Oakland Afterschool Science Learning Community

Promising Practices for Delivering High Quality Science Programming in Afterschool

"I used to hate teaching science but now thanks to the science learning community I am more confident about my teaching as a whole."
Oakland Afterschool Science Learning Community Member, Spring 2011

During the 2010-2011 school year, the Oakland After School Science Learning Community worked to increase the capacity of Oakland after school program providers to provide accessible, high quality, informal science education to students and increase participating staff members' confidence in delivering high quality informal science education.

With funding from the Noyce Foundation, The After-School Corporation, and the Collaborative for Building After-School Systems, Techbridge in partnership with the Oakland After School Programs Office developed a series of six professional development sessions and ongoing support through observations, coaching, and additional resources for staff leading after-school programs in Oakland elementary schools.

Overall, participants reported high levels of satisfaction with the different activities within the learning community. Based on the experiences and outcomes from the learning community, we have developed this promising practices guide for site and program coordinators. This guide explores specific ways that site and program coordinators can design and structure programs to best support staff in leading high quality STEM programming.

Instructional Promising Practices

As a site or program coordinator at your school, there are several instructional practices that after-school program line staff should utilize every day in their programs to ensure that students receive high quality science programming in each session. Outlined below are instructional practices that can be developed in line staff throughout the year. Included in each promising practice are strategies for you to support program staff in implementing quality science programming.

Elements of a Science Lesson

"I used to have a hard time putting my lessons together but now because of the Science Learning Community I can transform a regular lesson into a science lesson."

Science should be done on a regular basis throughout the year using a vetted after-school science curriculum. Each science lesson should include an introduction, a hands-on activity, and a structured reflection of the activity. An introduction should be about 5-10 minutes at the start of a lesson and the reflection should be about 10 minutes after the hands-on activity. This will ensure that students are engaged and making connections between what they are learning after school with their daily lives.

The key elements of an introduction are the following:

- Ask questions to access students' prior knowledge
- Make a career connection
- Give a real world application
- Do a demonstration

Support your staff in leading high quality introductions to activities by brainstorming with them ways to introduce an activity. Some ideas include showing a short 2-3 minute video clip of a scientist or engineer working on a similar real world project or doing a demonstration that gets students thinking and excited about the project. Use resources from Design Squad and Engineer Your Life to make the career connections. Work together with staff to develop questions that can spark a student's interest and tap into their prior knowledge. Questions can include things like: How does this relate to something that you have seen? What does this remind you of? How can you approach this challenge?

The key elements of the hands-on activity are the following:

- Ask questions
- Encourage curiosity and exploration
- Be a learner too

Support your staff in engaging students during the hands-on portion of the activity by encouraging them to be learners too! Try modeling this for them when you observe their programs. Remind them that they do not have to know all the answers to the questions they ask students or to the questions that students ask. Help your staff find resources that they can utilize if they want to find an answer to a question.

The key elements of the reflection and debrief are the following:

- Ask questions
- Give real world applications
- Make a career connection
- Have students reflect on their success and challenges with the activity
- Have students reflect on what they learned and how that may have changed previous ideas or perspectives

Support your staff in leading high quality debrief and reflections by brainstorming with them ways they can wrap up an activity. Some ideas include having students do a pair share with one another to highlight a challenge they had and how they overcame it or by having groups share their final product with the entire class. Provide the program with journals for students to reflect in after each science lesson. Work together with your staff to develop questions that can help students expand on concepts they learned in the activity. Questions can include things like: How would you use what you learned for to develop something that you would use in your life? Based on what you learned, how would you explain this to a 5 year old? How could you improve your design?

Inquiry Based Learning

"[Modeling activities] was very helpful because I was able to see and do the activity to know what changes or challenges the kids might face when they try and activity. It was helpful to see what an experiment would look like in order to have an idea of how to present it to my class."

The focus of inquiry based learning is the process of doing and discovering science, not simply completing activities or projects. Inquiry based learning encourages scientific attitudes with students. These attitudes include things like being curious, insisting on evidence, applying prior science knowledge, and working cooperatively.

- Being curious – Guide students to develop their curiosity by allowing them to explore the natural world and by encouraging them to ask questions
- Insisting on evidence and being willing to reflect and change ides – Encourage students to discover things and adjust a hypothesis as more information becomes available to them.
- Applying prior science knowledge – Relate activities to students' lives and experiences.
- Working cooperatively – Have students do activities in pairs, groups, and/or share results with one another.

Staff leading inquiry based activities with students should do the following:

- Engage students in activities
- Encourage them to explore concrete materials and reflect on what they have found
- Engage students in conversations, listen to their ideas, and provide guidance to help them build and test their own explanations of what is happening

Support your staff to understand the inquiry based learning approach by emphasizing that they also are learners in these activities and are not expected to know all the answers. Many after-school program line staff may be reluctant to do science with their students because of their own lack of comfort in science or math; therefore, doing the hands-on science activities with them can help alleviate that discomfort. Modeling inquiry based learning can also help lead to a deeper understanding of science concepts. As a site coordinator, you should ensure that your staff is encouraged to try the hands-on activities themselves before doing them with a class of students. This will ensure that staff are comfortable with the activity and know what to expect.

Questioning Strategies

"I do feel confident about teaching science. Comparing this to last year, I feel more confident answering and asking questions. Last year was a lot of teaching, little interaction, and this year, there's a lot more hands on versus me doing it. It's been really cool that [the students] can handle the materials too."

Asking the right question is at the heart of doing science and learning. There are various reasons to ask questions and knowing how to strategically ask a question at the right time is a skill that program staff should possess. Different questioning tools are needed by instructors, for example, to set the cognitive level of inquiry, to promote discussion by each student, to stimulate deeper thought by students, and to build meaningful explanations that connect investigative evidence to what students already know.

One important tool that program staff should possess is the skill of knowing how and when to ask open-ended and closed questions. Both types of questions are important for assessing prior knowledge and promoting new learning, but in very different ways. A closed question has a single correct answer. Students' responses to these types of questions help instructors asses their factual recall and observation skills and serve as great checks for understanding. An open-ended question is a question that can be answered in a number of ways. These types of questions enable all students to make useful contributions to a discussion and are more likely to promote inquiry than closed questions.

Different types of questioning can be used to promote students in inquiry throughout a lesson. Below are some of the various ways that questions can be used.

- Questioning to create motivation and interest
- Questioning to assess prior knowledge
- Questioning to initiate inquiry
- Questioning to guide discussion of observations
- Questioning to guide discussion of explanations
- Questioning to guide discussion of applications to new situations

Questioning strategies are crucial for afterschool program staff to feel comfortable with. Support your staff in feeling comfortable asking questions by sitting down with them to develop questions that they can use throughout any science activity. To help with this, we created a short guide for what types of open-ended and close-ended questions can be asked at various points in a science activity or depending on what your intended outcome is for the student. Use this as a starting point to come up with questions your staff can ask students.

It is also important to address the fear factor that your staff may have with answering questions as many may fear that they will answer incorrectly, or that will not have the "right" answer. It is important to reiterate that it is okay to not have all the answers and that the best instructors often times do not have the answers but rather they know how to direct students to discover their answers.

Career Exploration

"[The learning community] got me excited about science – I'm an arts person – so that's huge. I was able to bring excitement back to my kids, and that got them excited about science, too."

Girls and minorities are under-represented in science, technology, and engineering degrees and careers. Ensuring girls and students of color are participating in science, technology, and engineering and cultivating an interest in science is foundational in fostering potential exploration in science, technology, and engineering particularly among girls and under-represented minorities.

It is important to focus on strategies for career exploration both with and without role models. Role models are science, technology, or engineering college students or professionals that are brought into after-school programs to share their passions about the careers they have in science, technology, and engineering.

Career exploration can be integrated into the hands-on activities that program staff do with students. This can be accomplished via questioning, discussions, and facilitation strategies. Throughout activities it is important to highlight specific careers that are involved in similar real world products. This can be effectively highlighted in an introduction and reflection. Students should also be provided with concrete ideas and steps they can take in their immediate future to help them learn more about a career path. Some ideas include: classes to take in high school, typed of clubs and programs they can look into in middle and high school, and additional books to read or websites to check out.

Hands-on projects can spark an interest in science, technology, or engineering. But on their own they may not lead to a career interest in these fields. Role models are the best ambassadors for communicating information about the wide range of careers that are available. Role models can inspire students about their work and help them make informed decisions about their future.

Support your staff in including career exploration by providing additional resources that staff can use to learn more about specific careers or use to point students in the right direction to find more information about specific careers. These resources can include websites like Design Squad and Engineer Your Life. Make it a point to ask your staff how they are integrating careers into their science lessons.

Support role model visits to afterschool programs by finding adults who can come into your programs and organizing the logistics of the visit. Organizations like Society of Women Engineers (SWE), Society of Hispanic Engineers (SHPE), and National Society of Black Engineers (NSBE) are great organizations to reach out to for role models. There are also organizations that have resources to support these visits. Techbridge has a role model toolkit and guide that shares best practices for bringing adults into afterschool programs and also highlights specific activities that can be used in a role model visit.

Family Engagement

"I used to be afraid of teaching science, now I feel more comfortable because of the Science Learning Community."

Family engagement is a critical element of engaging students in science, technology, and engineering. Parents are an integral part of inspiring students to pursue and education and career in science, technology, or engineering. Nevertheless, finding ways to attract parents requires a concerted effort among program staff to keep them informed about the activities

that are happening after-school programs and to invite them to participate in similar activities at home. These are three specific ways that your site can engage families.

- Send welcome letters to parents at the start of the school year and program updates throughout the year.
- Encourage students to share projects and do extension projects at home with their families
- Host a family science night

Support your staff in engaging families by showing your commitment to family involvement. As site coordinator, send home a welcome letter to parents at the start of the school. Encourage your staff to talk to parents when they pick up their students. Encourage your staff to talk to their students about ways they can talk to their families about what they did and learned in their science lesson and if possible how to replicate the activity at home with their families.

Support the planning of a family science night. As a site coordinator, plan the logistics for the night and coordinate with the other afterschool programs to coordinate a family science night. Make sure to use resources from other organizations to help in the planning of a family science night. These include: *Science, It's a Family Affair*, a parent resource guide developed by Techbridge; a Family Science Night planning handout from Oakland Unified School District.

Science for All Learners

"I used to not feel confident about science but now because of the learning community, I do."

Ensuring participation and learning in science across all students promotes learning opportunities for every student, regardless of gender, ethnicity, or socioeconomic status. Program staff is a key resource to help students' bridge the gap from their varied experiences, languages, and knowledge backgrounds, and abilities to a hands-on way of doing science.

Strategies that can help support English language learners include the following:

- Speak slowly, distinctly, and write down key terms during instructions, explanations, and discussions.
    - Word wall - create a word wall for your program.
- Emphasize visual literacy

    - Use pictures and diagrams to explain concepts and allow students to use visuals to explain their thoughts and reflections.
- Think/Pair/Share
    - Sharing out in pairs or small groups allows students to practice their English skills in a low stakes environment.
- Journaling
    - Journaling regularly can help students practice their English writing skills. Interactive journals are a great way to have written conversations with students and to model good writing skills.

Support your staff in including these strategies in their programs by choosing two that fit their level. Provide materials for your staff to create a word wall in their program or provide visual resources or journals that they can use with their students. Encourage your staff to emphasize vocabulary with their students by writing down key terms for a science activity on the board. Help your staff come up with these key terms by sitting down with them to identify the words.

After-School Science Matters: Developing and Supporting High Quality Science Programming in Out-of-School Time Programs

OUSD Afterschool Programs Office
Techbridge

BOOST Conference

Palm Springs, CA

OAKLAND UNIFIED SCHOOL DISTRICT | *Community Schools, Thriving Students*

Techbridge

Agenda

- Welcome and Introductions
- Ice Breaker: Career Step Up
- Overview
- Hands-on Activity: Kitchen Kapers
- Promising Practices for Science in After School
- Additional Resources
- Q&A

Learning Targets

1. I can name *at least* two promising practices for designing and structuring quality science programming.

2. I can name two resources to support science programming at my site

Icebreaker: Career Step Up

Why is Science a Good fit in OST?

Youth Development Practices	Science Programming Foundational Practices
Safe Environments	Safe Environments
Supportive Environments	Supportive Environments
Interaction	Interaction
Engagement	Engagement

Techbridge: A Multi-faceted Program

GIRLS

- After-school and summer programs
- Field trips and role model visits

TEACHERS

- Trainings
- Summer Institute

FAMILIES

- Family events
- Resources

ROLE MODELS

- Trainings
- Resource guide

PARTNERSHIPS

- Resources

Oakland Unified School District

- 84 ASES and 21st CCLC Programs
- 16 Community Based Organization Partners
- 17,500 youth served in 2010-2011
- Partnership with Techbridge in 2010 to launch the Oakland Afterschool Science Learning Community

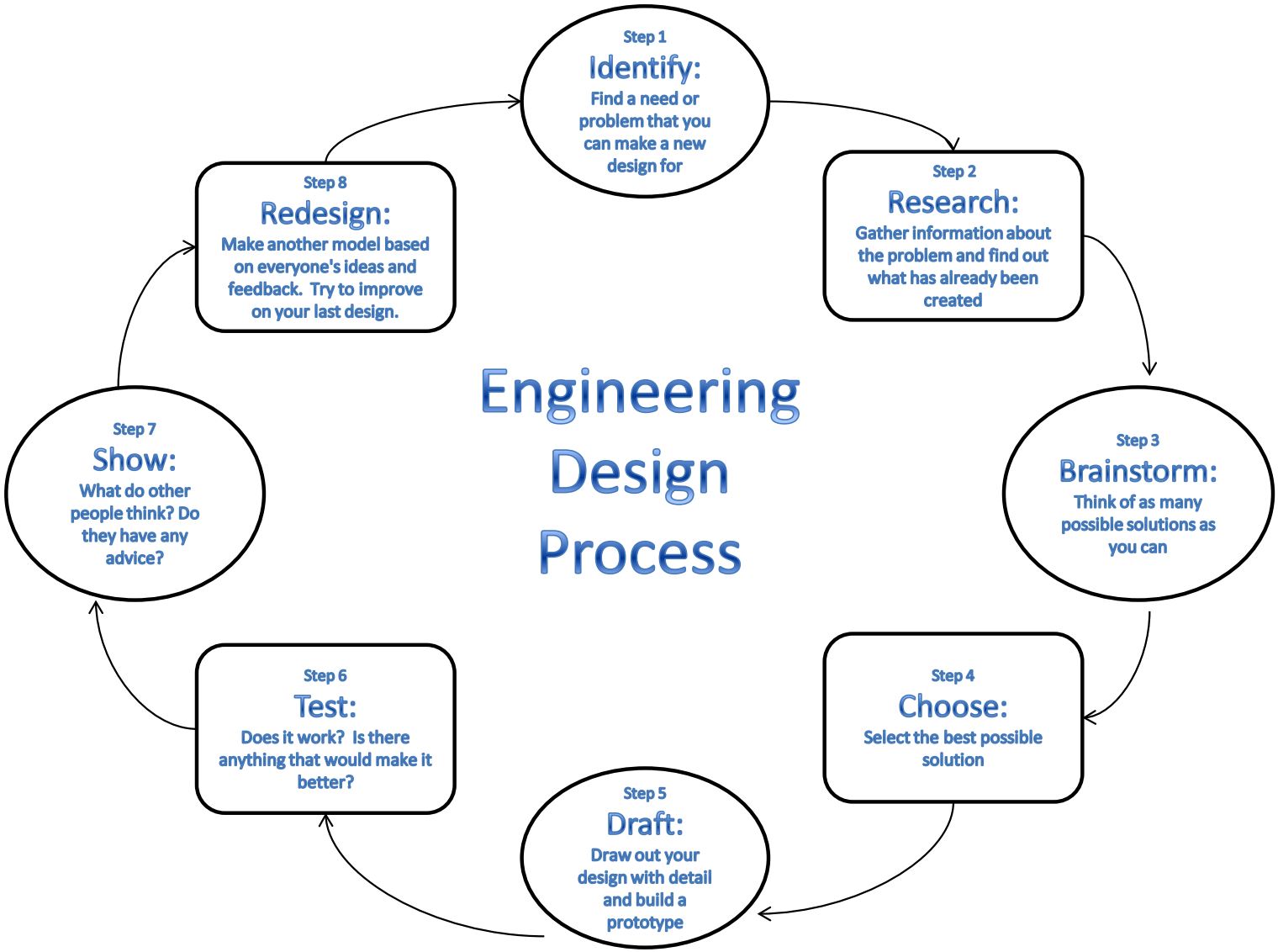
The Oakland Afterschool Science Learning Community

- Professional development workshops (co-inquiry, questioning strategies, career, engaging families and supporting equity)
- Low cost hands-on science, technology and engineering curricula
- Observations and coaching
- Stipend for project materials

OAKLAND UNIFIED SCHOOL DISTRICT | *Community Schools, Thriving Students*

Activity: Kitchen Kapers

- You are a **product designer** and must create a **prototype** of a kitchen utensil that every household MUST have and has not been invented.
- You have 7 minutes to complete your prototype.


Engineering Design Process
Step 1
Identify:
Find a need or problem that you can make a new design for
Step 2
Research:
Gather information about the problem and find out what has already been created
Step 3
Brainstorm:
Think of as many possible solutions as you can
Step 4
Choose:
Select the best possible solution
Step 5
Draft:
Draw out your design with detail and build a prototype
Step 6
Test:
Does it work? Is there anything that would make it better?
Step 7
Show:
What do other people think? Do they have any advice?
Step 8
Redesign:
Make another model based on everyone's ideas and feedback. Try to improve on your last design.

Kitchen Kapers: Debrief

- How was this activity made fun for students?
- What career exploration strategies did you see modeled during the activity?
- What made this activity a science activity?

Promising Practices for STEM in OST

- Fun, hands-on science activities that include: introduction, hands-on, and reflection and debrief
- Inquiry based learning
- Questioning strategies
- Engages all learners (supporting equity)
- Career exploration
- Family engagement

Brainstorm

- Identify specific things you can do to support your staff in each specific promising practice

Need: “I can be anything but…”

Recipe for Success

Icebreaker	• Sets tone and warms up girls and role models
Personal Story	• Makes connection to students
Hands-on Activity	• Engages students
Wrap-up and Reflections	• Questions and feedback

Let’s see some role models in action…

Family Night Agenda

- Light Dinner (20-25 mins)
- Welcome and Introduction (5-10 mins)
- Girl Presentations (20-25 mins)
- Hands-on Activity(10-15 mins)
- Resources and Evaluation (5-10 mins)

Additional Resources

- Promising Practices for Delivering High Quality Science Programming in Afterschool Guide
- Techbridge's *Science: It's a Family Affair* resource guide for parents.
- Questioning handouts
- Sample Techbridge curriculum
- Role Model Toolkit

Learning Targets

1. I can name *at least* two promising practices that support science activities in afterschool programs

2. I can name two resources to support science programming at my site

Thank You and Questions?

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Icebreaker – Career Step Up

Activity Time:
30 minutes

Preparation Time:
10 minutes

Grouping:
Individual

Introduction: In this activity students will learn about how different careers work together to create a product.

Objective: As a result of this activity, the girls will be able to:

- Describe different careers
- Learn about how different careers work together

Materials:

- 2 sets of Career Cards

Preparation:

- Familiarize yourself with the career cards and prompt questions

Directions:

1. Divide the students into two teams.
2. Give each team one set of career cards. Each girl should have a card, or two depending on the numbers on each team. Give the students time to read over the cards. Walk around and encourage questions or comments on the cards so they really understand the content.
3. Say a product and have the teams huddle up and decide which careers would have been involved in making that product. Remind the girls to think about the entire product. If the girls seem stuck, read a prompt question for that product to help them.
4. Once the teams have decided, the girls holding the careers they think were involved in the product should raise their card. For each correct answer, the team gets a point. (If two careers were involved and both of those girls stood, the team gets 2 points).
5. Ask all the students holding a particular career card to suggest one aspect of the product they worked on. For example, you might ask all the software engineers what aspect of a cell phone they helped build.

6. If a girl suggests a career that does not seem to be related to a product, encourage her to explain why she thinks that career might be involved in the product. If you think it is a valid explanation, give her a point.
7. The team with the most points at the end wins the game.

Careers:

Electrical Engineer

Toy Designer

Software Engineer

Mechanical Engineer

Material Science Engineer

Products:

Background Information for Leaders

Use the information and question prompts below if the girls are struggling with a certain product. Remind girls to think about the whole product and the different things it does when thinking about which careers were involved.

Cell Phone: Software Engineer, Electrical Engineer, User Interface Designer

1. What does a cell phone do? How does it know to do that? (Software Engineer)
2. Does a phone need a battery? (Electrical Engineer)
3. How do you get to all the different applications on your phone? Who set up what the screen looks like and how to find the different programs? (User Interface Designer)

Video Game Controller: Software Engineer, Mechanical Engineer, Electrical Engineer, Toy Designer,

1. How does the controller tell the game what to do? How does the game know what is going on? (Software Engineer)
2. If the power went out, would the controller work? (Electrical Engineer)
3. A controller doesn't work by itself. It is part of a system. Who designed the system? (Toy Designer)
4. Many controllers have joysticks. Who designed them to move a certain way? (Mechanical Engineer)

Hairdryer: (Mechanical Engineer, Electrical Engineer, Material Science Engineer)

1. What do you think is inside the hairdryer pushing the hair out? Is it something that is moving? (Mechanical Engineer)
2. How does the power get to all the parts? How do the switches and buttons make the hairdryer turn on or slow down? (Electrical Engineer)
3. Why do you think the handle stays cool even though the nozzle can become hot? (Material Science Engineer)

Elevator: (Mechanical Engineer, Electrical Engineer, Software Engineer)

1. What makes the elevator move up and down? How does it move? (Mechanical Engineer)
2. How do you know what floor you are on? Who made it so that the buttons light up or the screen shows a floor? How does the elevator know what to do when you push the button for the third floor? (Software Engineer or Electrical Engineer)

Hybrid Car: (Mechanical Engineer, Material Science Engineer, Electrical Engineer)

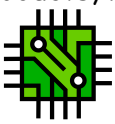
1. What type of person would design a completely new car engine, with all its different moving parts? (Mechanical Engineer)
2. What does a hybrid car run on? Who would help build an engine that runs on two different power sources? (Electrical Engineer)
3. FI a car is being powered by a batter and by fuel, who would help design engine parts that can process two very different substances? (Material Science Engineer)

Snap Circuits: (Electrical Engineer, Toy Designer)

1. What is Snap Circuits trying to teach you? Who would help figure out what should be taught? (Electrical Engineer)
2. What type of product is Snap Circuits? (Toy Designer)

Electrical Engineer

Electrical engineers design parts for anything that uses electricity. They think about how to power everything from very small products, like computer chips, to very large products, like airplanes.



Electrical engineers work with lots of other types of engineers to design new products and improve existing ones.

Electrical Engineers make around $58,000 a year!

Projects you might work on:

- Design a new iPod
- Develop a new video game
- Improve a computer chip to make it work faster
- Design the electrical supply to a clothing factory
- Build a new tiny camera that doctors use in surgery

Companies you might work for:

- Computer companies like Microsoft or Apple
- Car companies like Toyota or GM
- Toy companies like LeapFrog or Nintendo
- An energy company like PG&E
- An electronics company like Sony

Toy Designer

Toy designers develop and build new toys and games. They may be good at graphic design and computers to help design their invention, or mechanics to build a moving toy.

Toy designers are very creative and there is a large variety of special projects a toy designer can work on.

Toy designers make around $53,000 a year!

Projects you might work on:

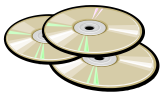
- Develop the idea for a new video game that appeals to girls
- Design an educational toy that helps kids learn to read
- Create a hands-on game for blind children
- Build a better controller for your video game system
- Design a mechanical animal kit children get to build themselves

Companies you might work for:

- Video game companies like Nintendo or Sony
- Classic toy companies like Mattel or Fisher-Price
- Children-themed companies like Disney

Software Engineer

Software Engineers write computer programs that are the instructions to the computer. Software engineers write code for everything from internet search engines to the settings on a digital camera or iPod.



Software engineers pay attention to details because one mistake means the computer could do the wrong thing.

Software engineers earn about $80,000 a year!

Projects you might work on:

- Develop a an interactive computer game
- Improve an internet search engine so it finds the right websites faster
- Create applications for a mobile phone
- Write a better word-processing program for people's home computers
- Develop new ways to connect to friends on social media websites

Companies you might work for:

- Internet sites like Google, Yahoo!, or Facebook
- Electronics companies like Sony or Cannon
- Computer companies like Microsoft or Apple

Mechanical Engineer

A Mechanical Engineer designs and tests all kinds of mechanical things. They build products with moving parts that help get a job done. Mechanical engineers work on everything from tools like can openers to complicated factory machines.

Mechanical engineers build models of projects they are working on to see what works the best. They experiment with lots of different ideas before they find one that works.

Mechanical Engineers earn about $60,000 a year!

Projects you might work on:

- Build a bike that is easy to pedal up hills
- Design a game with moving parts for blind children
- Create prosthetic hands that can type and write
- Design a space rover to collect data about Mars

Companies you might work for:

- Toy companies like Leapfrog
- Bike companies like Giant
- Aerospace companies like NASA or Boeing

Material Science Engineer

Material Science Engineers develop new and improved materials to use for different products. They might develop a plastic that is easier to recycle, or create synthetic materials that act like a bone to help accident victims heal.

Material Science Engineers also try to improve existing materials so products work better or are less expensive.

Material Science Engineers earn about $60,000 a year!

Projects you might work on:

- Invent a clothing that repels mosquitoes
- Create a type of plastic that is biodegradable
- Create a new coating for medicine to make it taste good
- Create a new magnetic material that helps computer chips run faster

Companies you might work for:

- Computer companies like Intel or HP
- Pharmaceutical (medicine) companies like Pfizer
- Chemical companies that make products like sun block or plastics
- Engineering companies that make environmentally friendly products like compostable containers

Activity – Kitchen Kapers

Grade Level:
Grades 5 - 12

Activity Time:
15 minutes

Preparation Time:
10 minutes

Grouping:
2 - 3 students per group

** Adapted from Gibbs, J. TRIBES: A New Way of Learning and Being Together, 2001, CenterSource Systems, LLC, p.290*

Introduction: In this activity students will work in teams to create a brand new kitchen utensil using a limited set of materials. They must make a commercial for their device and present it to the rest of the class.

Objective: As a result of this activity students will be able to:

- Work on with a team to design and build a prototype of a kitchen utensil.
- Explain what product designers and marketing specialist do.

Materials:
(per group)

1) Pencil/pen and paper (may be included in invention, or it may be used to draw blueprint of invention and/or for posters or logos for commercial.)
2) 2 paper clips
3) 4 toothpicks
4) 1 drinking straw
5) 2-inch strip of clear tape (wrap around straw)
6) Business-size envelope to put materials in

Directions:

Introduction:

1. Have students brainstorm their favorite product and why they love it so much.
    a. *Can you recall your favorite product? Why do you like it so much?*
2. Lead a discussion on how products are developed and the engineering design process.
    a. *Describe what you think the process is for making a product like an ipod or a purse?*
    b. *What types of people and careers are involved in making a product like an ipod or purse?*
3. Review definitions of a product designer and prototypes.
4. Explain to youth that today they will be product designers and will need to use their creative minds to create a prototype of a brand new kitchen utensil using a limited set of materials.

Activity – Kitchen Kapers

Activity:

5. Give each group one envelope with the materials inside.
6. Tell the students they have 7 minutes to build one kitchen utensil every household must have, that has not been invented yet. Encourage bizarre, unique, zany ideas.
7. All members must participate. They must use at least 6 items, and can use everything they have if they want.
8. Stop inventors at 7 minutes.
9. Tell them they now have 3 minutes to prepare a 30-second commercial to advertise the product. Come up with catchphrase(s), logos, posters, and music as needed.
10. Have the groups present their commercial to whole class

Debrief:

1. Follow up the activity with a discussion using the following questions:
    a. *What elements from other prototypes could be combined to improve your design?*
    b. *What would be the next steps you would take now that you have your prototype?*
    c. *How would you use apply what you just learned to develop a tool for tool that every single student in your district needs?*
2. Lead a discussion on the engineering design process and explain that the design challenge they just completed is an example of utilizing this process to develop a product.
3. Encourage students to try this activity at home with their family or to share what they learned in the activity.

Question Guide: Developing questions to support youths' critical thinking

Afterschool Science Learning Community

Introduction of the Activity

The purpose of asking questions when you introduce an activity to young people is to "set up" the activity by connecting it to something they've seen or done before. You can do this by asking questions that prompt them to remember information and/or make some real world connections.

Below are some sample questions that can be asked during the introduction of an activity.

- Can you recall...?
- What does this remind you of?
- What are other examples where this happens?
- What does this look like?
- How does this relate to _____?
- Have we ever solved a problem like this before?

To help youth make predictions:

- What things do you think will affect…?
- What do you think will happen when…?
- What would happen if…?
- Is there another way to think about this?

During Activity

Brainstorming

- What things do you think will affect how _____ works?
- What materials are you planning to use and why?
- What things do you think will affect how your device works?
- What does this activity remind you of?
- Are there are other ways to design this? Explain.

Building

- How does your design work? Why did you decide to build your design that way?
- Can you describe the different parts of _____ and their purpose?
- Can you identify the parts of...?
- Predict how you think your_____ is going to work.

Testing

- Which designs worked well and why?

- How do you think _____ affected _____?
- What elements from other _____ could be combined to improve your _____?

Re-design

- Which designs worked well and why?
- Describe the differences in your design and how they impacted how it worked.

Reflection

To help youth improve his/her design:

- How could you improve...?
- Which designs worked best and why?
- What elements from _____ could be combined to improve _____?
- What other materials would have been helpful in your design?
- Would it be better if...?
- What would you recommend...?

To help youth expand on concepts or ideas learned in the activity:

- How would you adapt your device for something that you would use in your life?
- What elements would you choose to change...?
- How would you apply what you learned to develop...?
- How would you solve _____ using what you have learned?
- What approach would you use to...?
- What way would you design...?
- How would you test...?
- Can you predict the outcome if...?
- Suppose you could _____, what would you do...?
- Can you propose an alternative...?
- Can you invent...?
- How did _____ happen?
- Why did...?
- Why do you think this happened?
- Based on what you know, how would you explain...?
- How does this relate to what real-world engineers do?
- Where do this scientific concept come up in your own lives?