEI was a top goal of employers surveyed (79%), but challenges remain to achieving it.
- Requiring prior lab experience can limit the pool to students at top 4-year colleges where undergraduate research opportunities are more common, employers said.

## Reducing barriers to recruiting more diverse students

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- It is not enough for leaders to prioritize DEI. To recruit and welcome diverse interns, managers need practical processes and criteria that align with their needs.
- Employers may need to rethink the role of interns to attract the broadest possible pool of future innovators.



*“We created the internship program as outreach to other parts of the state. Frankly, it gives us the ability to meet with members of Congress and state legislators. It has given them a reason to care about [our field] because kids in their community can come here and learn about it.” –Employer*

*“Mostly, it’s the engagement piece—to give the experience to do science, [...] to make them feel like they are scientists, and they can do it.” –Employer*

# Improving DEI With an Innovative Funding and Support Model

Growth Sector, a San Francisco-based workforce intermediary non-profit, partners with national labs, NASA centers, and advanced manufacturing, aerospace, defense, and technology employers to create internship opportunities for community college students.

The team works with employers to discuss students' technical preparation and prepares to help fill any gaps. By using Workforce Investment Opportunity Act funding and other federal workforce dollars to cover intern stipends and to hire community college instructors to provide additional support for interns, Growth Sector makes it easier for employers to take on students who have completed only one year of college. Fostering open communication with employers and students throughout the program is also key, said Growth Sector.

Growth Sector is a lead partner in the STEM Core Expansion Alliance, a national network of community colleges and employers that offers structured pathways to STEM degrees and careers for students who enter community college under-prepared in math—which is the majority of community college students. Paid internships in STEM fields are a central part of the STEM Core model.

# New regional initiative arose from improvised virtual internship program

Spurred by the “enormous need” they saw in spring 2020, materials science graduate program leaders at Texas A&M University planned and launched a virtual internship program in less than two months. After receiving over 250 applications for only 20 initially planned spots, they expanded the program to ultimately match 58 students with mentors—some from their own faculty and others at Los Alamos and Sandia National Laboratories, program leaders reported.

Overall, the summer program exceeded leaders’ expectations, they said. The seven interns we spoke with also each reported having very positive experiences. The team was proud of these successes but identified three ways it could improve recruiting to diversify its applicant pool.

First, to raise awareness quickly, they recruited through their own professional networks—reaching “students who were easily reachable” at schools with materials science programs. Second, it had not been feasible to provide equipment on the short timeline, meaning only students with adequate home Internet access and their own computers could participate. Third, the program did not have an appropriate way to collect participants’ demographic information. As the team reflected on the summer program’s successes and shortfalls, the idea for the new initiative took shape.

The new program leverages Texas A&M’s position as a materials science leader in a region with few such programs, as compared with, for example, California or the Northeast and Mid-Atlantic. The new program aims to provide research opportunities to students at colleges in the Central-Southwest that *do not* have materials science programs while they pursue degrees at their home institutions.

With this approach, the new virtual program can respond to a need in an underserved region and reach students less likely to have other undergraduate research opportunities in the field. By tracking participant demographics over time, the team can assess the diversity of its applicant and participant pools against program goals. And the team is now seeking funds to cover equipment and Internet access for participating interns as well.



# Lowering Barriers to Full Remote Participation

Remote interns may lack technical skills and equipment needed for their tasks. Employers need to determine what they will provide to ensure interns' full collaboration and productivity.

Mentors also proved more important in the virtual context. Employers recognized the need for mentor training to work with diverse students.

**Consider  
assessing and  
filling skills  
gaps in  
advance.**

- About a quarter of employers (23%) said better or different technical skills would help interns perform better.
- A quarter of interns (25%) reported lacking necessary skills for their internships.

## Reducing barriers to recruiting more diverse students

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- Make clear up front what skills students will need.
- Decide which skills you will train them on and which they need to acquire before starting.
- Consider covering the cost of needed courses.

**Get creative  
to fairly  
compensate  
interns.**

- Nearly all employers (92%) reported providing stipends. Nearly all students (90%) received one.
- Fifteen percent of students who completed a virtual internship reported having other paid jobs.
- During internships, students also took classes (20%), did unpaid or volunteer work (12%), and cared for family members (9%).

## Sources for intern funding

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- Can funds from federal, state, or local workforce programs be used for stipends?
- Do your program or grant rules permit you to provide training, equipment, or other benefits?

## Assign mentors and other formal support roles.

- All employers (100%) reported identifying mentors for interns. In most cases (85%), the mentor was not the intern's manager.
- Employers observed that 1:1 mentoring worked well in the virtual context.
- Students reported it was important to have someone to turn to when stuck.

### Tips for mentoring virtual interns

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- Provide training for mentors to support students from diverse backgrounds.
- Assign a mentor who is not the intern's manager can help interns gain broader experience and develop professional relationships.

*“In the future, we may pay more attention to PD [professional development] for faculty on the mentoring role and involve more student affairs experts.” –Employer*

*“We had a couple of instances where students developed some real difficulties [such as food or housing insecurity]. Those problems come out in the in-person environment; we can intervene sooner. In the virtual environment [during the pandemic], there were more problems, but less signaling that they were happening.” –Employer*



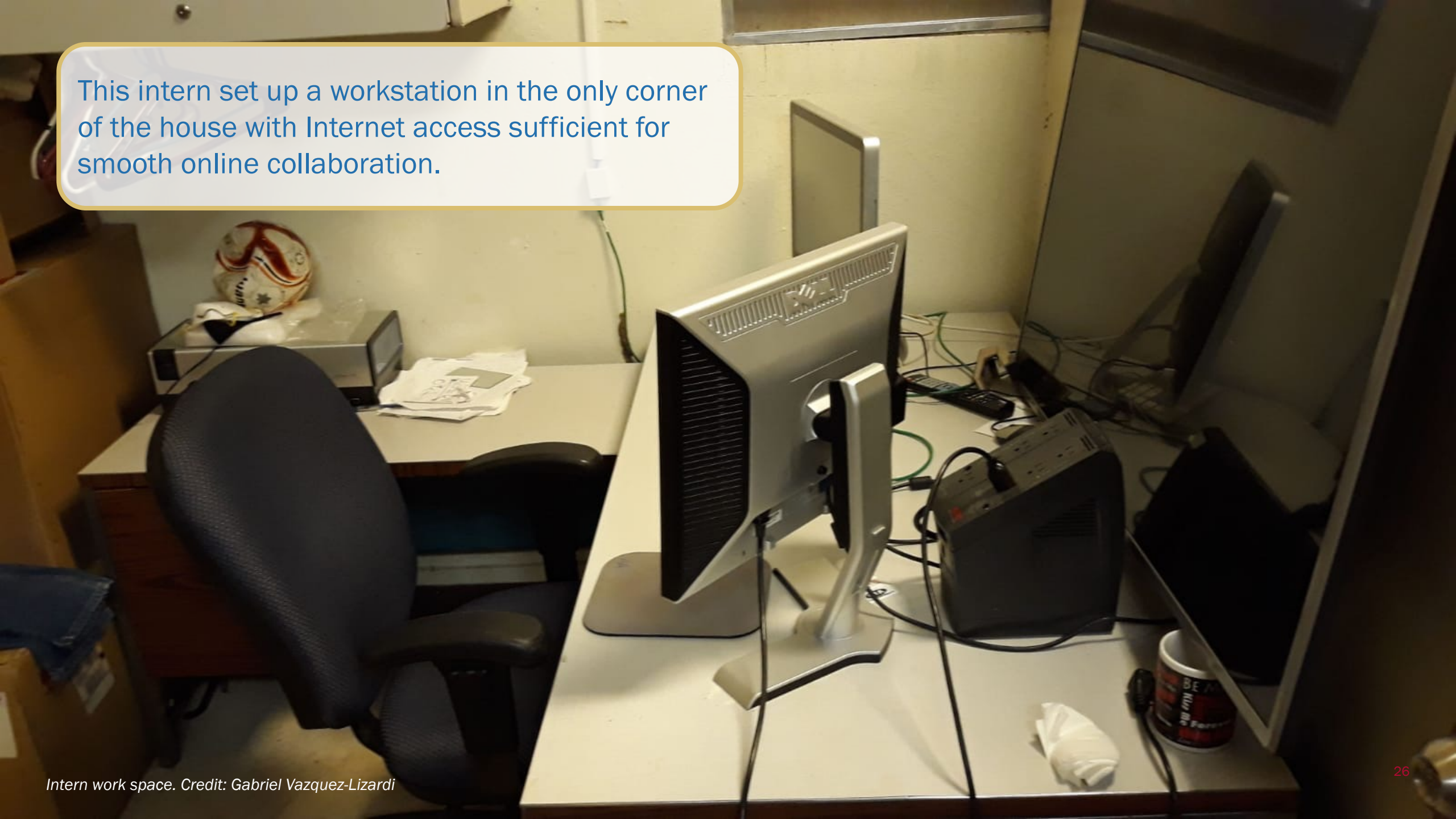
## Meet interns' equipment needs.

- Fewer than half of employers (46%) reported providing equipment.
- Only a third (33%) of surveyed interns said employers provided the equipment necessary for their internship.
- A few interns reported that lack of needed equipment affected collaboration and productivity.

Of the interns we interviewed, most had adequate equipment such as a laptop and reliable Internet access. They reported that employers would provide software and Internet access if needed. Only half of the interns were confident employers would provide additional equipment to do the work.



This intern set up a workstation in the only corner of the house with Internet access sufficient for smooth online collaboration.



# Wide Range of Hands-On Tasks Possible in Virtual Context

Most interns did data analysis, programming, and background research—the kinds of tasks easiest to complete online.

Some built things or conducted experiments. Engaging interns in hands-on STEM was easier than employers had expected.



A photograph of a wooden desk with various engineering and technology items. In the foreground, a silver laptop is open, displaying a software interface. To its right is a notebook with handwritten notes and a pen. In the background, a 3D printer is visible, along with a microscope and other mechanical parts. A semi-transparent yellow box with rounded corners is overlaid on the left side of the image, containing red text.

**Interns  
valued  
opportunities  
for hands-on  
STEM.**

**Mentors incorporated engineering, manufacturing, and data collection.**

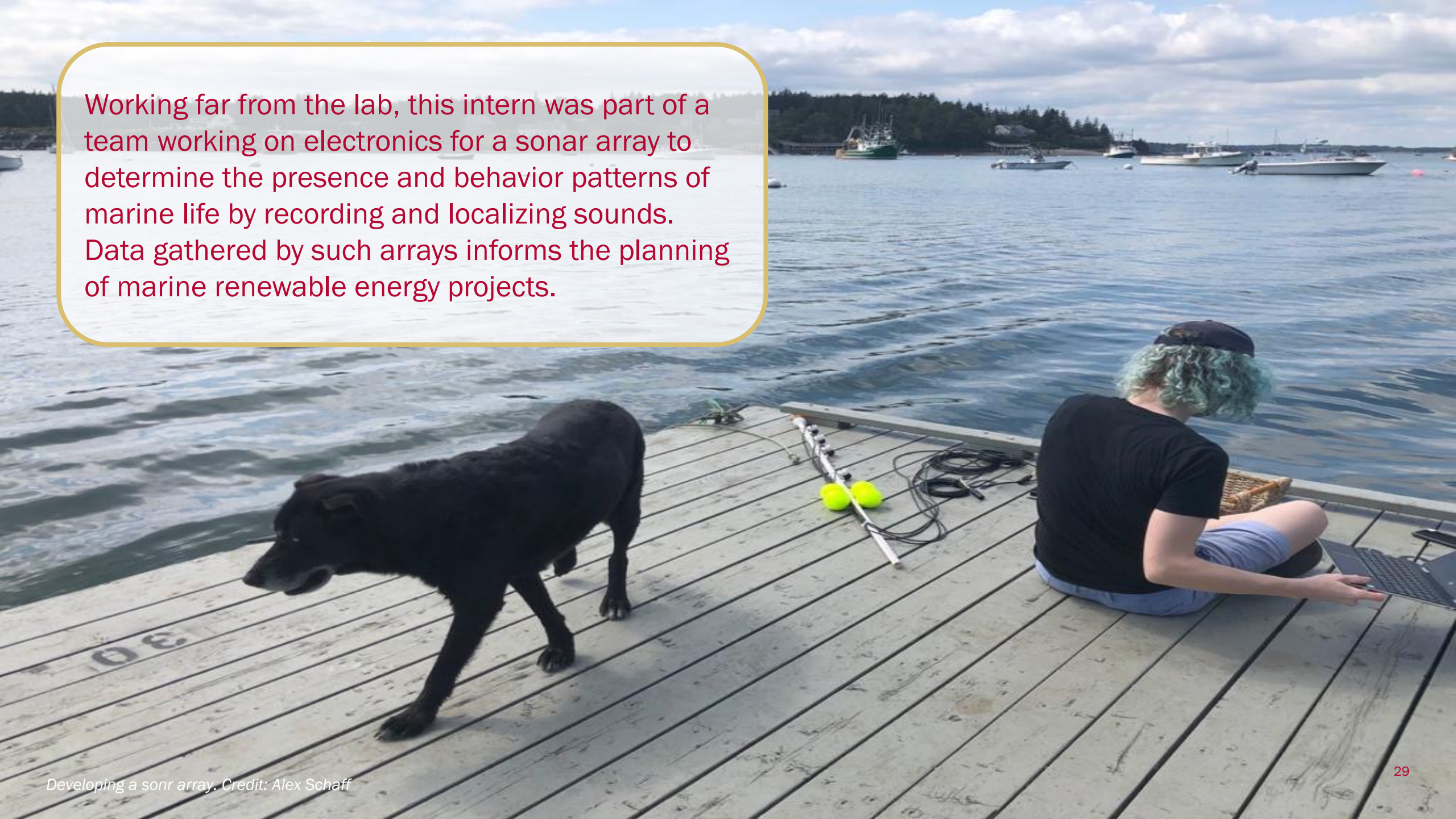
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Interns...

- tested generators to create electricity from biological processes in a nearby lake
- completed core exercises for an advanced manufacturing certificate with household machines in the garage
- designed and 3D-printed prototype control systems and surfaces for a novel ocean turbine at 3% scale.



Working far from the lab, this intern was part of a team working on electronics for a sonar array to determine the presence and behavior patterns of marine life by recording and localizing sounds. Data gathered by such arrays informs the planning of marine renewable energy projects.







*“I participated in virtual experiments for creating a transistors and how to characterize surfaces.” –Student*

*“I charted emergency lighting locations to meet fire code, explored storage options for inventory”  
–Student*

*“Field research. Avian point counts, backcountry navigating, use of Automated Recording Units, and more.” –Student*

*“My project was using algorithms to organize and analyze data trends and present those data trends on a website.”  
–Student*

**Coding and design tasks with real-world applications worked best.**

● Interns valued meaningful coding and design tasks.

Interns...

- developed a tool to use machine learning to quantify defects on a micrograph
- charted emergency lighting locations to meet fire code
- explored storage options for inventory.

● Fifteen percent of interns surveyed did not find their tasks meaningful.

*“Learning to effectively code and be a strong coder, coding as a method of problem-solving, [...] confidence and level of skill to apply to this research and elsewhere. Technical skill has really helped me to see ways you use this coding stuff as a resource. That’s been really impactful.”* –Student description of their learning in virtual internship

*“[They learned] the analytical tool on its own, so they come in with ideas about how to apply machine learning. One of the students used machine learning to [develop a tool] to quantify defects on micrographs. [...] This is a way that the student has a more rewarding summer experience—if they can pick up the tool, and this [virtual internship] is a way for them to do it.”* –Employer

# Setting Clear Task Expectations and Feedback Norms

Employers must provide more explicit guidance for interns both new to the workplace and new to working remotely.

Interns need support to break projects into tasks and to know when and how to seek feedback.

Interns value flexibility but most will do better working mostly synchronously during set hours.



**Interns need support to structure their remote workday.**

- Interns (51%) were twice as likely as employers to report intern time management (21%) was a challenge.
- Other top intern challenges were lack of quiet space (32%) and balancing competing priorities (23%).
- Unclear expectations were a challenge for some interns (15%).

**Clear task expectations and opportunities for feedback will help interns stay productive.**

**Nearly all employers (94%) organized work by project rather than by hours.**

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- Interns need support to break projects into tasks, know how much time to spend, and when and how to seek feedback.

### **Tips for intern productivity**

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- Offer mostly synchronous work hours with some flexibility.
- Model how to structure a productive day. Encourage breaks, fixed work hours, and disconnecting.

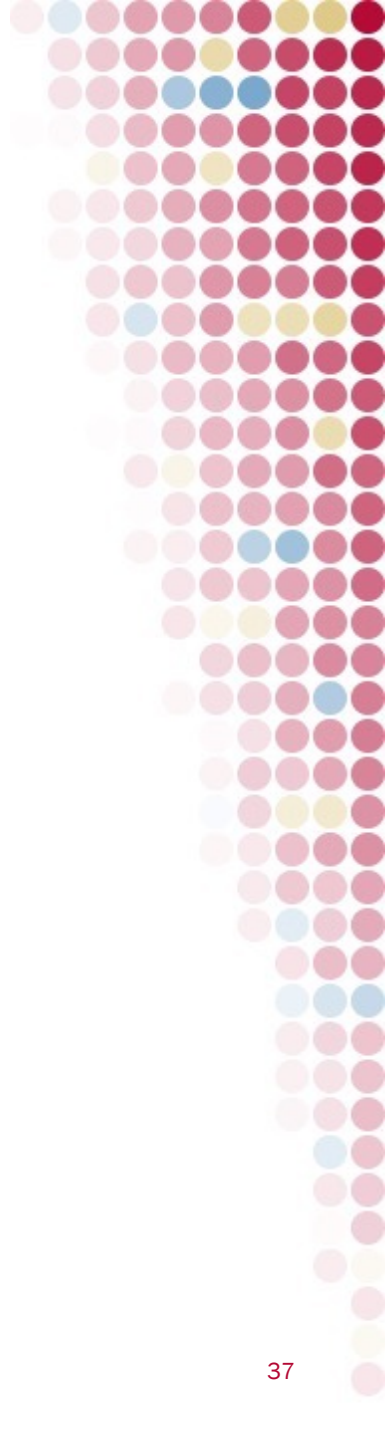
## **Clarify opportunities for informal feedback.**

- Employers and interns both reported communication was more difficult in the virtual environment.
- Interns reported not knowing how to leave the virtual environment or who to ask for help when unable to leave.

### **Tips for feedback opportunities**

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- Set expectations with interns to check in at key moments in a project.
- Provide access to and encourage interns to use shared calendars and chat tools.
- Identify how interns can seek input, such as by scheduling a brief meeting, attending “office hours,” and in team meetings.

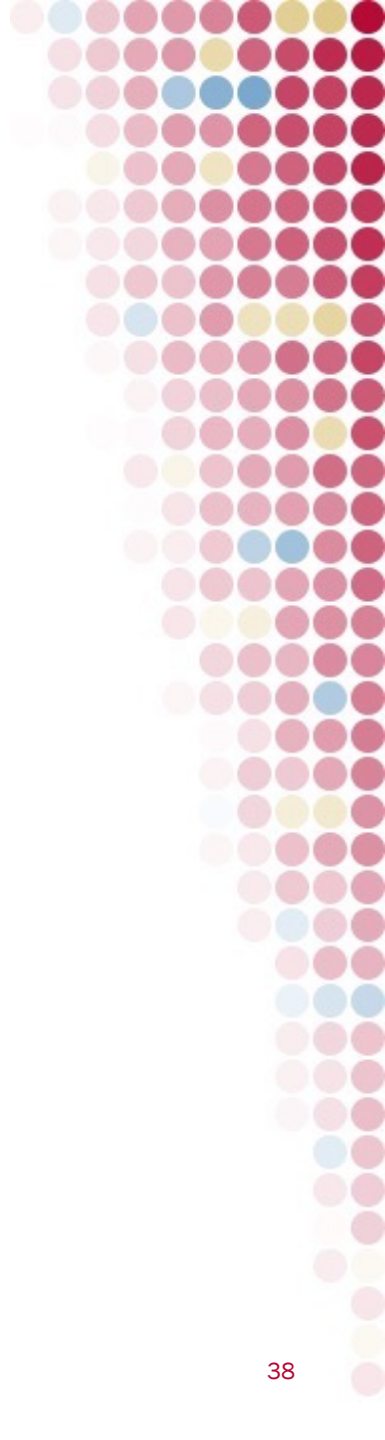


*“**B**eing on camera all day is hard. I think some on-camera is helpful, all on-camera is too much.”*

–Employer

*“**S**he [the remote intern] probably didn't get all the value she could have by sitting with two or three of us, who were with her in the lab all day; and you could just turn around and ask a question impromptu, wander the hallways, go to the cafeteria. All of that was missing, so I'm sure she could have gotten a much better experience, as our previous interns did, from the casual, happenstance kind of encounters you could have.”*

–Employer



*“Starting virtually in a company with no or little context of work at the company is challenging. In-person experiences help bridge gaps in knowledge that you were not aware of—for example, things you hear in cubes or break rooms. [...] And this was missing in this internship. I struggled with very little information to start with and not knowing who to contact for more details. This was also because there were only two other people in my team. Sitting through different high-level meetings helped me get better context in this case.”--Student*



# Supporting Intern Networking and Peer Collaboration

Fill in summary.

Fill in summary.

Fill in summary.

**Employers  
must  
reimagine  
networking in  
the virtual  
format.**

- About 1 in 5 students (19%) said lack of networking opportunities was a challenge.
- Some employers acknowledged falling short in developing virtual networking activities.
- Other employers offered online events with prominent figures from all over the globe.

## Benefits of virtual networking

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- Students said opportunities to learn from professionals extended their relationships and increased their understanding of key issues.
- One student felt comfortable contacting a leader at another organization after connecting with the person in an online networking event.

**Promote a mix of formal and informal peer collaboration.**

## Interns may need support to maximize peer-to-peer learning.

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- Only 69% of interns identified collaborating with peers as a benefit of their internship.
- Employers can model peer learning by helping interns learn one another's strengths.

## Interns also self-organized to collaborate.

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- Some created the impression of working side-by-side by keeping a Zoom line open throughout the day.
- Interns appreciated having chat channels and social time among themselves as well as with project teams and managers.

*“We hit on some best practices, [like] putting people in breakout rooms [in] small groups, because they want to talk, not just be talked to for an hour.” –Employer*

*“If we did it again, I would [ask interns in meetings to say...] ‘Here's my plan I had last week, what I accomplished, and my plan for next week.’ Help them to identify the challenges everybody is having . I think that would be a good way as opposed to ‘here's what I did last week.’” –Employer*

*“I think the students didn’t see the value in being a passive participant in something that was synchronous. If you’re going to be a passive participant, it’s much better for it to be asynchronous. –Employer*



# Open Questions

- **Will virtual internships really expand opportunities for students who live far from employers or lack reliable transportation?**

Evidence is mixed. On one hand, recruiting future employees was a top employer goal for remote interns. Nearly all employers (96%) said it was very or somewhat likely they would hire at least some of their remote interns. This suggests that virtual internships may more likely go to students who live close to employers or could feasibly move there after graduation. But, at some organizations, remote interns could potentially be recruited into fully remote positions.
- **Will virtual internships expand opportunities for students in groups underrepresented in STEM, including students of color, students with disabilities, and students from low-income communities?**

Work remains to realize this potential benefit of virtual internships. A majority of employers (79%) cited improving DEI as an internship program goal, but in interviews we noted disconnects between organizations' DEI goals and processes and practices for recruiting interns. Training is also needed for intern managers and mentors to support students from diverse backgrounds.

# Study Methods

Research questions guiding this study were:

- How can student and employer experiences with STEM virtual internships in summer 2020 inform how virtual internships are designed in the future?
- Can virtual internships fulfill their potential to broaden participation in STEM internships overall?

Findings in this report are from a document scan, surveys of students and employers, and follow-up interviews with a subset of student and employer survey respondents.

SRI developed the student and employer surveys based on findings from the document scan and conversations with STEM Core leaders. We piloted the surveys with students and employers, revised them for brevity and clarity, and then administered the surveys online using Qualtrics in fall 2020. We shared links to the surveys widely by email, including to association leaders and leaders of organizations that promote improving diversity, equity, and inclusion in STEM pathways and careers, as well as to all principal investigators of NSF-funded Research Experiences for Undergraduates (REU) programs. Emails asked recipients to take the survey and to post the link on social media. We also shared the links in a blog post, in a subreddit about canceled internships, and on social media (Instagram, Twitter, Facebook, LinkedIn).

# Study Methods

We eliminated duplicate and invalid survey responses, then calculated descriptive statistics for both sets of survey results and drafted an internal memo that summarized survey results.

We developed semi-structured student and employer interview protocols aligned to constructs in the surveys, with the aim of gaining rich qualitative insights into the survey findings.

From the subset of survey respondents who indicated willingness to be interviewed and provided contact information, we purposively sampled for interviews to capture a range of employer types, student institution and internship types, and student demographics.

We conducted interviews in fall and winter 2020. Interviewers prefilled survey findings into the protocol to tailor the interviews. We took time-stamped notes and audio recorded interviews to be able to accurately complete notes after each interview. We coded the interviews by the main constructs in the surveys and protocols, then reviewed the coded data to identify patterns, salient innovations and lessons learned, and illustrative quotations. We then summarized survey and interview findings thematically in an internal memo and, from that memo, developed this report.

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