



ENGINEERING FELLOWS PROGRAM PLAYBOOK

Created by Washington STEM and Washington MESA

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<https://tinyurl.com/EFPlaybook>

WHO WE ARE:

Washington MESA is a statewide organization housed in the University of Washington, Office of Minority Affairs and Diversity that builds pathways to college and careers for students in science, technology, engineering, and mathematics (STEM) fields. Washington MESA develops programming and initiatives that focus on supporting traditionally underrepresented students in these fields, including African Americans, Native Americans, Hispanics/Latinos, and women.

Washington STEM advances excellence, equity, and innovation in science, technology, engineering, and math (STEM) education for all Washington students. Washington STEM works as a backbone organization to serve as a convener and catalyst for STEM education to dramatically increase the number of Washingtonians that are “future ready”—individuals with the creative skills needed to thrive in today’s jobs and in the unknown jobs of tomorrow.

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WHAT IS THE ENGINEERING FELLOWS PROGRAM?

PROGRAM OVERVIEW

To bring engineering expertise directly into fifth grade classrooms throughout the state, in 2016 Washington STEM and Washington MESA partnered with funding from 100Kin10 to design and implement the Engineering Fellows Program. In 2016 and 2017, fifth grade teachers, engineers, and college students applied to take part in the program. The overall goals are as follows:

1. Advance fifth graders' interest, awareness, and practice in engineering design.
2. Increase teachers' readiness and confidence in teaching engineering design.
3. Foster college engineering students' experiences as mentors and mentees.

Beginning with an orientation and an intensive Summer Design Institute, teachers, engineers, and college engineering students worked together to develop a menu of engaging design challenges rooted in engineering principles and the Next Generation Science Standards (NGSS). Teachers implemented two to four challenges during the school year, with classroom support from the engineering students, professional engineers, and program staff. The entire cohort reconvened monthly throughout the school year for Saturday half-day sessions to refine the design challenges. Throughout the program, Fellows engaged in equity-focused discussions and activities, and teachers returned to their classrooms with practices designed to increase access, interest, and awareness of engineering—particularly for youth from underrepresented groups in STEM fields. Fellows also worked together to plan family engagement events and end-of-year showcase events.

Watch these short videos to learn more about different aspects of the program and hear from participants, students, families, and school leaders about the impact:

- [The Engineering Fellows Program: A Blueprint for Success](#)
- [The Engineering Fellows Program: Student Experience](#)
- [The Engineering Fellows Program: The Engineer's Role](#)
- [The Engineering Fellows Program: Collaboration is Key](#)
- [The Engineering Fellows Program: Design, Implement, Refine](#)

ENGINEERING AND CENTERING EQUITY

Engineering is essential to solving Washington's most complex challenges, including efficient transportation, environmental sustainability, affordable housing, and economic security. Engineering fuels our local job creation across every industry - tech, aerospace, manufacturing, clean energy, health and life sciences, agriculture and food manufacturing, construction, and retail.

Yet most of our public school students have no formal exposure to engineering. In order to increase access to jobs in engineering fields—in which women and people of color are underrepresented—students need access to knowledge about what engineers do, how engineering is relevant to their everyday life and community, and see engineering as an accessible and desirable career option. Additionally, education standards are changing. In 2013, Washington state adopted the NGSS, which have an unprecedented—and exciting—engineering component intended to drive learning about the engineering design process.

We believe that equity should be at the forefront of our educational efforts in Washington. With the right supports, all students are capable of complex learning. As stated in the [Framework for K-12 Science Education](#), we believe all students deserve access to the knowledge and practices that will allow them to engage in public discussions in science and engineering; be careful consumers of science and technological

information related to their everyday lives; learn about science and engineering outside of school; and possess the skills to enter the careers of their choice, including careers in science, engineering, and technology.

In addition to ensuring equitable access to robust engineering education and opportunities, we value diversity and explicit inclusion of youth from communities historically underrepresented in STEM fields.

Issues of equity and diversity are of value to the engineering field at large. In his 2000 address to the National Academy of Engineering, William Wulf made the argument that the engineering field—broadly speaking—is hindered by a lack of diversity of perspective and life experience:

"Without diversity, the life experiences we bring to an engineering problem are limited. As a consequence, we may not find the best engineering solution. We may not find the *elegant* engineering solution." (p. 2)

As we continue to confront our state's most complex challenges described above, it is imperative to ensure engineering design teams accurately represent the diversity of experience and background of our residents.

In examining our K-12 system, we know that in schools deemed "failing" by No Child Left Behind policies—often those serving poverty-impacted communities and students underrepresented in STEM fields—instructional time in science was drastically decreased in the last decade. The Engineering Fellows Program is a way to re-invigorate learning in schools in which educators were directed to divert instruction away from science, let alone engineering. The design challenges, along with opportunities to interact with college engineering students and professionals, provide a mechanism to energize and inspire students, while providing opportunities to develop foundational skills in engineering design and problem-solving.

WHY FIFTH GRADE?

If we want to give kids—especially those most underrepresented in STEM—access to great lives and great careers in our STEM-rich world, we need to give them access to the basics of engineering early on. Research shows that children's interest in careers develops by sixth grade, and, with it, an implicit determination of where they will end up in the world and how they will get there. The fifth grade is important for another reason: it's the last stop before middle school, where our partner Washington MESA has a network of programming in math, engineering, and science around Washington. By targeting fifth grade teachers, the project will help expand the reach of that programming into the earlier grades while creating a pathway to more hands-on STEM education through MESA and other partners in middle school and beyond.

PURPOSE OF THE ENGINEERING FELLOWS PLAYBOOK

This playbook offers our best thinking, resources, and tools for implementing all aspects of the Engineering Fellows Program. We hope this Playbook serves as a resource for additional organizations, districts, and schools to take up this work in their local system, and that it gives us a common set of resources to work from.

We recognize that educational leaders may want to try out just one component of this program, so we've designed this Playbook to allow users to pull out a particular Play for use in another program, or even the Engineering Fellows Program at a smaller scale.

For example, we've learned a tremendous amount about engaging college engineering students in this work, and our tools and resources may be of interest to others' looking to engage college students in other efforts. We also have developed a set of outcomes, measures and tools to better understand the experiences of students, teachers, college students, and professional engineers in this type of program--these could be similarly employed (as-is or adapted) in other programs.

The table below describes our best thinking about how to scale up or down critical program activities, with more detail provided in the Plays.

ENGINEERING FELLOWS PROGRAM: PROGRAM COMPONENTS AND LEVELS OF IMPLEMENTATION

COMPONENT	IMPLEMENTATION OPTIONS		
	MINIMUM	MEDIUM	FULL
Staff	Part time coordinator	Part time coordinator + Teacher leader	Full time coordinator + Teacher leader(s)
Participants	12-15 teachers 5 college undergrads/grads 1-3 engineers	15-20 teachers 5 college undergrads/grads 3 engineers	30 teachers 5-7 college undergrads/grads 3-5 engineers
Summer Institute	Orientation + 3 days	Orientation + 4-5 days	Orientation + 5 days + Reception
Design Challenges	Full menu provided, teachers select 2-3 challenges to implement with minimal adaptations	Full menu provided, teachers select and adapt 2-4 challenges	Full menu provided, teachers select 1-2 challenges and develop 1-2 new challenges
Professionals and College Students	Participate in program professional development activities	Participate in program professional development activities, visit classrooms 1-2 times	Participate in program professional development activities, visit classrooms regularly throughout school year
Mentorship for College Students	Informal + 1 session	Informal + 1-2 sessions	Informal +3 sessions
Saturday Sessions	3 half-day Saturday sessions (fall, winter, spring)	5 half day Saturday sessions OR 3 full day Saturday sessions	7 half-day Saturday sessions OR 4 full day Saturday sessions
Community and Family Engagement	Determined locally (take-home design challenge, design challenge during conferences or existing school events)	Same as minimum, and/or cross-classroom or school activity	Same as medium + participation in community STEM showcase/event
Classroom Materials	\$200-500 per teacher, consider local business/community contributions and/or DonorsChoose		
Communication and Advocacy	Update emails to school/district leadership: kickoff and end of year Updates on social media, newsletters, etc.	Same as minimum, and invite school/district leaders to program events/workshops	Same as medium, and invite select EFP participants to co-create social media blurb, story, etc. Invite school/district leadership into program leadership, help advocate for program

THE PLAYS

PROGRAM ORGANIZATION AND PLANNING

Play 1 – Establish Partner Roles

GUIDING QUESTION

How will key partnerships be established to make the program successful?

GUIDING PRINCIPLES

- The Engineering Fellows Program requires buy-in and contributions from a range of allies.
- It is important to periodically revisit roles and responsibilities across individuals and organizations.
- All voices in the partnership—lead organizations, teachers, college students, professionals, and fifth grade students—are heard and valued.
- Communication with, among, and between all partners is essential to foster inclusion in the program.



GETTING STARTED CHECKLIST

- ✓ Identify program partners that could add expertise and resources to the program.
 - Watch this video to learn about how Washington MESA, Washington STEM, and the South Central Washington STEM Network leveraged their partnership to implement the Engineering Fellows Program in 2017-2018. [The Engineering Fellows Program: Power in Partnerships.](#)
- ✓ If multiple partner organizations will be involved, set up opportunities to clarify partner and individual roles and responsibilities, and revise as necessary. See [this example of program leadership roles and responsibilities](#) at the organization level. See [this example of roles and responsibilities at the regional partner level](#).
- ✓ Develop relationships with local engineering firms and professional engineering associations to begin to identify professionals to participate in the program. Local industry partners can also contribute in different ways: in-kind contributions, classroom materials, hosting field trips, etc.

- ✓ Develop relationships with local university faculty to help recruit and select college engineering students.
- ✓ Consider setting up an advisory board of local allies to help champion and shape the program. See [this example Advisory position description](#).

KEY QUESTIONS

- What are the short- and long-term goals of the program?
- How can existing resources be allocated or re-purposed to support program leadership coordination?
- If this program is wildly successfully in three years, what would it look like??
- Who will be allies in making this program a success? How will they to contribute to and guide this work?
- Which regional partners will provide expertise and leadership to the project?
- How will the program be sustained beyond the first year?
- Can a science materials center (through the local Educational Service District or individual school districts) offer support regarding materials?

Play 2 – Develop a Program Budget

GUIDING QUESTION

What are the costs and funding opportunities associated with program components?

GUIDING PRINCIPLES

- The Engineering Fellows Program is an investment in building teaching capacity in engineering, particularly for teachers working with students from groups underrepresented in STEM fields.
- Regional [STEM Networks](#) are a great resource for identifying and working with local partners to raise funds and in-kind support.

GETTING STARTED CHECKLIST

- ✓ See [this sample budget](#) for estimated program costs.
- ✓ Consider ways in which existing FTE can be used for program coordination.
- ✓ Family engagement costs vary widely. Have teachers identify existing school/community events into which engineering can be integrated at low- to no-cost.
- ✓ Costs such as classroom materials and teacher stipends are often appealing to business and industry partners. Connect with your [regional STEM Network](#) to identify potential sponsors.
- ✓ Consider using crowd-sourcing platforms such as [DonorsChoose](#) for classroom materials. DonorsChoose can also provide guidance on launching local fundraising campaigns.
- ✓ To build teacher leadership capacity, consider shifting the teacher stipend allocation to fewer, larger stipends for building/district teacher leaders that will participate as well share knowledge and resources at the building/district level.

Engineering Fellows Program 2017-2018		
Sample Budget		
This sample budget is based on the following assumptions:		
<ul style="list-style-type: none"> Teachers and college students receive stipends for participation Adequate program staff time and FTE costs can vary widely based on organization Indirect costs are not included 		
Implementation levels: green = full, blue = medium, orange = minimum		
Expense	Budget	Notes
Program staff	~\$25,000 ~\$60,000 ~\$25,000	Variable based on FTE and organization; medium and full levels include Teacher Leader
Materials and Supplies	\$4,000-6,000 \$6,000-9,500 \$16,500	Classroom, PD, and family/community engagement materials
Consultants or Contractors	All levels - \$10,000	Specialists in NCSS, equity-focused teaching, etc.
Meetings / Conferences	\$3,000 \$5,000 \$7,000	Facilities, food, transportation, etc. Variable based on facility rental costs
Teacher Stipends	\$36,000-45,000 \$45,000-60,000 \$80,000	Based on \$3000/teacher
Engineering Student Stipends	\$15,000 \$15,000 \$15,000-21,000	Based on \$3000/student
Family/Community engagement	\$3,000 \$5,000 \$7,000	
Total	\$99,000-110,000 \$143,000-159,500 \$227,500-233,500	
Optional: Faculty sponsors	\$5000	Depends on faculty involvement – facilitating PD, supporting college/grad students, etc.
Variable: travel	\$10,000	

KEY QUESTIONS

- How can program costs and activities be integrated into existing activity? For example, can local schools/districts cover some professional development (PD) costs during the school year as part of regularly mandated PD time?
- Can the local Regional Science Coordinator assist in providing teacher professional development on the engineering performance expectations in NGSS?

RECRUITMENT AND SELECTION

Play 3 – Recruit Participants

GUIDING QUESTION

How will teachers, college students, and professional engineers be recruited to participate?

GUIDING PRINCIPLES

- Equity drives the program vision and goals, and this is explicit in recruitment materials and efforts.
- Teachers are recruited from schools serving primarily students from groups that are underrepresented in STEM professions.
- Every effort is made to recruit a diverse cohort of professionals and college students in terms of ethnicity, gender, age, and field of expertise.
- Interview each potential teacher, engineer, and college student to determine alignment of goals/purpose.

GETTING STARTED CHECKLIST / SPECIFIC IDEAS

PLANNING

- Develop a coherent, efficient, and appealing recruitment process that is tailored to the needs of teachers, college students, and engineering professionals.
- Identify key partners in local industry/businesses, colleges and universities, and schools to advise on and support recruitment.
- Consider using the videos in the Program Overview to recruit participants.
- Create a timeline for recruitment and selection, starting in the January prior to the planned Summer Design Institute. See this [sample recruitment Gantt chart](#).
- Using an online platform such as Canvas, SurveyMonkey, or Google Forms, develop separate applications for teachers, college students, and engineers. See sample application questions below:
 - [Teacher application questions](#)
 - [College student application questions](#)
 - [Professional engineer application questions](#)
- Develop and distribute recruitment flyers that include clear responsibilities, timeline, and expectations. The following templates are here for your consideration.
 - [Teacher recruitment flyer](#)
 - [College student recruitment flyer](#)
 - [Professional engineer recruitment flyer](#)
 - [Recruitment flyer template](#)



“As a recent graduate, I was a little nervous about how much help I would really be for this program, but being with the students and teachers really helped build my confidence. Seeing them struggle to understand concepts at first and being able to understand them after I explained was really satisfying. I think the biggest ‘aha’ moment would be seeing the excitement of the teachers and having it be because I helped them develop an understanding of my type of engineering. It was then that I really affirmed that what I’m interested in is extremely genuine and really exciting. It’s hard to remember that when you have struggled through all the classes leading up to that point. So, I would say this has actually affirmed my passions.” - 2017-2018 EFP Engineer

ACTION

- See this [detailed action plan](#) for key steps in recruiting participants.
- Recruiting often requires a face-to-face meeting. Consider the following modifications for recruiting engineers:
 - Set up meetings with company/business supervisors as well as engineers to ensure buy-in and support.
 - Remove the dates from the flyer but keep a brief description of the program and goals.
 - After interest is determined, set up a face-to-face meeting to discuss what engagement looks like.
 - Discuss classroom visits and emphasize the goal of having fifth grade students meet and get to know real-world engineers.
 - Be flexible but clear with expectations for engagement.

KEY QUESTIONS

- How will participant (e. g. changes in a teacher’s assignment/school, changes in a college student’s schedule) be accounted for?
- What dates are critical for engineer involvement and which could be optional?
- What are the different ways engineers could be engaged to work around their schedules? How will expectations be set for scheduling classroom visits?

RECRUITING A DIVERSE GROUP OF ENGINEERS AND COLLEGE STUDENTS

A key component of the Engineering Fellows Program is the inclusion of a diverse pool of engineering professionals and engineering students. These engineers serve a variety of roles within the program, from working with teachers to creating engineering design challenges, assisting with classroom implementation, as well as serving as role models for students. Ensuring that these engineers mirror the diversity found in many classrooms is critical. When students are able to connect with an engineer that looks like them, or may have the same background as them, it can help fundamentally shift their concept of what an engineer looks like and who is able to be an engineer.

Mark Cheney, South Central Washington STEM Network director, made the recruitment of a diverse pool of engineers a top priority. But that's not to say that he didn't run into a few challenges when doing so.

"One of the needs for this program is seen in the lack of the diversity in the engineering field, and that problem was reflected in our recruitment efforts. Our region in Washington has a high degree of racial diversity, but when I attended local professional engineering association meetings or visited engineering firms, the need for this program was driven further home."

As it would turn out, there were very few persons of color or women at those meetings. Mark recalled that the vast majority of the time he found himself speaking to and seeing Caucasian, male engineers.

"I realized that my shotgun approach to locating a diverse set of engineers just wasn't going to work. For example, the female engineers I did manage to recruit said they were unlikely to attend professional association meetings because they would often be the only woman in the room. And for them, that just wasn't a comfortable context."

Mark knew that in order to make sure students in the Yakima valley saw engineers that looked like them, he would have to switch up his recruitment strategies. He decided that if putting out a broad call for a diverse pool of engineers wasn't going to work, he would instead work on contacting specific individuals that could connect him to the right engineers.



"I went to meet with a key individual within the Department of Transportation, and I was completely transparent with him. I told him what we were doing, why we were doing it, and why engineers that were women and people of color were so important to this effort. It was a direct approach with that individual, and once he understood what I was trying to do, he was able to help identify and connect me with those individuals. And while I found out that approaching professional association meetings wasn't going to work for me, I was able to meet with the president of the Association of Civil Engineers. The president of the association knew there was a diverse group of members that just

didn't attend meetings, and he was willing to give me their individual contact information. I was then able to setup one-on-one conversations with those engineers to encourage their participation in the Engineering Fellows Program."



Mark found that when recruiting professional engineers, focusing on key individuals at firms, professional associations, or other engineering-focused organizations was far more beneficial and productive than a passive all-call. Mark also noted a serendipitous outcome of having these one-on-one conversations was an increased buy-in from these individuals, both for the program and recruitment efforts.

When it came to recruiting a diverse group of engineering students, Mark pointed out that this experience was very different from professional engineer recruitment.

“When I went to our local two-year and four-year colleges, I was happy to find that there were professors and student groups of engineers who were actively engaged in equity and representation in engineering. For example, when I reached out to the head of engineering at Yakima Valley College, who happened to be an engineer of color, I learned that he had been regularly visiting students of color in area schools and encouraging them to pursue engineering and STEM.”



Mark also noted that at the college level, there were far more students of color actively working towards an engineering credential. Student groups were particularly excited to be a part of the Engineering Fellows Program. So much so, one student engineering association had several of their members participate in the program, as well as express interest in maintaining a relationship with the STEM Network so they can continue to participate in the next year's program.

“I hadn't initially thought about reaching out to student leadership in these institutions or groups, but after my conversations with them and seeing their level of excitement for the program, it was a shift in strategy I was happy to make.”

Mark freely admits that recruiting a diverse pool of engineers was often times challenging. But by being flexible, tapping into groups not previously considered, and by building relationships across various levels of leadership in a variety of organizations, he ultimately was able to find success in his efforts to bring a diverse group of engineers to the Engineering Fellows Program in his region. Through Mark's own experience in recruitment, the urgency and need for this program was further highlighted for him. He discovered that in order to really move the needle on equity in engineering, he had to go the extra mile to make sure students in his region could truly understand the breadth of opportunity waiting for them in STEM.

“For me, one of the key things that I learned was that the most effective strategy was a personal strategy. The most effective engineers I've seen with kids are the engineers we've sat down with and established an alignment of values and purpose. You're not going to achieve the outcomes you want if you're not willing to get to know folks and hear their stories. Additionally, it allowed me to discern who would work well with students and if they would be able to plug into the program and participate like we hoped they would.”

Play 4 - Select Participants

GUIDING QUESTION

How will a qualified and engaged cohort of participants be selected?

GUIDING PRINCIPLES

- Priority is given to teachers from schools serving primarily students that are underrepresented in STEM.
- Prior experience in education is not required for professionals and college students.
- Selected participants should be able to attend the full Summer Design Institute, including Orientation.
- Selected engineers and college students comprise the gender and racial diversity of the student populations they will work with.

PLAY

Select participants based on a clear set of criteria and begin to build relationships that will support participation in the EFP program.

GETTING STARTED CHECKLIST / SPECIFIC IDEAS

TEACHERS

- ✓ Check Free and Reduced Lunch/demographics of student population ([OSPI report card](#))
- ✓ Include principals on acceptance emails and agreement forms to teachers. See examples below:
 - [Teacher acceptance letter](#)
 - [School and teacher agreement document](#)
- ✓ Request summer contact information—some teachers use a different email address when school is not in session.

COLLEGE STUDENTS

- ✓ Preference is given to junior/senior/graduate students.
- ✓ Consider including college students in drafting design challenges prior to Summer Design Institute.
- ✓ Attempt to match field of study with professional engineer.
- ✓ Ensure agreement with expectations and time commitment. See example below:
 - [College student agreement document](#)

Dear

Congratulations! You have been selected as one of **XX** 5th grade teachers in Washington State to participate in the **2017-2018** cohort of the Engineering Fellows Program (EFP). This unique program was launched by Washington MESA and Washington STEM in 2016 as part of a national White House initiative called [100Kin10](#). Our goal is to advance interest, awareness, and learning of engineering for 5th grade students in Washington. We are excited to continue implementing and refining the program this year through local support and partnerships. During the EFP experience, you will be a critical partner in continuing to shape the program to best meet the needs of our students.

We are looking forward to having you join a special team of 15 of your [\[insert region\]](#) peers, 5 college engineering students, professional engineers, and our staff to select and develop authentic engineering design challenges and teaching plans for the next school year. There will also be a cohort in [\[insert region\]](#), and we will spend time this summer and during the school year sharing best practices and design challenge ideas across the two regional cohorts.

The program will begin this summer with the following program components. Please save these dates and times on your calendars.

Summer Dates	Times	Professional Experience	Location
[insert date]	[insert times]	Orientation	[insert location]
[insert date]	[insert times]	Engineering Fellows Program Summer Design Institute	[insert location]
[insert date]	[insert times]	Engineering Fellows Program Reception and Summit	[insert location]
		<i>*Principals, administrators, and district coaches/specialists invited.</i>	

To confirm your participation, please complete the enclosed form with your principal, scan it, and email it to [\[insert program coordinator\]](#) by [\[date\]](#). We will be sending you additional details next month.

We look forward to meeting and working with you this summer and the **2017-2018** school year.

PROFESSIONALS

- ✓ Attempt to match professional field with college students' field of study (e.g. civil engineering, environmental engineering, etc.).
- ✓ Ensure support of supervisor.

ALL

- Compile a spreadsheet with all participants' contact information, as well as school, district, and/or employer. This becomes very handy for communications and reporting purposes.
 - [Participant info spreadsheet template](#)

KEY QUESTIONS

- What will be done to ensure transportation is not a barrier for college students to participate in classroom visits?

IMPLEMENTATION: SUMMER DESIGN INSTITUTE

Play 5 – Pre-Institute Participant Preparation

GUIDING QUESTION

How will participant prior experiences and expertise be used to guide the design of the Summer Design Institute? What will participants be asked to do or think about before the Institute?

GUIDING PRINCIPLES

- Include input from teachers, college students, and professionals while designing the Summer Design Institute.
- Take care of as many participant logistics as possible before Orientation.

GETTING STARTED CHECKLIST

PARTICIPANT PRE-INSTITUTE ACTIVITIES

- ✓ For all participants:
 - Request information you may want to include in Orientation/publicity resources, e. g. short bio, photo, media releases. See this [example request](#)
- ✓ For teachers:
 - Set up a [pre-institute survey](#) for teachers to gather information about access to technology, integration with existing teaching and curriculum, and students served.
- ✓ For college students and professionals:
 - [Request a photo of an element of their work and to prepare a two minute “elevator pitch”](#) describing the engineering represented in the photo—to be used in the kickoff “What is Engineering” activity.

PRE-INSTITUTE LOGISTICS

- ✓ Set up STEM clock hours approval with local agency.
- ✓ Identify local partners (industry, university) that can host lab visits and/or lead relevant engineering activities.
- ✓ Check school district calendars for following year as soon as they become available –schedule Saturday sessions around breaks, conferences, etc.

- ✓ Identify speakers who will assist with the Institute sessions (e. g. engineering in NGSS, equity in engineering, engineering design framework, classroom visits 101).

KEY QUESTIONS

- How will program work be aligned with ongoing regional and state-wide NGSS implementation work?
- How will different learning and resource needs across districts and schools be accounted for?
- What connections does the host organization already have with local industry/university partners?

Engineering Fellows Program

Pre – Institute Survey

****Set up questions in online survey platform, send link to teachers****

The Engineering Fellows Program team aims to develop a meaningful and impactful Summer Institute for our 30 accepted teachers in South Puget Sound and the Yakima Valley. To that end, we ask that you please take 20 min to complete the following survey so we can best support you in this collaborative work. The questions address access to technology, curriculum, and integration with your existing teaching.

1. Will you have access to a laptop or tablet during the Summer Design Institute?
(yes/no)
2. Do your students have access to computers/laptops/tablets in the classroom for our developed assessments?
(yes/no/other)
3. Are you already teaching engineering in your classroom? If yes, please briefly describe.
(large text box)
4. How much time do your students have for science each week (e.g. 30 min three times a week, 60 min every day, etc.)?
5. Approximately how many students will be in your class(es) in 2017-2018?
6. Do you see any "hot spots" for integrating engineering, or are there any engineering design challenges you are interested in trying out? If you have any documents or resources that would give us more details about your curriculum (scope and sequence, curriculum guide, etc.) please email them to [\[insert program lead\]](#)
7. Please describe your most successful science/engineering unit or series of lessons. What made this unit or series of lessons successful?
(large text box)
8. As an adult learner, what engineering topics are you most interested in?
(large text box)
9. What specific engineering topics would you like to know more about in order to better engage your students in engineering?
(large text box)
10. What engineering topics do you think would interest your students and/or community?
(large text box)
11. What type of family engagement event (Curriculum Night, Back-to-School night) does your school host in the fall? What is the structure of the event?
(large text box)
12. Do you have any successful strategies / ideas related to teaching engineering that you would be willing to share with your fellow colleagues in a short session (20 minutes max)?
(large text box)

Play 6 – Summer Design Institute Agenda

WHAT IS THE ENGINEERING FELLOWS SUMMER DESIGN INSTITUTE?

The Summer Design Institute is the official kickoff of the year-long program. During the Institute, the teachers, college students, and engineers learn about each others' expertise and develop or adapt design challenges for fifth graders. By the end of the week, participants have an increased understanding of engineering education as well as an implementation plan for their chosen design challenges. The week wraps up with a reception to celebrate and showcase the participants' hard work and design challenges, and key allies (principals, coaches, community members, etc.) are invited to participate.

GUIDING QUESTION

How will the Summer Design Institute meet the program goals?

GUIDING PRINCIPLES

- Equity in engineering drives the agenda—find a balance between high-level discussions and in-the-minute instructional moves.
- During the professional development, model the pedagogical norms and moves that we want teachers to practice.
- Balance the agenda between structured learning and extended collaboration time.

- Encourage design teams to develop and/or adapt challenges that encourage students' completing several iterations of their design solutions.
- Consider the learning needs and contributions of each constituency—teachers, college students, professional engineers.

GETTING STARTED CHECKLIST

- ✓ Set agenda, then **identify key dates/times for professional engineers' participation**. Consider the different learning needs of teachers, college students, and professional engineers – ensure they have clear roles during each part of the Institute.
- ✓ Include activities to support **professional relationship building**.
- ✓ Provide opportunities for design teams to try out different design challenges. **Model the norms and classroom culture** that is required for engineering.
- ✓ Provide **opportunities to practice** teaching.
- ✓ Provide opportunities for college students and engineers to engage in **mentorship activities**.
- ✓ Find ways to **include external allies** (principals, district administrators, college faculty, employers) in the Institute.
- ✓ Cross-reference Institute activities with program goals/outcomes.
- ✓ See a sample [Summer Design Institute agenda](#) and the **EFP Reception and Summit agenda**



"I began to think of engineering as problem solving and less as some distant career choice a student might pursue." 2017-2018 EFP Teacher

KEY QUESTIONS

- What knowledge do participants already have about Engineering in the Next Generation Science Standards?
- What are the tradeoffs between doing multiple challenges vs. sustaining one to two challenges over an extended period of time during the school year?
- In what ways are design challenges potentially relevant to students underrepresented in STEM?
- How will teacher learning needs be accounted for? Some teachers will need to see a few "fully-cooked" design challenge lesson plans in contrast with participants who are ready to develop new design challenges from scratch.



"We are all engineers! Recognizing this, I feel much more confident teaching engineering in my classroom." 2017-2018 EFP Teacher

SUMMER DESIGN INSTITUTE TOOLS AND RESOURCES

GOAL	RESOURCE	NOTES
Establish clear goals and expectations for participation	Program Goals and Expectations	
Provide opportunity for engineers and college students to share their work and increase teachers' awareness of engineering careers and fields.	Before Institute: Photo and Elevator Pitch request During Institute: Engineering Photos activity	This session can be done all at once or throughout the week—have participants look at and write about each photo, then have engineers and students share their elevator pitches.
Deepen understanding of engineering and foster conversation and questions about what counts as “engineering.”	Engineering is Elementary “What is Engineering” Questionnaire and Key Learning STEM Through Design: Students Benefit from Expanding What Counts as “Engineering”	Some teachers have also opted to use the questionnaire and key with their students.
Increase participants' understanding of engineering in the Next Generation Science Standards	Engineering in NGSS NGSS 101 part 4- Engineering Design (scroll to bottom of page) Common Misconceptions About Engineering in NGSS	It is important to tailor this session depending on participants familiarity with NGSS. It may be useful to have a separate session for college students and professionals.
Establish common language and practices for access and equity in engineering; collect baseline data from teachers regarding their teaching practice.	Equity and Access survey: 1st round	For more information on this survey, see the Evaluation section of the Playbook.
Collect daily feedback from participants in order to celebrate successes, identify challenges, and course correct throughout the Institute	Daily evaluation survey	
Engage participants in discussion of program outcomes and establish expectations for data collection.	Classroom Visitor Survey Student Assessment	For more information, see the Evaluation section of the Playbook.

Play 7 – Design Challenges

GUIDING QUESTION

How will design challenges be developed and/or revised?

GUIDING PRINCIPLES

- Design challenges should be accessible and relevant to students from groups underrepresented in STEM professions.
- Participants should have an opportunity to try out common design challenges and reflect on their experience.
- Design teams should have flexibility and time to research locally relevant scenarios and design challenges.
- Design challenge lesson plans should be shared via an online platform so all participants have access for use and revision.

KEY QUESTIONS

- Considering time, teachers' familiarity with engineering, and facilitator capacity, what will be the balance between implementing existing design challenges, adapting existing design challenges, and developing new design challenges?
- What are the "hot spots" for integrating engineering into teachers' existing curricula? Science and math often connect well with engineering, but there may also be opportunities in language arts and social studies.

See the following pages for design challenges resources and the design challenges developed by the Engineering Fellows 2016-2018.

DESIGN CHALLENGES RESOURCES

GOAL	ACTION AND RESOURCE
Help participants understand the potential impacts of implementing design challenges with support from engineers and college students.	Watch this video about students' experiences with the 2016-2017 design challenges: The Engineering Fellows Program: The Student Experience .
Support participants' understanding of the nuances of the engineering design process.	See pages 5-7 in "It's a Process" for a sample PD design challenge and an activity that can be used at the end of any design challenge to call out engineering practices.
Provide examples and resources of existing design challenges.	Have participants explore examples and resources .
Provide design teams with common materials that they can use when exploring design challenges.	Find a local business or industry partner to sponsor materials for the Institute and classrooms. See our 2017 Institute materials .
Establish a common language and understanding of the engineering design process.	A quick internet search for "engineering design process" yields many variations of images and explanations about how engineers execute and think about their work. Our team reviewed several different versions, and developed a graphic that centers on communication in the engineering design process.
Set clear expectations for documenting design challenges, adaptations, and revisions.	Unless teachers are selecting fully developed design challenges, it is unlikely (and unreasonable!) to expect fully detailed design challenges at this point in the program. Consider using a common template .
Identify ways for design challenges to be integrated into other content areas.	Read the vignette "Embrace the Chaos" on pg. 21 about the value of engineering and how a 2017-2018 EFP teacher integrated design challenges into the school day. This is particularly important for students who are pulled out during science instruction to receive English language learner or Special Education services.



2016-2018 DESIGN CHALLENGES

Design Challenge	Description
Columbia River Barges (2017)	Design a barge that can safely carry 26 charcoal briquettes without tipping or pouring any waste into the water.
Bridgespan Challenge (2017) Bridge Over Stream (2018) Earthquake-Proof Bridge (2018)	Design a model of a bridge that meets different criteria.
Catapults (2017) Launchers (2018)	Design a catapult that a) solves the problem posed in the book <u>Those Darn Squirrels</u> , b) expedites moving food for farm animals or c) helps a child clean up a room full of Legos *Adapted from " Science for All "
Circuits Challenge (2017)	Design an electrical lamp that meets the needs of someone at home or in your community.
Earthquake Challenge (2017)	Design an earthquake-safe structure that is two stories high and can withstand shaking at the base.
Pencil Case Challenge (2017)	Design a a) pencil case or b) wallet to meet the criteria of a classmate
Vertical Farming Challenge (2017) Vertical Gardens (2018)	Design a vertical farming system that uses minimum water and fits within a 1ft x1ft space
Water Filtration Challenge (2017) *sample Materials List (2018) Camping Water Filter (2018)	Design/improve a filtration system for a) local storm water b) community drinking water or) reduces microorganisms in pond/puddle water.
Nature's Fidget Spinner (2018)	Design a wind-powered generator for use in a power outage.
Prosthetic Engineering (2018)	Design a prosthetic hand that enables a person with limited or non -use of a hand to pick apples or other agricultural harvesting.
Reducing Lunch Waste (2018)	Design a system to reduce lunch food waste in your school.
Roof Structure (2018)	Design a roof structure can withstand heavy snowfall and can protect an object underneath.
Safe Car (2018)	Design a vehicle that withstand a fall (off of a cliff or bridge) with minimal damage.
Vehicles – Colonial Rides (2018)	Design a colonial-era vehicle that stands up to terrain challenges and can carry goods long distances.

“EMBRACE THE CHAOS” HOW TO MAKE TIME FOR ENGINEERING DURING THE SCHOOL DAY

Amber Wirth is a fifth grade teacher at Edison Elementary School in Tacoma. Like every teacher, Amber faces the daunting task of squeezing in math, reading, history, lunch breaks, and addressing the social and emotional needs of her students into each short day. What’s more is that all of these lessons must be aligned to Washington’s state learning standards, including Next Generation Science Standards. So how does Amber do it? By following her unofficial model—“embrace the chaos.” Amber knows that there will be many goals and objectives when it comes to her classroom teaching, and that standing alone, these goals may seem at odds with each other and with little room to fit in yet another subject—engineering. Rather



than deciding that this subject wouldn’t fit, Amber dove right in and looked for ways to integrate.

“I teach engineering by integrating it into the work we’re doing in other subjects. I had students read a book about disaster preparedness for reading, and then we focused on doing a design challenge on how to make bridges more structurally sound,” said Amber.

Amber notes that rather than distracting students from the learning goals at hand, the work amplified student learning. “Students were so much more engaged in that project. They went so much deeper in their understanding because it was integrated,” Amber stated. The theme threaded through her subjects gave her teaching day structure and allowed her students to see the whole picture.

“Engineering can really enhance any other content unit,” Amber states. In addition to building bridges, Amber’s students explored space and rockets from engineering, history, and reading perspectives.

Edison Elementary serves students living in high-poverty communities in Tacoma, where few students initially knew what engineering was when Amber introduced the concept. Yet, Amber’s integrated approach resonated with students deeply.

“When I introduced this high-rigor material, the students jumped on board and tackled the challenge in a variety of ways. Their creative problem solving was so unique and so engaged. Now, every student considers themselves an engineer.”

And because Amber made time during the school day for engineering, it turns out that students are making time outside the school day for their own projects.

“At parent-teacher conferences, a few parents exclaimed ‘oh, that’s why I’m finding collected recyclables under my kid’s bed!’” Amber laughed. It seems a bit of chaos in a school day mixed with a powerful teaching theme threaded throughout leads to engaged learning—and our state’s next engineers.

Play 8 – Provide Guided Mentorship Opportunities

GUIDING QUESTION

How will mentorship opportunities be provided for college/graduate students and professional engineers?

GUIDING PRINCIPLES

The Summer Design Institute and select Saturday sessions should be structured such that college/graduate engineering students and professional engineers have opportunities to participate in guided mentorship opportunities.

GETTING STARTED CHECKLIST

- ✓ Identify times during the Summer Design Institute and Saturday sessions in which participation by the college/graduate students and professionals is not necessary (e.g. when teachers are working on student assessment, etc.).
- ✓ Select a facilitator to guide college/graduate students and professional engineers through mentoring sessions. Consider partnering with local Workforce Development Councils, College Career Centers, and other student support services to facilitate mentoring sessions.
- ✓ We recommend adapting resources such as the [Career Readiness Workshop Playbook](#) and the Washington State Opportunity Scholarship (WSOS) 2016-2017 [Skills That Shine](#) modules to fit your program needs.
- ✓ The table below includes the resources that we have adapted from the Career Readiness Workshop Playbook and WSOS specifically for Engineering Fellows:

GOAL / TOPIC	RESOURCE
Provide clear goals and expectations for mentorship opportunities within the program.	EFP Career Mentorship Overview
Kickoff mentorship sessions and develop/practice elevator pitches.	Mentorship Orientation and Elevator Pitch
Learn about industry-specific resume practices and gather feedback on resume drafts.	Resume Building
Expose college students to the types of questions and scenarios they should expect to encounter in an industry-specific job interview.	Interview Skills

KEY QUESTIONS

- How much time can be allocated to mentorship opportunities during the Summer Design Institute and Saturday sessions?
- What capacity does the facilitation team have for running mentorship sessions? If limited, who in the community can support facilitation?

IMPLEMENTATION: SCHOOL YEAR ACTIVITIES

Play 9 – Saturday Session Scope and Sequence

GUIDING QUESTION

How will Saturday sessions be designed to ensure that participants reflect on implementation, improve equitable teaching practices, and refine design challenges?

GUIDING PRINCIPLES

- Each session should follow roughly the same pattern: reflection, new learning, and design challenge revisions.
- Data from the Access and Equity survey, classroom visit surveys, student assessments, and participant feedback should inform the content of each Saturday session.

GETTING STARTED CHECKLIST

- ✓ Watch this video about how the EFP participants continue to work together throughout the school year: [The Engineering Fellows Program: Design, Implement, Refine](#).
- ✓ After the Summer Design Institute, use data from the teachers' Access and Equity surveys to scope out the Saturday sessions. See this [sample Saturday session plan](#) Saturday session resources will be updated in June 2018.



KEY QUESTIONS

- How will the Saturday sessions be designed so there is coherence and connection throughout the year?
- What guest speakers can be brought in to Saturday sessions?

Play 10 – Design Challenge Implementation

GUIDING QUESTION

How will design challenge implementation be supported during the school year?

GUIDING PRINCIPLES

- Design challenge lesson plans are a guide, not a script.
- Design challenge lesson plans are works in progress.
- Teachers, college/graduate students, and engineers need consistent and frequent opportunities to debrief and reflect on design challenge implementation.

GETTING STARTED CHECKLIST

- ✓ Consider using an online platform such as Box, Google Drive, Schoology, Catalyst, etc. to store and share design challenge lesson plans, as well as other group resources.
- ✓ Provide guided reflection questions and set the expectation that teachers capture their “implementation notes” after each design challenge. See a sample list of [reflection questions](#).
- ✓ Make implementation notes available to the whole cohort in a timely manner.
- ✓ Build sustained time into every Saturday session for design teams to debrief how design challenges went and what could be improved for next time.
- ✓ Provide regular time during Saturday sessions for design teams to revise design challenge lesson plans, and make sure that these are available to the whole cohort.
- ✓ Identify ways to incorporate feedback from college students and professionals after their classroom visits.
- ✓ Provide time and clear expectations for scheduling visits from engineering students and professionals to classrooms.

Engineering Fellows
Reflection Questions for Implementation Notes

1. What changes did you make as you implemented this design challenge, and why?
2. What would you do differently next time, and why?
3. Which parts of the design challenge implementation were successful, and why?
4. Please share any observations/suggestions that improved this design challenge experience.
5. What evidence of student learning did, or could, you collect as a result of this design challenge?
6. How did the lesson engage the students in collaborative learning?
7. How did this lesson cognitively engage students?

KEY QUESTIONS

- How will teachers’ need for differing levels of detail in the design challenge lesson plans be accounted for?
- What online platforms are participants already using that can be used for resource/document sharing?
- How can reflections from college/graduate students and engineers be authentically included in the design challenge revisions?

MAKING ENGINEERING LOCALLY AND PERSONALLY RELEVANT

Nate Yasuda, a 21-year-old mechanical engineering student at Seattle University, knows that Seattle kids like Seahawks football. That's why one of the first things he did when he came into Tia Nguyen's fifth grade classroom at Highland Park Elementary was to play a video of a robot head in a football helmet getting dropped and surviving the drop with little impact.

"I knew he had them when one of the students who hides in the back in a puffy coat had his hand up immediately asking questions," said Tia. "The lesson appealed to what kids love. And for the kids that kids don't love football, they love smashing things. Everyone was engaged!"

"I showed the video about constructing a safer football helmet because that's what engineering is about. You are given a challenge, you design, you build, you test, you do all the steps to get to a strong solution," said Nate.

Nate was educated in Seattle's public schools, and he came away with some strong opinions about what makes engineering engaging for kids. His top piece of advice? "Make it fun. And start early—with Legos or erector sets. The sooner kids get into imagining and building, the better it is overall."

Tia states that she chose to invite Nate into her classroom so her students could learn who engineers really are and what they really do. "It helped to have someone come in who looks more like the kids, who is closer to their age, who can break it down and show the students what engineering is all about."

Tia hasn't stopped with football in her classroom—she's worked hard to integrate learning about issues deeply impacting the local community. "When we did the water filter challenge, we learned about the Duwamish River. We showed appreciation for the Duwamish people and learned about how overpopulation has impacted the water quality," Tia stated. "The students loved it. The challenge was hard, but it made them feel empowered to do projects that make changes in their community."

On the other side of the mountains, Mark Cheney, running Yakima's Engineering Fellows program, agrees it's crucial to keep engineering personally and locally relevant to students.

"In the Yakima Valley, many kids grow up facing generational poverty. Playing to what they know, and what they're familiar with, is crucial to keeping them plugged into engineering. By looking at local problems that students know about, you're making it easy for students to see themselves in problem solving roles," says Mark.

Mark also pointed out that having professionals come into the classroom to keep the work locally relevant helps a challenge many teachers face—moving from general to specific. "Teachers struggled because they had a general idea of the design challenges without a specific context," said Mark. "Engineers didn't have a problem of making things local. They already had the mindset of bringing the problems they work with on a daily basis into the classroom."

And hey, remember that kid in the puffy coat? After seeing his enthusiasm, Tia told him, "I think you're going to be an engineer." He smiled and responded, "I'm okay with that!"

Play 11 – Community and Family Engagement

GUIDING QUESTION

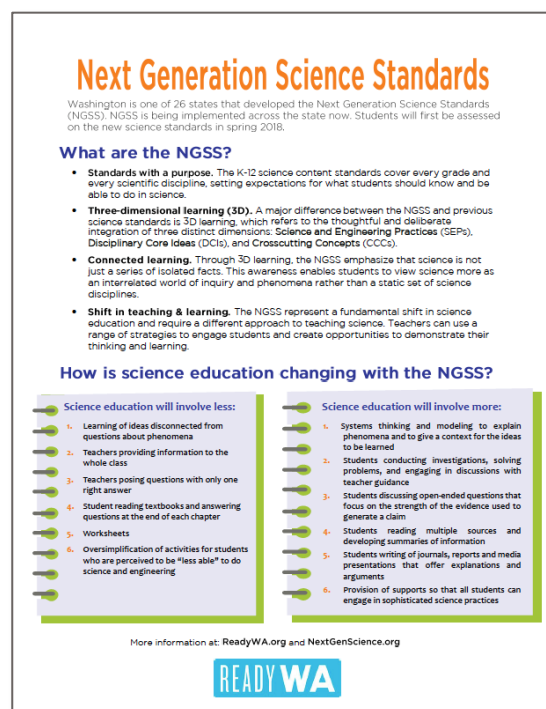
How will teachers be supported to involve families and community partners in engineering education?

GUIDING PRINCIPLES

- Families can and should be involved in learning about their student's engineering experience.
- Family culture, language, and transportation access needs to be considered when designing family engagement opportunities.
- Interacting with college/graduate engineering students and professional engineers can have a lasting impact on families as well as students.

GETTING STARTED CHECKLIST

- ✓ Think outside of the box about how to engage families, specifically families of students underrepresented in STEM.
 - Provide on-site translation services as well as translated materials. [Rev.com](#) offers translation services for many languages at a reasonable cost, with a quick turnaround.
 - Provide food and beverages for the entire family.
 - Consider the venue—is the school easy for people to get to? Is there a local community center that families might prefer or have easier access to?
 - Consider providing transportation, especially in rural communities.
- ✓ [Family engagement](#) can take many forms:
 - Family STEM / Engineering night
 - Family design challenge during conferences
 - Back-to-School Night design challenge
 - Participation in community-wide STEM / Engineering event
- ✓ Working through a design challenge with families presents an opportunity to help them understand the NGSS. Our first-year teachers found the following resource to be at the right level of detail for families with limited time during family engagement events.
 - [How is science education changing with the NGSS?](#)
- ✓ Consider connecting with your regional STEM Network or MESA Center for community support. If you are in a region without a STEM Network or MESA Center, [here is a template](#) for connecting with community partners for funding.



KEY QUESTIONS

- What family engagement opportunities already exist in teachers' schools and/or community centers?
- For program coordinators: does the host organization have the capacity to organize a large family/community event for all EFP participants and their students? What are the tradeoffs between a large event and smaller, school- or district-based opportunities?

APPENDIX A: OUTCOMES AND IMPACT MEASURES

GUIDING QUESTIONS

What outcomes can and should be measured to assess the value and impact of program activities? What tools, resources, and processes can be used to measure desired outcomes?

GUIDING PRINCIPLES

- All participants are partners in the program. Their feedback, reflections, and interpretations of the data are used to inform the program and help us all get better at this work.
- It is important to measure outcomes for each of our participants—teachers, college and graduate students, professional engineers, and fifth grade students.
- Individual participant data is kept confidential.
- Outcomes and measures reflect our current best thinking but may change over time as we continue to refine the program.
- Data is used formatively to anchor reflection and improvement of the program.

CONTEXT

In Year 1 of the program, we tested out measures of success with support of a100Kin10 Networked Improvement Community. In Year 2, we worked with an external evaluator to further develop our outcomes, tools, and processes to best inform the program design and implementation. **Our goal here is to share how these outcomes, measures, and tools could be implemented or adapted for use by program providers in similar programs.**

OUTCOMES, TOOLS AND PROCESSES

Our [2017-2018 target outcomes](#) focused on **access, equity, awareness, and participant learning.**

- ✓ Develop a [timeline](#) with clear roles and responsibilities related to each tool.
- ✓ Be transparent about how participant feedback shapes the program. For example, take a few minutes at the beginning of each day of the professional development to [share the feedback and course corrections from the previous day](#).

HOW TO USE THE TOOLS

Tool: [Adapted Draw an Engineer](#)

Target outcomes:

- Increase in student awareness of engineering career possibilities.
- Increase in participant's sense of identity as someone who could be in an engineering-related career (STEM and other).

Engineering Fellows Program Evaluation Outcomes 2017-2018	
Engineering Fellows Program Evaluation Outcomes and Tools 2017-2018	
Note: Some tools measure multiple outcomes, but each tool is only linked the first time it is referenced.	
Student Outcomes	Tool
1. Awareness of engineering career opportunities and pathways - Increase in student awareness of engineering career possibilities.	Retrospective Student Survey Draw an Engineer
2. Sense of community connection to engineering - Increase in student awareness of how engineering is relevant to or present in their community.	Student Pre/Post Survey Student Exit Ticket
3. Engineering practices - Increase in student engagement in engineering practices.	Student Exit Ticket
4. Identity in engineering career - Increase in participant's sense of identity as someone who could be in an engineering-related career (STEM and other).	Student Pre/Post Survey Draw an Engineer
5. Degree of engineering social capital - Increase in a student's connections with a positive and caring adult mentor who can help them along a desired career pathway in engineering.	Student Pre/Post Survey
6. Level of enjoyment - Positive student perceptions of enjoyment of the engineering design challenges.	Student Exit Ticket
Teacher Outcomes	Tool
7. Learning about engineering - Increase in teachers' understanding of engineering and what engineers do.	Summer Institute Survey
8. Confidence in teaching engineering - Increase in teachers' confidence in teaching engineering.	Summer Institute Survey
9. Equity practices - Increase in classroom implementation of equitable instructional practices in engineering and other disciplines.	Access + Equity Survey Summer Institute Survey Saturday Session Survey
10. Value/satisfaction - Positive teacher perceptions of the utility of the EFP experience for their classroom context.	Summer Institute Survey Saturday Session Survey

How we used it: Students took the Draw an Engineer assessment at the beginning of the school year, before doing any engineering activity. Teachers then reviewed the students' work during the first (or second) Saturday session using an adapted "[Rapid Survey of Student Thinking](#)", looking for patterns in student thinking that they could address throughout the year. Students took the Draw an Engineer assessment again at the end of the year, and teachers brought their work to the last Saturday session for another review and comparison to the beginning-of-the-year assessments.

Lessons Learned: It was powerful for teachers to see changes in student awareness and identities in engineering and to be involved in the analysis and reflection on student thinking.

Tool: [Student retrospective pre/post survey](#)

Target Outcomes

- Increase in student awareness of engineering career possibilities.
- Increase in participant's sense of identity as someone who could be in an engineering-related career (STEM and other).
- Increase in student awareness of how engineering is relevant to or present in their community.
- Increase in a student's connections with a positive and caring adult mentor who can help them along a desired career pathway in engineering.

How we used it: Students completed the survey online at least several weeks before the last Saturday session. We provided teachers with their classroom data set during the final Saturday session. Regional data sets were provided to program coordinators. The external evaluator analyzed the full set.

Lessons Learned: We originally designed this as separate pre- and post- surveys. After feedback from the teachers and coordinators about the amount of time available for engineering activities, we modified this into one retrospective survey that students take at the end of the year.

Tool: [Student Exit Ticket](#)

Target Outcomes

- Increase in student awareness of how engineering is relevant to or present in their community.
- Positive student perceptions of enjoyment of the engineering design challenges.

How we used it: Teachers were assigned to have their students complete an exit ticket for one of their design challenges, though they had the option to use the exit tickets as often as they'd like.

Lessons Learned: It was helpful to have a program coordinator available to enter the student exit ticket data into a spreadsheet for our analysis. Without an evaluation specialist, we probably would have had teachers compile their data during a Saturday session to identify patterns in how their students were engaging with the design challenges.

Tool: [Summer Engineering Design Institute Survey](#)

Target Outcomes

- Increase in teachers' understanding of engineering and what engineers do.
- Increase in teachers' confidence in teaching engineering.

- Increase in classroom implementation of equitable instructional practices in engineering and other disciplines.
- Positive teacher perceptions of the utility of the EFP experience for teachers' classroom context.
- Positive perceptions that college students' and engineers' contributions are valued in interactions with students and teachers.
- Increase in understanding of teaching and learning (for college students and engineers).
- Positive perceptions of the utility of the EFP experience for college students' and engineers' professional development/work.

How we used it: Participants were provided with 20 minutes on the last day of the Institute to complete the survey. The link was emailed to them and provided on demand. Facilitators emphasized participants' role as co-designers of the program.

Lessons Learned: The Summer Design Institute data was critical for designing the Saturday sessions to meet participant learning needs. Participants appreciated the opportunity to provide feedback and be partners in designing the program.

Tool: [Access and Equity Survey](#)

Target Outcomes

- Increase in classroom implementation of equitable instructional practices in engineering and other disciplines.

How we used it: Teachers were engaged in a [discussion and session on the Access and Equity practices](#) during the Summer Engineering Design Institute. Then they took the survey for the first time, providing baseline data on their instructional practices. The teachers took the survey two more times during the school year—after their first or second design challenge (December) and again at the end of the school year. Program Coordinators and lead teachers reviewed the aggregated data from the Access and Equity survey and used it to identify topics for further development during Saturday sessions. The teachers also reviewed the first and second rounds of data during the January Saturday session.

Lessons Learned: The survey takes 20-30 minutes to complete. Some teachers were frustrated or intimidated the first time they took it, because they had never attempted to teach engineering before. Once they understood that the survey really was a tool to help us all get better, it was better received. Teachers reported that it was a valuable way to reflect on their practice and pushed their thinking.

Tool: [Saturday Session Survey](#)

Target Outcomes:

- Increase in classroom implementation of equitable instructional practices in engineering and other disciplines.
- Positive teacher perceptions of the utility of the EFP experience for teachers' classroom context.
- Increase in understanding of teaching and learning (for college students and engineers).
- Positive perceptions of the utility of the EFP experience for college students' and engineers' professional development/work.

How we used it: Teachers, college students, and engineers took the survey at the end of three Saturday sessions, and their feedback was incorporated into subsequent Saturday sessions and classroom support.

Lessons Learned: The data validated our perceptions of how well the Saturday sessions were going, which could be attributed to the open and trusting relationship participants had with program staff.

APPENDIX B: CLASSROOM VISITS

101

Utilizing the Classroom 101 road map ensures proper planning for successful classroom visits during the school year. Participating engineers can review how to prepare for upcoming classroom visits, classroom etiquette, and post-classroom protocol.

PREPARING FOR A CLASSROOM VISIT

When preparing for an upcoming classroom visit, make sure to coordinate the following steps with participating teachers during Saturday session workshops:

- Devise a clear plan on how to support teachers with the implementation of the engineering design process/engineering concepts on day-of design challenge. Types of support include, but are not limited to:
 - Engineering presentation
 - Design Challenge support
 - Skype session
- Coordinate one- to two-hour visits with participating teachers—ensure date/time and duration of the visit is clear with participating parties.
- Prepare a five- to ten-minute introductory presentation of who you are, your area of engineering, etc.
- Upon coordinating schedules, make sure to update calendar share via Google Drive.
- Cover any administrative protocols for schools prior to classroom visit (volunteer forms, background check, etc.).

CLASSROOM VISITS—ETTIQUETTE

- Keep equity at the forefront—all students learn differently. Honor and respect where each student is coming from.
- Arrive on time and notify your primary if you will be arriving late. Allow 24-48 hours' notice of cancellation for teachers.
- Be flexible—teachers' schedules are demanding and cancellations may occur last minute. Confirm that you and your partnering teacher have each other's contact information, and communicate in a timely manner if plans change.
- Dress appropriately for classroom visits (business casual, clothes that you don't mind getting dirty, etc.).
- Refrain from cellphone usage during visits (some exceptions may be made upon prior arrangements).
- Ensure that the instruction of the engineering challenge is the teacher's responsibility. Unless coordinated beforehand with the teacher, students and engineers are volunteers only.
- Picture taking—depending on school/classroom protocol, images should be of engineering prototypes only. No child should be in photos unless cleared with the teacher/school.

CLASSROOM VISITS – INSIDE THE CLASSROOM

- Student/engineer role in classroom—students and engineers can participate in the following roles during a classroom visit (usually one to two hours):
 - Volunteer
 - Students and engineers volunteer time to support teachers in engineering design challenge instruction. Students/engineers bridge engineering concepts/terms and help make connections for fifth grade students during challenges.
 - Circulate around the room and provide any needed support during the engineering design challenge.

- Support teacher with classroom set up, material distribution, and additional instructional support.
- Prepare a 10- to 15-minute presentation of the following:
 - Who you are.
 - Your engineering field of interest.
 - Your personal story of your engineering pathway and experience.
 - A real-world connection to their area of study.
- If an in-person classroom visit is not possible, consider a virtual visit using Skype, Google Hangouts, or other video conferencing system (depending on school policies and firewall).
 - Provide a virtual tour of a workplace or lab.
 - Introduce an engineering challenge, then participate in another virtual visit to hear about students' designs and provide feedback.

POST CLASSROOM VISIT

After visiting a classroom, engineers have an opportunity to reflect on their experience in the following ways:

- **Classroom survey:** Engineers reflect thoughtfully about their classroom visit. Participants can discuss their classroom experience, successes, challenges, and feedback for teachers on how to strengthen future design challenge experience(s). All who complete a survey receive a stipend payment and help to enhance the engineering experience for the program.
- **Upload pictures to program Google Drive/Box/Dropbox:** Pictures/videos documented in classroom are essential to capture the engineering experience for students. When completing your classroom visit, upload any pictures, videos, and/or other documentation items from the classroom visit.
- **Thank you note for teacher/classroom:** Prepare a brief thank you note after your classroom visit. Describe any highlights or “aha” moments.

THE VALUE OF ENGINEERS IN FIFTH-GRADE CLASSROOMS

For those who work in the education system, or parents of students in that system, a fifth grade classroom probably feels familiar. But for people outside of that system who likely haven't been in a fifth grade classroom since they advanced to the sixth grade, it may not feel that way. This may not seem like much of an issue, but for the professional and student engineers involved in the Engineering Fellows Program, it can be daunting to know how to operate in a classroom environment. Can I really help students learn? Is my experience relevant to fifth grade students? How can I work with a teacher for the best possible outcomes? These are all questions that these engineers might ask themselves.

Tasha Tardieu, a civil engineering student at the University of Washington, had some of these very questions herself. But her excitement, open mind, and dedication to equity in engineering helped her step into the classroom and set her anxiousness aside.

“I was a little bit nervous when I went to the classroom because I wasn't completely sure what the teacher may want of me. It was the first week of school and the students were getting to know each other, the teacher, and they were all preparing for their first engineering challenge. The teacher had told her students that an engineer was going to be visiting the classroom; when I walked in, a lot of the students exclaimed, 'Oh my gosh, she's a girl! Are you sure she's an engineer?'”

For Tasha, the surprise that came from the students took her aback at first. But it was this very example that provided a strong reminder of why she was participating in the Engineering Fellows Program. A key component of the program is to bring a diverse group of professional and student engineers into the classroom. The physical presence of the engineers can really help students see that anyone can be an engineer, regardless of gender, race, or ethnicity.

"I was lucky to have an undergraduate experience where there was 50/50 gender representation in my program, but I know that's not the norm. Given the students' initial reaction, it felt very reminiscent of the state of the engineering industry right now. Being a female engineer in this classroom, in this context, made me feel proud to represent that image. This is something that we're still fighting for in the industry. Students were a little shocked, but it was amazing how quickly my presence broke down some of the stereotypes they had. I think that revelation immediately had more girls and boys excited about tackling the day's challenge."

As a part of the Engineering Fellows Program, teachers have students draw and describe what and who they think engineers are. On Tasha's first day in the classroom, she reviewed those assessments and saw that most of the students' responses featured images of men, car mechanics, and other narrow examples. By just entering the classroom, Tasha was helping to expand the scope of what was possible for these students. But entering the classroom is only a first step, and an engineer's impact on the classroom will extend well beyond that first impression.

"After my first class was dismissed, I went to another classroom to give a presentation on what I do as a civil engineer and why I chose to pursue it as a career. Afterwards, I sat down with a group of young girls who were eager to share their thoughts. One of those students had her interest piqued and was playing with the idea of being an engineer. The other two students weren't sure they wanted to be an engineer, but they had grasped a concept that was just as important. They told me, 'I don't think I want to be an engineer, but I do think these skills will be useful in the future for other jobs.'"

The realization that engineering skills and knowledge is applicable to other subject areas and other fields of study is incredibly important for students to grasp. Tasha was so excited to hear these young girls express that engineering was an option for them, but even more importantly, that they understood that an engineer's approach to problem solving and critical thinking would be a huge asset in any career. The Engineering Fellows Program is not designed to track all students into engineering careers, but rather to provide opportunities to practice the problem-solving skills and design thinking that extend well beyond engineering fields. But fifth grade students aren't the only ones learning through this program. Tasha had some pretty big takeaways from her time in the classroom.

"I've learned a lot about how teachers manage their classrooms and what it takes to make sure every student is learning. In terms of engineering, we can get caught up in how complex it can become, but I've been reminded that it can be simplified and broken down so that anyone can do it. It's really cool to be a part of a profession that can empower anyone. When it came to the students, their creativity really blew me away. As an engineer, it was a really good reminder to make sure I'm trying to tap into that kind of creativity. The way that students jumped into the mindset of creativity and exploration was inspiring. And personally, the whole idea of failing forward was something I wish I would have been able to internalize as a fifth grader. I continue to grapple with these things as a college student but for these fifth graders, they're going to have such a solid foundation of learning, whether they choose to pursue engineering or not."

Tasha also spoke about seeing the application of science in action. For students, an engineering design challenge may look like a fun opportunity to build, create, and collaborate. But behind the scenes, these students are putting the fundamental practices of science and engineering to work in service of solving real-world problems. Connecting real-world practices to classroom learning can provide an invaluable experience as students continue to grow, learn, problem solve, and plot out the directions for their lives. As Tasha continues to look forward to the rest of the school year, she had some thoughts she wanted to share broadly.

"I don't think I can stress enough how much of an impact this program has on the students. Engineers are people students don't see as of their world until you step into that classroom. Being able to sit with them, work with them, and validate what they're doing is so empowering for the students. There are so many smiles and lightbulbs going off for them when you just sit and talk with them. From the reactions that I've seen, it's such a powerful thing for the students to feel heard and feel like their ideas are worthwhile. When a teacher, an engineer, and students can work together to make those things happen, it's such a valuable experience."

THANK YOU!

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Aaron McAtee	Larchmont Elementary, Tacoma Public Schools
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Angie Nall	Arbor Heights Elementary, Seattle Public Schools
Ann Aliberti	Chief Kamiakin Elementary, Sunnyside School District
Antonio Valencia	Computer Science, Yakima Valley College
Armand Shahbazian	Electrical Engineering, Seattle University, Seattle City Light
Ashkay Thapar	Civil Engineering, Yakima Valley College
Aubrey Ashenbrenner	Kimball Elementary, Seattle Public Schools
Aven Samareh	Industrial and Systems Engineering, University of Washington
Barbara Medina	Mechanical Engineering, Seattle University
Brian Buehler	Harrah Elementary, Mt. Adams School District
Carmen Hom	Civil Engineering, University of Washington
Catie Larsen	Covington Elementary, Kent School District
Chris Brase	Marvista Elementary, Highline Public Schools
Chris Lesesne	Aerospace Engineering, Triumph
Dan Hollrah	Civil Engineer, WSDOT
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Donna Pearson	East Hill Elementary, Kent School District
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Dwight Lee Bates	Mechanical Engineer, Boeing (retired)
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Erin Williams	East Hill Elementary, Kent School District
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