TEACHER GUIDE

Dive In! An Integrated Design Thinking/STEM Curriculum Teacher Guide

The d.loft STEM Learning project

This curriculum is the collaboration of the Stanford University d.loft STEM Learning staff, Stanford University students in the Winter and Spring 2012 sections of the course, *Mentoring Young STEM Thinkers*, teachers and students from the East Palo Alto Phoenix Academy in East Palo Alto, CA, the Bayside S.T.E.M. Academy in San Mateo, CA, and the Stanford-Sunnyvale Summer School in Sunnyvale, CA.

d.Loft STEM Staff

Maureen Carroll, Research Director

Aaron Loh, Curriculum Writer and Teaching Assistant

Eng Seng Ng, Teaching Assistant

Molly Bullock, Research Assistant

Shelley Goldman, Professor and Principal Investigator, and Sherri Sheppard and Bernard Roth, Co-Principal Investigators

REDlab
Research in Education & Design

Stanford Student Contributors

Tara Adiseshan

Stephanie Bachas-Daunert

Samantha Brunhaver

Molly Bullock

Cecilia Corral

Megan Elmore

Ben Hedrick

Timothy Huang

Jessica Jin

Camille Jones

Kara Kamikawa

Ann Lesnefsky

Diana Lin

Landon Medlock

Gretchen O'Henley

Mindy Phung

Shauntel Poulson

Tianay Pulphus

Joyce Rice

Taryn Sanks

Holly Sewell

Payal Shah

Christine Smith

Stefanie Tanenhaus

William Wagstaff, Jr.

REDlab
Research in Education & Design

redlab.stanford.edu

Copyright

Introduction:

The *Dive In! An Integrated Design Thinking/STEM Curriculum Teacher Guide* provides an overview of the project goals, background information on design thinking, teaching tips, a curriculum calendar overview, descriptions of materials, lesson plans, and material lists and resources.

Project Overview:

President Obama has launched an "Educate to Innovate" campaign to improve the participation and performance of America's students in science, technology, engineering, and mathematics (STEM). This campaign will include efforts not only from the Federal Government but also from leading companies, foundations, non-profits, and science and engineering societies to work with young people across America to excel in science and math. Design Thinking - an innovative, human-centered approach to defining and solving complex problems- is the foundation upon which the STEP Summer Program is built. The program goal is to introduce students to the design thinking process through hands-on, interactive learning activities that foster deep content knowledge in STEM fields and those engaged in STEM careers.

Dive In! An Integrated Design Thinking/STEM Curriculum provides an integrated approach to building science, technology, engineering and

math knowledge and skills while engaging students in both identifying and solving problems in their communities and the larger world using a design thinking approach. The focus of this year's curriculum is water. In this four-week program, students will dive into a range of high-energy activities as they solve water-based challenges. They will be immersed in learning about the water conservation, drought, purification, recycling, patterns of use, products that have been designed for those in developing countries and other topical issues that impact global water usage. As they conduct interviews and do observations, they will develop empathy. Data synthesis provides the opportunity to uncover deep user needs and insights. Highly generative brainstorming techniques will give student tools to create innovative solutions. They will build prototypes, test them, and incorporate user feedback. Students will leave the program with the creative confidence to become active problem solvers in innovative, human-centered ways that will help them confront the challenges and possibilities that surround us in the 21st century.

Contents

REDlab
Research in Education & Design

INTRODUCTION: HOW TO USE THIS CURRICULUM

For first-time teachers or teachers who would prefer to dive straight in, the lessons in this curriculum are laid out in such a way that they form a cohesive curriculum when taught in the order they are presented – just keep turning the page.

For those who prefer to customize their lessons, or feel that the current order doesn't fit the needs of the class, feel free to mix it up and perhaps substitute some of the additional activities we've included. You know the needs of your users best!

We've also included three activities designed to expose students to the exciting possibilities of careers in STEM fields. Feel free to insert these lessons into the flow of your curriculum wherever you think it would be most useful.

Now let's talk a little about the design thinking process that is the central thread of this curriculum.

THE DESIGN THINKING PROCESS
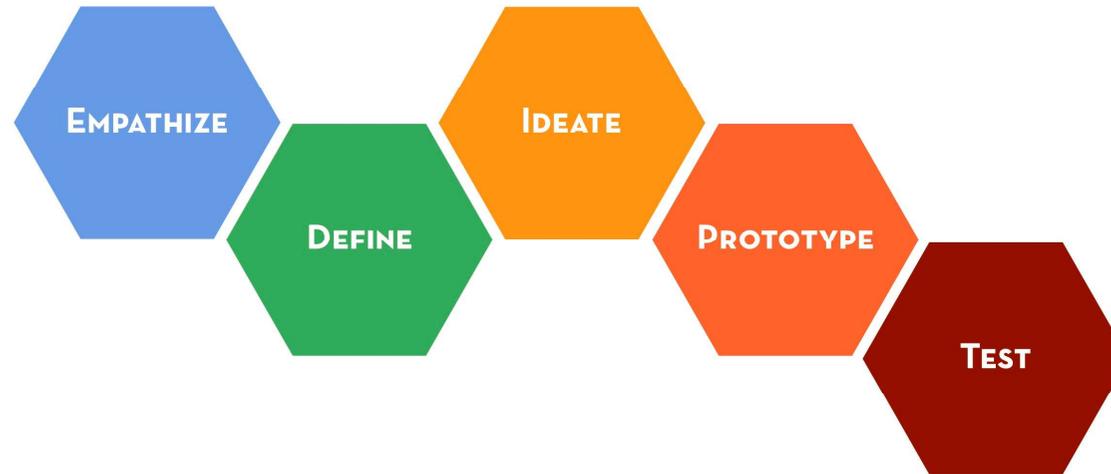
Dive In! An Integrated Design Thinking/STEM Curriculum is a pilot program that was developed by REDlab (Research in Education & Design),

a partnership between Stanford's Hasso Plattner Institute of Design and the Graduate School of Education. REDlab received a grant from the

National Science Foundation to study both the impact and the integration of design thinking in K-12 classrooms.

There are many different strategies that enhance learning. Design thinking is an orientation toward learning that encompasses active problem-solving and believing in one's ability to create impactful change. It engenders a sense of creative confidence that is both resilient and highly optimistic. David Kelley, founder of design consultancy IDEO and Stanford's Hasso Plattner Institute of Design, says, "My contribution is to teach as many people as I can to use both sides of their brain, so that for every problem, every decision in their lives, they consider creative as well as analytical solutions."[1],[2] This model, which has energized business innovation, is being applied to K-12 education with considerable impact[3]. With its central emphasis on human needs, it refocuses curriculum and assessment and forefronts solving real-world problems.

The partnership between STEP (Stanford Teacher Education Program) and REDlab is an opportunity to bridge the gap between theory and practice, and serves as a prototype for introducing design thinking and fostering STEM learning while supporting STEP's mission to prepare program graduates to meet both the practical and intellectual challenges of the teaching profession.

---

[1] http://www.fastcompany.com/magazine/132/a-designer-takes-on-his-biggest-challenge-ever.html
[2] http://www.publicschoolinsights.org/visionaries/DavidKelley
[3] Carroll, M., Goldman, S., Britos, L., Koh, J., & Royalty, A. (2010). Destination, Imagination & The Fires Within: Design Thinking in a Middle School Classroom. International Journal of Art & Design Education. Vol 29 Issue 1 (February 2010)

REDlab
Research in Education & Design

EMPATHIZE

Design thinking is a process of human-centered innovation. Rather than looking at what we, the designers, think is the most important thing, our focus is our user and his or her needs. This needfinding is different than directly asking "What do you want from a backpack?" or "What do you want from a cafeteria?" If you ask this you might get too-specific answers like "I wish the backpack had wider straps", or too general answers like "I wish the cafeteria had better food". It's up to us, the designers, to dig a little deeper, and understand what problems the users are really having. As interviewers, we need to uncover what our subjects really need, and look beyond their words, body language and search for meaning as we dig deeper.

Before we can understand the specific problem, we need to be able to put ourselves "into the shoes" of the users. If you're a seventh-grade student in the United States, with reliable access to clean water from any tap or drinking fountain, you might not understand the problem of an African villager who needs to walk five miles to the nearest drinking water supply. Before you can fix someone's problems, you have to understand the problems. Before you can understand the problems, you have to understand their situations.

Some of the empathy exercises in this curriculum are standalone, like the Memory Box exercise (p. 25) and "Water Without Faucets" (p. 28). These are designed to get the students in the mindset of looking at problems from their final user's perspectives rather than their own perspectives, to see the things that might be useful in their lives but not possible in the lives of their users and vice versa. Each of the longer design thinking segments also generally begins with an empathy exercise ("Water at Home" p. 45 and "Water at School" p. 79).

The crucial interviewing process is also broadly included in the empathy section of design thinking. The best way to understand someone is, whenever possible, to talk to them directly and try to gain empathy for the person you are interviewing and try to go beyond surface questions. We'll learn to do that in intro exercises as part of the two longer challenges ("Water at Home" p. 48, "Water at School" p. 83).

DEFINE

So let's say we now understand our future user and his or her life and problems. We've also chosen to focus on a specific part of their lives to improve, and we've interviewed them about that topic. The next big step in the design thinking process is to take that understanding and condense it into a "Point of View Statement" – a short sentence or paragraph that sums up what we've learned about them and about the problem we need to solve.

Our goal is to find the "non-obvious insights" – things that we wouldn't say "Oh, yeah, of course" from the time we first started the challenge. We want things that wouldn't have been clear to us before this empathy and interviewing portion. And we want to express them in a clear and concise statement so that we can easily remember it and refer back to it while we're doing the rest of the design.

Making a good Point of View Statement is tough, and there's no magic formula for learning it. The best way is to do a few rounds of interviewing followed by writing up statements, then checking them to see:

- Do the statements demonstrate empathy and understanding?

- Do they show non-obvious insights?

- Do they give us a direction for our later design work?

- Are they clear and concise?

The best way to learn P.O.V. statements is practice, and that's why we've included a couple of P.O.V. writing exercises as part of the bigger challenges on pages 57 and 86. (Unfortunately, it's hard to design a standalone P.O.V. statement exercise, because to write a good P.O.V. statement you need to have done some fairly time-consuming empathy and interviewing for that specific problem beforehand.) These exercises should give you and your students some practice and hands-on knowledge of what constitutes a good P.O.V. statement.

REDlab
Research in Education & Design

IDEATE

Now that we've gotten through the work of empathizing with the user, figuring out the problems they have, and writing a good, solid P.O.V. statement to sum up what they need from us, we can start the interesting task of coming up with ideas to solve those problems.

The design thinking brainstorming process is a bit more structured than the traditional brainstorm where everyone sits in a circle and comes up with ideas. There are a couple of rules and a procedure for making sure that ideas get recorded, and for stimulating the process where people's ideas can build on each other and get to a really innovative place.

The brainstorming exercises for the big challenges are found on p. 63 ("Water at Home") and p. 89 ("Water at School"). On p. 63, you'll also find a warm-up brainstorming exercise which can be done independently if you choose to do it that way, as well as a comprehensive overview of the rules and principles of the design thinking-style brainstorm.

After brainstorming, it's time to do a bit of narrowing down and refinement of ideas before we move into the building and prototyping stage. In the classical design thinking process, we don't spend very long on the narrowing-down process. We figure out the few ideas that we think are worth further pursuing, or that we need to pursue a bit before we decide if they're good or bad. We don't argue for a long time about which one to go and test, because that time could be used to do more tests.

The lessons which correspond to this part of the curriculum are on p. 66 ("Water at Home") and p. 92 ("Water at School").

REDlab
Research in Education & Design

PROTOTYPE & TEST

The final stage of the design thinking process is to create quick prototypes to make our ideas a bit more real. This is one of the main areas where design thinking differs from other engineering and design philosophies. In most other places, you plan for a long time, discuss the pros and cons of different ideas, and once you've decided on something, you build one very nice prototype to prove that it works. If it doesn't work, though, or if there's something you didn't think of, you're in trouble and you've wasted a lot of time.

Instead of using prototypes to prove that ideas work, design thinking uses prototypes to test and make sure they work. In that sense, prototypes that fail are just as useful as prototypes that succeed, because they all contribute to our understanding of how to make a good final product. We build by the saying "fail early and often" – by creating a lot of rough prototypes which are just barely good enough to get the essence of our idea across, we're able to get valuable feedback from our users which we can use the next time we try another prototype. Going through a few rounds of the prototyping and testing process will give us an incredibly detailed and useful picture of what our final product needs to be.

We've provided you with examples of standalone prototyping-themed activities on p. 22 ("Water Tower Challenge") and p. 35 ("Aluminum Foil Boats"). These activities are designed to get your students into the prototyping mindset of failing early and often. You'll find that the teams which dive straight in and start building towers or boats might fail at the beginning, but they'll have great products at the end after all the failures. The teams that spend too much time planning might make an interesting design, but if it doesn't work, they'll never have time to fix it.

After they've completed those challenges and gone through all the previous steps of the long design challenges, they'll be ready to do prototyping and testing for their long challenges. This is a fun and rewarding step of the process, the part where they make things real, and then get to hand them to the users who'll be able to give real feedback, and ultimately produce really great designs.

The prototyping exercises within the challenge "Water at Home" is located on p. 71. For "Water at School", simply follow exactly the same instructions, just with the new ideas. The prototyping process itself is exactly the same.

WARM-UP AND INTRODUCTION EXERCISES

A TASTE OF DESIGN THINKING: REDESIGNING THE MIDDLE SCHOOL CAFETERIA

Overview:
One of the most important mindsets of design thinking is a bias towards action. The purpose of this lesson is to provide students with an overview of all phases of the design thinking process. They will work in pairs, interview each other, generate ideas, and design innovative user-centered solutions.

Learning Objectives:

Students will:

- Engage in a design challenge
- Develop empathy
- Conduct an interview
- Synthesize information
- Brainstorm ideas
- Build prototypes
- Test prototypes
- Share information

Materials/Resources:

- Set up the PDF *A Taste of Design Thinking: I CAN'T EAT THAT! Redesigning the Middle School Cafeteria* so that students can view it. (Note: Each student will also have a copy of what he or she is viewing on the screen.) As you give students directions for each page, move through the presentation slides.
- Handout: *A Taste of Design Thinking: I CAN'T EAT THAT! Redesigning the Middle School Cafeteria Experience* (1 Per Student)

- Prototyping Materials: Creation Station Kit (1 per classroom)

Lesson Outline

Time	Activity	Description
5 min	Activity Set Up/ Introduction	- Show the first slide, and tell the class that they are going to learn the design thinking process which is a new way to identify and solve problems. - Give each student one copy of the handout *A Taste of Design Thinking: I CAN'T EAT THAT! Redesigning the Middle School Cafeteria.*
4 min	Creating the story	Tell the students to go to the first page of the handout and ask them to design the ideal plan for the middle school cafeteria experience. Ask them to sketch their ideas in the indicated space. After 4 minutes, ask them to turn to the next page. Tell the students that what they just did was problem solving, and what they are going to do next is try a design thinking approach.

11 min	Interviews	• Ask the students to find a partner. Tell them to turn to the next page. Explain that they are going to redesign the middle school cafeteria, not for themselves, but for their partner, and that they will begin by interviewing their partners.
		• Review the questions. Tell the students to begin with these questions first, and if they have time they can ask additional questions based on their partners' responses.
		• Tell the class that they should choose who will be the first interviewer and interviewee, and that you will prompt them to switch roles after 5 minutes.
		• Tell the students to write brief notes and/or sketches as they conduct their interviews, and record this in the box marked "Notes/Sketches."
		• After both interviews are complete, ask each student to think about what his or her partner said, and capture some thoughts in the box marked "Insights." Give the students 1 minute to capture insights.

REDlab
Research in Education & Design

8 min	Defining Needs	• Tell the students to turn to the next page in the handout. Explain that the goal of this part of the design thinking process is to build empathy for their partners' needs.
		• Have the students write the name of the person they interviewed in the box on the left hand side ofthe page. Ask the students to take 3 minutes to think about the interviews, and use the questions provided to help them reflect on what was important. Tell the students that they do not have to write answers to the questions, but use them as a thinking guide.
		• Tell the class that their next task is to write a "Needs Statement." Explain that a Needs Statement is a way to synthesize what they heard in their interviews, and that there are three main parts of a Needs Statement: user, need, and insight. Tell the students that the need must be a verb, and the insight is something that stood out to them as something that was important to their partners with respect to the cafeteria experience. Read the examples given aloud. (Note: This part of the process can be difficult. Encourage students to try to capture a need- it doesn't have to be complex.)
5 min	Ideation	• Ask the students to turn to the next page in the handout. Tell the class that they are going to brainstorm possible solutions to meet their partners' needs. Explain that when you brainstorm you don't judge any ideas and you try to think of as many ideas as you can to meet your partners' needs. Tell the students that they have 5 minutes and should come up with 25 or more ideas! Ask the students to write or sketch their ideas in the space provided.

REDlab
Research in Education & Design

18 min	Prototyping & Testing	● Tell the students to turn to the next page in the handout. Ask the students to choose one of their ideas that they are most excited about and explain that they are going to build prototypes for their partners. Show them the materials in the Creation Station, and tell them that will use these materials to build their prototypes. ● Tell the class that a prototype is not a model, but is a way to make an experience tangible. Explain that if they were going to build a new seating arrangement, instead of drawing a sketch, they might use the desks in the room. Remind them to think about creating something their partners can interact with. Give the students 8 minutes to build their prototypes. ● After 8 minutes, tell the students that they are going to test their prototypes on their partners for 5 minutes each, and that you will tell them when it is time to switch. Review the right side of the handout so that the students are aware of how to capture feedback from their partners. Tell the students to fill in the four boxes provided to capture feedback.
6 min	Reflection	● Tell the students to turn to the final page in the handout. Ask each student to answer the questions.

REDlab
Research in Education & Design

WATER TOWER CHALLENGE

Overview: The purpose of this lesson is to introduce students to collaborative design tasks. Students work in teams to conceptualize and build a "water tower", adhering to a list of design requirements. After completing the task, students reflect on their work processes.

Learning Objectives:

Students will:

- Experience working on a complex design challenge with several design requirements
- Engage in the design process under the constraints of resource availability and time
- Work in collaborative teams

 Materials/Resources:

   Per Team

- Playing cards (1 pack)
- Scissors (1 pair)
- Scotch tape (1 roll)
- Gummi Bears (2)
- Marshmallow (1)

   Per Class

- Water Tower Design Requirements" handout
- Hairdryer x1
- 14 inch strip of paper x1

Lesson Outline

Time	Activity	Description
5 min	Introduction to Gummi Bear Challenge	- Form students randomly into teams of 3. Your goal should be to encourage students to work with others that they do not know well. - Frame the challenge. Tell students that they are engineering firms that have been contracted by the Gummi Bear Valley Construction Company to design and build the community's first elevated water tower. - Distribute the "Water Tower Design Requirements" handout and review it with the class. - Inform students that they have 35 minutes to complete, conceptualize and build their tower.

REDlab
Research in Education & Design

10 min	Brainstorming	• Begin the first part of the brainstorming component by telling the students to come up with as many ideas as possible for the tower.
		
		• Share the brainstorming guidelines below with the class:
		    o Go for quantity
		    o Don't judge
		    o Encourage wild ideas
		    o Build on the ideas of others: "Yes, and…!"
		
		• In the last 5 minutes, instruct students to select one idea to pursue.

25 min	Building	• Check on the teams' progress, and encourage them to try out their ideas. • Let the students know when there are about 10-15 minutes left in the class period. • As time gets near the end of the class period, remind the teams to move to testing.
10 min	Testing	• Check each team's tower, ensuring that it meets the design requirements. • Test each team's tower with the hairdryer. • If a camera is available, take a photo of each team with their tower. • Distribute the remaining Gummi bears to teams for a snack.

REDlab
Research in Education & Design

10 min	Debriefing	• Facilitate a whole class discussion of the students' experience with the task. Use the questions below.
		
		  o Which of the design requirements did your team focus on? Why?
		  o If the tower "failed", describe the failure. What was the "root cause"?
		  o If the tower did not fail, what aspects of the tower was your team most concerned about during the process?
		  o How did each member of the team contribute to the process?
		  o If you were to do the task again, what would you do differently?

REDlab
Research in Education & Design

WATER TOWER DESIGN REQUIREMENTS

1**.** A height of *14 inches* (this may seem a bit short, but given that the average height of a Bear is 2 cm, this makes for a pretty tall building in Bear terms, and more than adequate water pressure!).

2. A *platform* on the top of the structure that will hold a marshmallow water tank and 2 Bears (in order for them to perform any necessary repairs).

3. Stability through a hairdryer *wind* at 14 inches from a westerly direction. Designs that exceed this requirement are acceptable too.

4. *Pleasing* to look at.

5. As light *weight* as possible, since the structure will be constructed off-site, then trucked into the Valley for final installation.

6. Construction *materials*: 1 standard deck of playing cards, 1 roll of tape, a pair of scissors.

7. The final structure *must contain* the roll of tape and the pair of scissors. The Bear Valley citizens are sensitive to responsible use of materials.

8. Completed construction in *35 minutes*. This may seem like a short period, but given that the life span on a Bear is only 2 days, there is no time to waste!

REDlab
Research in Education & Design

MEMORY BOXES

Overview:

This lesson introduces students to the concept of empathy, which is one of the fundamental underpinnings of the design thinking process. Using "memory boxes" filled with artifacts, photographs, memorabilia etc., students will craft a coherent, meaningful narrative story about an imaginary person as they assemble disparate pieces of information and put themselves into "someone else's shoes."

Learning Objectives:

Students will:

- Interpret and integrate facts and information into a coherent narrative
- Develop a sense of empathy for others' lives and stories
- Work in collaborative teams

Materials/Resources:

Per Team

- 1 "memory box" per group. Examples of what might be included the box include dried flowers, ribbons, medals, rings, programs,ticket stubs, trinkets, photographs, trophies, etc. You may choose any assortment of items that seem appropriate in reflecting things that a person would care enough about to collect. You can use a jewelry box, a plastic box, a shoe box, or any kind of box that might house a treasured collection. Include 5-10 items per box.
- Large sheets of 9 x 12 construction paper
- 1 pack of Post-its

REDlab
Research in Education & Design

Per Person
- Printer paper (One sheet per person)
- Markers or pens (One per person)

Lesson Outline

Time	Activity	Description

5 min	Teacher introduction	• Divide the students to groups of 4-6.
		• Give each group a Memory Box, two large sheets of construction paper, and markers.
		• Tell the students that they are going to explore the contents the artifacts in the box and use their imaginations to collectively create a story about a person's life.
		• Provide the students with the following instructions:
		    o -Use all the items in the box.
		    o -There is no one "correct" story.
		    o -Use printer paper to take notes.
		    o -Use the construction paper to write or draw scenes from the person's story.
		    o -Be prepared to share out.

REDlab
Research in Education & Design

15 min	Creating the story	• As the students are exploring the Memory Box, monitor the small group interactions to ensure that all students have the opportunity to contribute to the story. • Remind the students to record their ideas on printer paper. • Tell each group to write its final story on the large piece of construction paper.
25 min	Sharing the story	• Have the students post their stories on a wall. Tell them that they will participate in a "Gallery Walk" in order to view their classmates' stories. Encourage the students to actively listen to each group's story. • Appoint 2-3 storytellers from each group who will take turns narrating their story. • Instruct the storyteller to use artifacts to illustrate each significant moment of the story. o *Note: This substantiation of significant points with artifacts is important to ensure that their story is grounded in the "data" provided by the artifacts.*

10 min	Reflection	• Ask students to reflect on the activity. Use the questions below as prompts.
		
		    o What did they like about the activity?
		
		    o What parts of the activity were challenging?
		
		    o Did they worry about getting the story "right"?
		
		    o What did they like about another group's story that they would have liked to include in their own story?
		
		• Ask students to write their thoughts down on Post-its, and to place the Post-its in their Journals.

WATER WITHOUT FAUCETS

 Overview:

This lesson helps students compare their experience of water use with the experience of people in developing countries without access to piped water. Students will participate in a team activity highlighting the difficulty of collecting and transporting water without the benefit of faucets.

Learning Objectives

Students will:

- Learn about issues and challenges relating to access to water in developing countries
- Develop empathy for people who live in developing countries without easy access to water
- Develop an understanding of the difficulty of transporting water over long distances
- Make connections between access to water and water usage

Materials/Resources:

Per Team (6 students)

- Two large water containers
- Two large water buckets
- Six small bowls
- Stopwatch or Virtual Stopwatch www.timeme.com/stopwatch.htm

Instructional Resources

- Google Maps https://maps.google.com/ or Google Earth Download at http://www.google.com/earth/index.html
- YouTube videos (Pre-load)

  Women in Ethiopia fetching from well and carrying (1:00) http://www.youtube.com/watch?v=iqwuPJr3YCE&feature=relmfu

  Girls in Uganda fetching water (0:52) http://www.youtube.com/watch?v=-UR4XKOnRr0&feature=related

  Fetching water from pump and carry (3:21) http://www.youtube.com/watch?v=hdc7AxdJHfo&feature=related

  Girls carrying water on head in Honduras (0:22) http://www.youtube.com/watch?v=8JQdaHhDTYs&feature=related

  Walking for water http://www.youtube.com/watch?v=gVMbrbPuCw4&feature=relmfu

Lesson Outline

Time	Activity	Description
3 min	Activating Prior Knowledge	Write the question "Where does water come from?" in a circle. Ask students to brainstorm responses and record their answers around the circle.

| 7 min | Building Background Knowledge | • Tell the class that they are going to view videos about how people access water in developing countries. Use Google Maps (https://maps.google.com/) or Google Earth to view the location of Ethiopia, Uganda, Haiti and Honduras.

• View the following videos:

   a. Women in Ethiopia fetching from well and carrying (1:00) http://www.youtube.com/watch?v=iqwuPJr3YCE&feature=relmfu

   b. Girls in Uganda fetching water (0:52) http://www.youtube.com/watch?v=-UR4XKOnRr0&feature=related

   c. Fetching water from pump and carry (3:21) http://www.youtube.com/watch?v=hdc7AxdJHfo&feature=related

   d. Girls carrying water on head in Honduras (0:22) http://www.youtube.com/watch?v=8JQdaHhDTYs&feature=related

   e. Walking for water http://www.youtube.com/watch?v=gVMbrbPuCw4&feature=relmfu

• After the students have finished viewing the videos, ask them to draw a quick sketch of what they learned. |

10 min	Discussion	• Facilitate a whole class discussion. Use the following questions as prompts:
		
		  a. What was the most surprising thing you learned?
		
		  b. What are the differences between the experiences of the people using water in the videos and your own experiences?
		
		  c. How many steps do the people in the video have to take to get access to water?
		
		  d. Describe your impression of the following issues from the videos:
		
		    i. Water quality
		
		    ii. Effect of water access on quality of life
		
		    iii. Dependability of access to water
		
		  e. Put yourself in the "shoes" of one of the people featured in the video and write two sentences describing what you think the biggest challenges to accessing water is.

REDlab
Research in Education & Design

5 min	Set Up Instructions	- Set up an outdoor space. Place a large water container 25 yards away from your starting point. - Divide the students into groups of six. Split each group into 2 subteams of 3 students each. - Ask one subteam to use the faucet to fill one of the large buckets. - Ask one subteam to use small bowls to transport water from the container to fill one of the large buckets. - Explain to the teams that the objective of the game is to fill up the large water containers, and that the group that fills their container the fastest gets a prize.
20 min	Fill the Bucket Activity	- Run the activity and record the time for each team. - Once one team successfully fills up their bucket, have the groups swap roles.
10 min	Closing discussion	- Facilitate a reflection on the activity. Use the following questions as prompts: - Which was faster, using the faucet or carrying water? Which was harder? - If you had to carry water everyday, would you use more or less water? Why? - Do you think there are more people in the world using faucets or carrying water?
5 min	Journal Reflection	Have the students to revisit their responses to the prompt: *Put yourself in the "shoes" of one of the people featured in the video.* Ask them write two sentences describing any changes in their thoughts on water access after participating in the lesson activities.

REDlab
Research in Education & Design

ALUMINUM FOIL BOATS

Overview:

This lesson serves as a prototyping experiment. It also teaches students about density and surface area as it pertains to water. Students will build boats that need to hold as much payload(coins) as possible before sinking. They can rapidly build as many boats as possible to hold more and more weight

Learning Objectives:

Students will:

- Learn about the concept of buoyancy and why things float.

- Learn about surface area and how to distribute weight

- Learn that problem solving and design are iterative processes where solutions can constantly be refined,

 Materials/Resources:

Per Group

- One large plastic tub filled w/water (at least 1ftx1ftx6in)

REDlab
Research in Education & Design

- Coins, or other items that can be used as weights (at least 2lbs)

- Aluminum Foil (approx. 12inch x 12inch)

- Paper Cups

- Saran Wrap

- Paper Clips

- Scissors

- Scratch paper

Lesson Outline

Time	Activity	Description
5 min	Introduction to Boat-building activity	- Assign students to groups of 2-3. - Give each group a sheet of aluminum foil. Explain to them that they need to construct a boat that will float and then hold as much weight as possible before sinking. - Each group can place the weight on the boat as they please.
15 min	Design and build	- Allow the students to build one boat and place it in the plastic tub. - Instruct students to test the boat by adding coins / weights - Instruct students to record the number of weights that prototype 1 could carry before sinking.

REDlab
Research in Education & Design

10 min	Discussion and instruction	• Ask students to share out what made their boat sink or float • Explain the concept of buoyancy to the students. • You may wish to use the diagram appended at the end of this lesson.
15 min	Design and Build (Round 2)	• Have the students continually build and test their boats and generate feedback. • If the students seem to maximize the weight on aluminum foil boats, require them to use the additional items (e.g. cups and saran wrap) to make building more challenging. • With these new materials build, test, and generate feedback.
5 min	Closing	• Ask students to write down at least one observation or insight they had during the boat-building process.

REDlab
Research in Education & Design

BUOYANCY

Buoyancy is the force that water exerts on a object. Gravity times the mass of the object is a

downward force and buoyancy pushes upward. As long as the object is not more dense than the

water then it will float. The diagram on the side should illustrate this effect clearly.
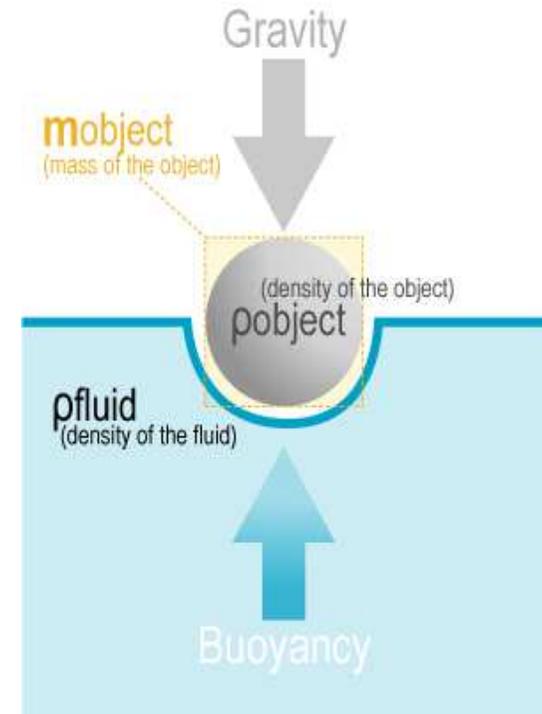
WATER TASTE TEST

Overview:

This lesson serves to raise issues pertaining to the consumption of water. Students will run a blind taste test to determine the difference in taste between different varieties of bottled water and tap water.

In a separate exercise, students will also complete a "Draw an Engineer" worksheet, which will ask them to share their familiarity and perspectives on engineering.

Learning Objectives:

Students will:

- Learn about how taste and consumer impressions of different kinds of water impact desirability

Materials/Resources:

- 2 different types of cold bottled water

- Cold tap water

- 3 paper cups per participant

- 1 sharpie per 2 students

- 1 blindfold per participant

Lesson Outline

Time	Activity	Description
10 min	Introduction to Water Taste Activity	- Organize students into pairs. - Inform students that they will be carrying out a water taste test with 3 varieties of water: tap, "brandless" bottled water, and "branded" bottled water. - Inform students that they will take turns to be testers and tasters. - Instruct students to decide who will go first. - Distribute paper cups such that every student has 3 cups. Instruct students to use the Sharpie to label the cups A, B and C.

REDlab
Research in Education & Design

20 min	Water Taste Activity	• Instruct tasters to put on their blindfolds.
		• Instruct testers to come to teacher's station to collect water
		• Students should fill each of the three cups with one type of water.
		• Students should record on scratch paper which cup holds which kind of water.
		• Instruct testers to hand tasters one cup at a time, in random order, recording their guess as to which kind of water is in the cup.
		• They should ask tasters which cup of water they liked the most.
		• They should also record any comments tasters had about the taste of each cup (e.g. "tasted metallic").
		• At the 10 minute mark, prompt groups to switch roles if they haven't already done so.
10 min	Closing discussion	• Facilitate a discussion on the Water Taste Activity Ask, using the following questions:
		• Were the blindfolded students able to correctly guess all the different varieties of water? If not, why not? If so, how did they achieve this?
		○ Which variety of water was the favorite for a majority of the students? Was there any correlation between this favorite water, and the cost of the water?
		• Why do people buy bottled water, when tap water is safe to drink?
		• Is the taste of water an important factor in how much water students drink?

REDlab
Research in Education & Design

FIRST DESIGN CHALLENGE: REDESIGNING WATER CONSERVATION AT HOME

PART 1: INTRODUCTION

Overview:

This lesson is the introduction to the first extended design challenge: *Redesigning Water Conservation at Home*. Students will learn about the steps of design thinking process, and background information about water.

Learning Objectives:

Students will:

- Learn the design thinking process
- View videos
- Write notes/draw sketches to summarize information

Materials/Resources:

- Set up the PPT/PDF/KEYNOTE *REDLab Curriculum Water Conservation Challenge* so that students can view it.

Per Person
- Printer paper (Two sheets per person)

- Markers or pens (One per person)

Lesson Outline

Time	Activity	Description
5 min	Introduction to the Design Thinking Process	- Tell the students that they will be participating in a second design challenge and that it will be an extended version of what they learned in the *Redesigning the Middle School Cafeteria Challenge*. - Ask each student to think about how he or she usually solves problems. Invite students to share their problems solving processes with the entire class. - Show the class slides 1-8. You can read them aloud, ask the students to read them silently, or ask the students to read them aloud or any combination of these options.
12 min	Building Background on Design Thinking	- Show the class slide 9, which contains a short video of students using design thinking in their school. - Ask the students what they thought about the video. Have them compare the way they usually solve problems to the way these students solved a problem.
10 min	Introduction to the Challenge	- Show the class slides 10-14, which introduces the challenge *Redesigning Water Conservation at Home*. - Show the class slide 15 and tell them tha you are going to begin the challenge by focusing on empathy, which is the first step in the design thinking process.

20 min	Building Background on Water Issues	- Show the class slide 16 and slide 17. Provide each student with two sheets of paper. Tell the class that they are going to be watching a series of short video clips on water. - Ask the students to take brief notes and make sketches about their reactions and responses as they view the videos. Show the class the videos that are featured on slides 18, 19 and 20. - Pause for 2 minutes after each video to give students time to reflect on each video and capture their thoughts. Video 1 is 2:31, Video 2 is 4:35, Video 3 is 3:18.
2 min	Review of Design Thinking Process	Show the students slide 21 and 22. Ask them to define what design thinking is. Show them slide 23 as a summary that highlights what they have learned. Tell the class that they will continue the challenge as they participate in an activity to learn more about water in the second part of the class.

PART 2: EMPATHY

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at Home.* Students will learn about the empathy phase of design thinking process.

Learning Objectives:

Students will:

- Learn the design thinking process
- View videos
- Write notes/draw sketches to summarize information

Materials/Resources:

- Set up the PPT/PDF/KEYNOTE *REDLab Curriculum Water Conservation Challenge* so that students can view it.
  (*Note: Begin at slide 24, and end at slide 54.)*

Lesson Outline

Time	Activity	Description
3 min	The Design Thinking Process: Empathy	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at Home*. • Show the class slide 24 and tell them that they will be focusing on the "Empathy" phase of the design thinking process.
5 min	Design Thinking Definition Review	• Review the information on slides 25-28 to reinforce the definition of design thinking.
8 min	Defining Empathy	• Show the class slides 29-32. This information is provided to introduce the students to the importance of empathy in the design thinking process. • Show the class slide 33. Ask the students if they remember what empathy means from their Empathy Memory Box activity. • Show the class slides 34-41. You can read them aloud, ask the students to read them silently, or ask the students to read them aloud. You can also choose any combination of these options. As you move through these slides, ask your students if they have any questions or need clarification of the ideas that are presented. • Show the students slide 42 and ask them how they think people might develop empathy. • Show the students slide 43 and tell them that design thinkers have a toolbox that contains ways to develop empathy for their users.
8 min	Observation	• Show the students slides 44-45 and emphasize the importance of observing with fresh eyes, particularly when you are observing a place you are familiar with, such as school. • Slide 46 contains a brief (1:55) video that challenges students' observation skills. After viewing the video, ask students to discuss their reactions to it.

REDlab
Research in Education & Design

15 min	Observation Picture Skills	• Show the students slide 47 and tell them that they are going to use their observation skills to describe what they see in slides 48-51. Spend 2-3 minutes observing each picture. Encourage the students to go beyond their initial observations, and continue to try to come up with more fine grained and nuanced observations. For example, you might ask them to imagine stories about the people in the pictures and use the details in the pictures to support their ideas.
5 min	Review of Observation	• Show the students slide 52 and ask them to summarize what they have learned about observation.
3 min	Revisiting Design Thinking Definition	• Ask the students to describe design thinking in their own words. Show the students slide 53. As a class read the definition of design thinking aloud. Clarify any questions the students might have about what they have learned about the design thinking process. • Tell the class that they will continue the challenge as they participate in an activity to learn more about water in the second part of the class. End by viewing slide 54.

REDlab
Research in Education & Design

PART 3: ROLEPLAYING AND INTRO TO INTERVIEWING

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at Home*. Students will learn about the empathy phase of design thinking process. Students will engage in role plays, critique interviews, and participate in a Gallery Walk.

Learning Objectives:

Students will:

- Learn the empathy design thinking process
- Review information on interviewing
- Generate good and bad interviewing techniques
- Engage in role playing
- Write critiques
- Participate in small group and whole class discussion
- Participate in a Gallery Walk
- Evaluate information on interviewing techniques

Materials/Resources:

- Set up the PPT/PDF/KEYNOTE *REDLab Curriculum Water Conservation Challenge* so that students can view it. (*Note: Begin at slide 55, and end at slide 67.*)

  Per Person

- Printer paper (3 sheets per person)

48

- Markers or pens (One per person)

Per Team (Each team has 4-6 students)

- One large piece of chart or butcher paper

Lesson Outline

Time	Activity	Description
3 min	The Design Thinking Process: Empathy	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at Home*. • Show the class slide 55 and tell them that they will be focusing on the "Empathy" phase of the design thinking process. Show the class slide 56, and tell them that you are going to show them how to become a great interviewer.
4 min	Review of Good & Bad Interviewing Techniques	• Show the students slide 57, and ask them to recall the interviewing lesson they did. Ask the students to state 4 or 5 principles that characterize a good interview and 4 or 5 principles that characterize a bad interview.

REDlab
Research in Education & Design

24 min	Practicing Good & Bad Interviewing Techniques	• Show the class slide 58. Ask the students if they are familiar with role playing. If they are not, tell them that a role play is an imaginary improvised skit where people take on roles and act out a scenario. Remind the students that there is no right or wrong way to do a role play. • Each role play scenario and reflection should take approximately 8 minutes: 5 minutes for the role play and 3 minutes to reflect and share. • Show the students slide 59, and tell them to copy the chart on a piece of paper. As they watch the role play, have them complete the chart. • Show the students slide 60, which has the first role playing scenario. You may wish to participate in the first scenario to model for your class. Show the students slide 61 which is a copy of the chart. • After scenario 1 is complete, ask the students to share what they captured in the "What Went Well" and "What Could Be Improved" charts. • Show the students slide 62 which features the second scenario for role playing. Show the students slide 63 which is a copy of the chart. After scenario 2 is complete, ask the students to share what they captured in the "What Went Well" and "What Could Be Improved" charts. • Show the students slide 64. Ask the students to generate a new scenario of their own and conduct a role play. Show the students slide 65 which is a copy of the chart. After scenario 3 is complete, ask the students to share what they captured in the "What Went Well" and "What Could Be Improved" charts.
10 min	Evaluating Ideas	• Divide the class into groups of 4-6 students. Give each group a large piece of chart or butcher paper. Show the students slide 65, and ask the students to create a list entitled "How to Be a Great Interviewer." When they are finished, post each group's work on the wall. Have the students participate in a "Gallery Walk" around the room and read each other's lists. Tell the class they have 3 stars to give out. Have them draw a star next to their three favorite ideas for how to be a great interviewer. After the Gallery Walk is complete, find the best three ideas and share them with the entire class.

CUTTLEFISH RESEARCHERS

Overview:
This lesson highlights STEM Careers. Students will watch a documentary video, *Kings of Camouflage* that features researchers who attempt to measure the intelligence of cuttlefish. They will participate in a guided discussion of the excerpt in the context of a STEM career, focusing on the importance of the research work and the scientific method behind it.

Learning Objectives:

Students will:

- Learn about STEM careers
- Learn about the how researchers create and conduct experiments
- Learn about the principles of animal research
- Participate in a whole class discussion
- Draw a response to the video

Materials/Resources:

- Projector
- Computer

Lesson Outline

Time	Activity	Description
23 min	Video Viewing	• Go to http://video.pbs.org/video/1150618835/ and skip to part 3 (at 17:25). Watch until the end of part 4 (at 35:27).

22 min	Follow-up Discussion and Response	• Engage the students in a discussion. Use the following prompts to begin:
		
		• Why is the work important?
		
		    o How do the scientists make sure their results are valid?
		
		    o What sort of intelligence are they testing?
		
		    o Are there other components to intelligence that they could test?
		
		• Focus on helping the students gain an understanding of control groups, repeatability, and controlling for external factors.
		
		• Ask the students to draw a sketch of what they have learned from the video in their Journals.

PART 4: INTERVIEWS AND EMPATHY MAP

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at School*. Students will learn about the empathy phase of design thinking process. They will interview users and construct an Empathy Map.

Learning Objectives:

Students will:

- Learn the empathy phase of the design thinking process
- Conduct interviews
- Analyze and synthesize interview data
- Create an Empathy Map

Materials/Resources:

- Set up the *Water Conservation Challenge* so that students can view it.

  (*Note: Begin at slide 68, and end at slide 74).*

- Review Empathy Map in the Teacher Guide prior to beginning the lesson.

  Per Team (Each team has 4-6 students)

- Printer paper (3 sheets per note taker)

- Markers or pens (One per person)

- One large piece of chart or butcher paper

  Note: You may choose to create a blank Empathy Map with the four quadrants "Say, Do, Think and Feel" or have

  each team construct its own at the appropriate point in the lesson.

Lesson Outline

Time	Activity	Description
2 min	The Design Thinking Process: Empathy	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at Home.* • Show the class slide 69 and remind them that it is important, as a design thinker, to dive into the process with a positive attitude even when they are not sure of the outcome.
10 min	Interviewing Roles	• Divide the class into teams of 4-6 students. Tell the students that each team will conduct interviews. The interview subjects should be the teachers and student teachers. If you do not have one interviewee per group, you can have two groups interview one interviewee. If you do this, make sure that each team's main interviewers have an opportunity to ask questions. • Show the students slide 70, and review the instructions for the roles each team member will have during the interview. Clarify the meaning of "building rapport" for the class. For example, it is important to introduce yourself, look the interviewee in the eye, and be very interested in what the interviewee has to say. Give the teams 5 minutes to decide on the roles each member will take.

3 min	Interviewing Questions/Prompts	• Show the class slide 71, which has a list of interview questions. Tell the students that they should begin their interviews with these questions. After they ask these questions, they can build on what they have heard and ask additional questions. Show the class slide 72 and review the tips for interviewing.
15 min	Conducting Interviews	• Have each team conduct its interview for 15 minutes.

REDlab
Research in Education & Design

25 min	Creating Empathy Maps	- Show the students slide 73. Tell the class that they are going to learn how to create an Empathy Map, and that this is a way for them to synthesize their interview data. Tell them that synthesizing data is an important part of being a design thinker. - Show the students slide 74, which features an Empathy Map. There are four quadrants: "Say, Do, Think, and Feel." - It is important to model how to create an Empathy Map for your students. Draw an Empathy Map on a large piece of chart paper. First, conduct a 5 minute interview of a student teacher or a student. This interview will provide you with data to model how to construct an Empathy Map. Example topics include pets, favorite vacations, or college experiences. - After the interview is complete, model how to construct an Empathy Map based on this interview. Begin by asking the students what the interviewee "said" during the interview, and write this information in the "Say" quadrant of the Empathy Map. Ask the students what the interviewee "Did," which includes things such as body language, looking away, tapping his or her feet. - Tell the class that the "Think" and "Feel" portion of the Empathy Map is their chance to make some inferences about what their interviewee thinks and feels based on what he or she said and did. Remind the student that there is no wrong answer. For example, an interviewee might have said that she goes home at lunch to walk her dog. One might infer that she "thinks" her pets are important, or that she "feels" a strong sense of love for her dog. Record the students' responses in the "Think" and "Feel" quadrants of the Empathy Map. - Give each team a large piece of chart paper and ask them to draw the four quadrants of the Empathy Map. (You may also wish to do this in advance for them.) Tell the students to complete an Empathy Map based on their interviews. Visit each team to clarify any questions the students might have.

PART 5: THE POINT-OF-VIEW STATEMENT

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at Home.* Students will learn about the define phase of design thinking process. Students will create Point of View statements based on the needs they uncovered during their user interviews.

Learning Objectives:

Students will:

- Learn the define phase of the design thinking process
- Create Point of View statements based on user needs

Materials/Resources:

- Set up the *Water Conservation Challenge* so that students can view it.

    (*Note: Begin at slide 75, and end at slide 80.*)

- Review Define and the Point of View Madlib in the Teacher Guide prior to beginning the lesson.

- Preview the video clip of First Time Teaching (Neema) at http://www.youtube.com/watch?v=ewlHN9SGuv0

    Begin at 0:47 and stop at 1:18. You will use this clip to model the construction of a Point of View Statement.

- Preview the video clip of Teachers First Day (Shanda) at http://www.youtube.com/watch?v=kcfD0GDKYiA&feature=related. Begin at

REDlab
Research in Education & Design

0:21 and stop at 1:22. You will use this clip to model the construction of a Point of View Statement.

Per Team (Each team has 4-6 students.)

- Markers or pens (One per person)

- One large piece of chart or butcher paper

Note: You may choose to create a blank Point of View Statement for each team or have each team construct its

own at the appropriate point in the lesson.

Lesson Outline

Time	Activity	Description
2 min	The Design Thinking Process: Define	- Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at Home*. - Show the class slide 75 and tell them students that they are going to begin the "define" phase of the design thinking process.
10 min	Understanding a POV Statement	- Show the students slide 76 and tell them that the next thing they are going to do using their interview data is to construct a Point of View Statement. Explain that a Point of View Statement is a way to synthesize their interview data, and that they will use this statement to help solve the design challenge for their users. - Show the students slide 77, which highlights the structure of a Point of View Statement. Tell the students that Point of View Statement has three parts: a user description, a need, and a surprising insight, and that they will get the information to create a Point of View Statement from their interviews of their users.

3 min	Modeling How to Create a Point of View Statements	- Tell the students that they are going to view a video clip of Neema, http://www.youtube.com/watch?v=ewlHN9SGuv0, a new first year teacher as he talks about how he feels before he begins teaching. Show the class slide 78- click on the video and begin at 0:47 and stop at 1:18. - As a class, construct two or three different needs statements for Neema. For example, you might write the following Point of View Statements: - Neema, a nervous first year teacher, needs a way to feel less nervous, because he wants to do a good job as a new teacher. - Neema needs a way to remember his lessons, because he gets confused when everyone is staring at him. - Tell the students that they are going to view a video clip of Shanda, http://www.youtube.com/watch?v=ewlHN9SGuv0, a new first year teacher as he talks about how she feels before she begins teaching. Show the class slide 79- click on the video and begin at 0:21 and stop at 1:22. - Shanda, a new teacher, needs a way to make her students enjoy learning because she wants them to have as much fun as she did when she was a student. - Shanda needs a way to feel prepared for her first day of teaching because she is nervous about having her first class of students.

15 min	Creating Point of View Statements	- Have the students work in their challenge teams and tell them that they are going to create Point of View Statements for their users. Give each group a blank piece of chart paper and have them fill in the three parts of a Point of View Statement from slide 77. - Give the students 15 minutes and tell them to create 2-3 Point of View Statements. As the students work, go to each group and clarify any questions the students might have.
15 min	Sharing & Critiquing Point of View Statements	- Have each group share its Point of View Statements with the entire class. Discuss the statements using the following questions: - Could we think of many solutions to meet the need that is described in the Point of View Statement? - Is there a clear description of the user, the need and the insight?
5 min	Debrief	- Ask the students if they have any questions about the design thinking process. - Show the class slide 80, and reiterate the definition of a design thinker.

PRINTING A HUMAN KIDNEY

Overview:
This lesson highlights STEM Careers. Students will watch a TED Talk that features Anthony Atala, a researcher and surgeon who is inventing procedures to manufacture artificial organs. They will participate in a guided discussion and create a 60 second commercial based on what they learned.

Learning Objectives:

Students will:

- Learn about STEM careers
- Learn about the work of medical researchers
- Participate in a whole class discussion
- Create a 60-second commercial highlighting what they have learned

Materials/Resources:

- Projector
- Computer

Per Student

- Two sheets of writing paper
- Markers or pens

Lesson Outline

Time	Activity	Description
20 min	Watch video	• Ask the students if they have any questions about the design thinking process. • Show the class the TED Talk at http://www.ted.com/talks/anthony_atala_printing_a_human_kidney.html.
10 min	Post-watching discussion	• Engage the students in a discussion about the video. Use the following questions as prompts. o What did you think of his talk? o What did you learn? o What surprised you? o Why do you think he chose to begin his talk the way he did? o What problem was he trying to solve? o How did he go about solving the problem? o Do you think the work he is doing is important? Why or why not?
15 min	Creating a 60-second commercial	• Divide the class into teams of four students. Ask the students to write a script for a 60-second commercial based on some aspect of the TED Talk. The purpose of this activity is not for them to produce a polished finished product, but for them to engage in the process of summarizing information and quickly communicating ideas. This is an important part of developing two key design thinking mindsets: a bias towards action and developing a prototyping mindset. • Ask for volunteers to share the commercials with the entire class.

PART 6: IDEATION - BRAINSTORMING

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at Home*. Students will learn about the ideate phase of design thinking process. They will learn the rules of brainstorming, brainstorming techniques, and participate in a brainstorming session.

Learning Objectives:

Students will:

- Learn the ideate phase of the design thinking process
- Learn the rules of brainstorming
- Learn brainstorming techniques
- Participate in a brainstorming session

Materials/Resources:

- Set up the PPT/PDF/KEYNOTE *REDLab Curriculum Water Conservation Challenge* so that students can view it.
  (*Note: Begin at slide 81, and end at slide 91.*)
- Review Ideate Mode, Brainstorm Rules, and How to Facilitate a Brainstorm in the Teacher Guide prior to beginning the lesson.

Per Team/Person (Each team has 4-6 students)

- 1 Sharpie marker per person
- A Copy of the team Point of View Statement
- One large piece of chart or butcher paper for writing "How Might We Questions"
- One pack of Post-it notes per person in team spaces

Lesson Outline

Time	Activity	Description
2 min	The Design Thinking Process: Ideate	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at Home*. • Show the class slide 81 and tell them students that they are going to begin the "ideate" phase of the design thinking process. Explain that ideation is a way for them to generate many possible potential solutions to meet the needs of their users.
5 min	Brainstorming Mindsets	• Show the students slide 82 and explain to the class that brainstorming is built upon mindsets, and that mindsets are a "road map" for how things are done. • Show the students slides 83-89, which feature the fundamental mindsets that underlie the ideation process in design thinking. Clarify any questions students might have as they view each slide.

REDlab
Research in Education & Design

15 min	Creating "How Might We?" Brainstorming Prompts	• Have the students place their Point of View Statements on a wall where everyone on the team can see them. Tell the students that they will be brainstorming solutions to meet their users' needs as they are expressed in the Point of View Statements. • Model how to generate a "How MIght We?" question for the class. A "How Might We?" is a way to get from a Point of View Statement to a brainstorming prompt. • Use the examples on slide 90 to show students how to do this. Below each Point of View Statement is a "How Might We?"question. • Review each group's Point of View Statement, and, as a class, come up with a question in the form of "How Might We?" to use as a brainstorming prompt. Have each group write its "How Might We?" prompt on a piece of paper and place it in the team space where everyone can see it.
5 min	Brainstorming Rules & Modeling	• Show the students slide 91, which contains a list describing "How to Brainstorm." • Read each rule aloud. • Demonstrate, with 2 or 3 people, how to conduct a brainstorm. Use one the following topics for your brainstorm: "Where to Go on a Summer Vacation", "Desserts", "Amusement Park Rides", "Ways to Use a Pipe Cleaner", "Ways to Use Paper Clips" or "Crazy Pet Names."
15 min	Brainstorming	• Tell the students that they are going to brainstorm solutions based on their "How Might We?" questions. Remind them that they are coming up with as many ideas as they can for user-centered solutions. Tell the students to come up with a minimum of 35 ideas and to set a goal of generating more than 50 ideas. • Give the class 15 minutes to brainstorm. Play upbeat music during the brainstorming session to keep the energy level high.
3 min	Debrief	• Ask the students to share their brainstorming experiences with the entire group by responding to the phrase "I like_____" or "I wish _____."

REDlab
Research in Education & Design

PART 7: IDEATION - ORGANIZING IDEAS

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at Home.* Students will learn about the ideate phase of design thinking process. They will cluster the ideas they have generated in themes and learn how to make decisions on which ideas to move forward to prototype.

Learning Objectives:

Students will:

- Learn the ideate phase of the design thinking process
- Learn how to cluster ideas thematically
- Learn how to select ideas to prototype

Materials/Resources:

- Set up the PPT/PDF/KEYNOTE *REDLab Curriculum Water Conservation Challenge* so that students can view it.
  (*Note: Begin at slide 92, and end at slide 95.*)
- Review Ideate Mode, Brainstorm Rules, and How to Facilitate a Brainstorm in the Teacher Guide prior to beginning the lesson.

Per Team/Person (Each team has 4-6 students)

- 1 Sharpie marker per person

Lesson Outline

Time	Activity	Description
2 min	The Design Thinking Process: Ideate	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at Home*. • Show the class slide 92 and tell them students that they continue working on the "ideate" phase of the design thinking process.
15 min	Idea Clustering	• Show the class slide 93 and tell them students that they are going to cluster their ideas into themes. Have them do this by rearranging their post-it notes. Some possible themes the students might generate include ways to remember to conserve, devices that conserve water, or sharing the message about water conservation.
15 min	Idea Selection	• Show the class slide 94. Tell the students that they are going select their favorite ideas that would like to build for their users. • Tell the students that each person has 3 votes, and that he or she should choose their top • 3 favorite ideas and indicate them by placing a check mark on the post-it containing that idea. Discuss the different possible ways to choose a favorite. These might include an idea that is easy to build, a crazy idea, or an idea that they are really excited about building. • Have each group tally its 3 favorite ideas.
10 min	Idea Sharing	• Show the students slide 95. Ask each group to share its top 3 ideas.
3 min	Debrief	• Ask the students to share their idea clustering and idea selection experiences with the entire group by responding to the phrase "I like_____" or "I wish _____."

PROTOTYPING: THE MARSHMALLOW CHALLENGE

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at Home*. Students will learn about the prototyping phase of design thinking process. They will create a prototype, watch a video, and debrief the experience.

Learning Objectives:

Students will:

- Learn the prototyping phase of the design thinking process
- Build a prototype
- Work collaboratively in teams
- Participate in a whole class discussion

Materials/Resources:

- Set up the *Water Conservation Challenge* so that students can view it.
  (*Note: Begin at slide 96, and end at slide 99).*
- Preview the TED Talk at http://www.youtube.com/watch?v=H0_yKBitO8M that features the Marshmallow Challenge.

  Per Team (Each team has 4 students.)

- 1 handout of The Marshmallow Challenge Rules

REDlab
Research in Education & Design

- 20 sticks of spaghetti, one yard of tape, one yard of string, and one marshmallow

Lesson Outline

Time	Activity	Description
3 min	The Design Thinking Process: Prototype	• Set up each team space (4 students) with the materials for the Marshmallow Challenge and the handout entitled "The Marshmallow Challenge Rules." • Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at Home*. • Show the class slide 96 and tell them students that they are going to begin the "prototype" phase of the design thinking process. Explain that prototyping is a way to quickly build their ideas and make them tangible.
5 min	The Marshmallow Challenge Rules	• Ask the students to go to their team spaces. Tell them that they are going to participate in a prototyping exercise called The Marshmallow Challenge. Show the students slide 97 which explains the goal of the exercise. • Show the students slide 98 and review the rules. Clarify any questions the students may have.
24 min	The Marshmallow Challenge	• Begin the challenge. Stop after 18 minutes. • Measure each group's structure. • Congratulate the winners.

REDlab
Research in Education & Design

8 min	The Marshmallow Challenge Video	• Show the students the TED Talk video featured on slide 99 at http://www.youtube.com/watch?v=H0_yKBitO8M.
5 min	The Marshmallow Challenge Debrief	• Ask the students to share their reactions to The Marshmallow Challenge.

PART 8: PROTOTYPING

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at Home*. Students will learn about the prototyping phase of design thinking process. They will create watch a video and create user-centered prototypes. Students will learn about the testing phase of the design thinking process and test the prototypes they build on their users.

Learning Objectives:

Students will:

- Learn the prototyping phase of the design thinking process
- Build a prototype
- Work collaboratively in teams
- Participate in a whole class discussion
- Learn about the testing phase of the design thinking process
- Test their prototypes on users
- Capture feedback from users

Materials/Resources:

- Set up the *Water Conservation Challenge* so that students can view it.
  (*Note: Begin at slide 100, and end at slide 104.*)
- Preview the video "Caine's Arcade" at http://vimeo.com/40000072 that features a story on prototyping.

Per Team

●Creation Station prototyping materials

Lesson Outline

Time	Activity	Description
3 min	The Design Thinking Process: Prototype	• Tell the students that they will be continuing the design challenge *Redesigning Water* • *Conservation at Home,* and that they are in the prototyping phase of the design thinking • process.
11 min	About Prototyping	• Show the students slide 100. View the video "Caine's Arcade" at http://vimeo.com/40000072. • After the students are finished ask them to share their responses to the video. • Ask each student to write a definition of what he or she thinks a prototype is based on The Marshmallow Challenge and the Caine's Arcade video. Ask for volunteers to share their definitions. • Explain to the class that design thinkers build prototypes that are not finished products and that the purpose of a prototype is to put something in the hands of their user quickly to see if the person likes the idea. • Show the students slide 101 which explains some of the features of a prototype. Review each point and clarify any questions the students may have.

15 min	Prototype Building	• Divide the group into subteams of 2 or 3 students. Remind the students that they are going to build prototypes for their users. • Have them go back to their list of the top 3 ideas they selected and have each subteam choose 1 idea to build a prototype of. This means that each team will have 2 prototypes to test on their user. Tell the class to save their prototypes for user testing. • Show the students slide 102 which instructs them to begin building.
20	User Testing	• Show the students slide 103, and tell them that they are going to move into the "Testing/Feedback" phase of the design thinking process. • Show the students slide 104, and explain that they are going to test their prototypes on their users and capture feedback. Ask each group to copy the questions on slide 104 and record the feedback from their users. Have each user divide the time so that he or she can test each of the group's two prototypes. Each group should watch as the other group conducts user testing.
2 min	Planning	• Tell the students that they are going to create presentations highlighting the story of their design process that will be featured in a Mini-Expo, and that they will have one hour to prepare their presentations the following day. Explain that the second hour will be a Mini-Expo where they will have an opportunity to see their classmates' presentations.

INTERMISSION: A TASTE OF DESIGN THINKING – REDESIGNING THE BACKPACK

Overview:

One of the most important mindsets of design thinking is a bias towards action. The purpose of this lesson is to provide students with an overview of all phases of the design thinking process. They will work in pairs, interview each other, generate ideas, and design innovative user-centered solutions.

Learning Objectives:

Students will:

- Engage in a design challenge

- Develop empathy

- Conduct an interview

- Synthesize information

- Brainstorm ideas

- Build prototypes

- Test prototypes

REDlab
Research in Education & Design

- Share information

Materials/Resources:

- Set up the PDF *A Taste of Design Thinking: Redesigning the Backpack* so that students can view it. (Note: Each student will also have a copy of what he or she is viewing on the screen.) As you give students directions for each page, move through the presentation slides.

- Handout: *A Taste of Design Thinking: Redesigning the Backpack*(1 Per Student)

- Prototyping Materials: Creation Station Kit (1 per classroom)

Lesson Outline

Time	Activity	Description
5 min	Activity Set Up/ Introduction	• Show the first slide, and tell the class that they are going to have another experience to learn the design thinking process. • Give each student one copy of the handout *A Taste of Design Thinking: Redesigning the Backpack.*
4 min	Creating the story	• Tell the students to go to the first page of the handout and ask them to design the ideal backpack. Ask them to sketch their ideas in the indicated space. After 4 minutes, ask them to turn to the next page. Tell the students that what they just did was problem solving, and what they are going to do next is try a design thinking approach.

11 min	Interviews	• Ask the students to find a partner. Tell them to turn to the next page. Explain that they are going to redesign the backpack, not for themselves, but for their partner, and that they will begin by interviewing their partners.
		• Review the questions. Tell the students to begin with these questions first, and if they have time, they can ask additional questions based on their partners' responses.
		• Tell the class that they should choose who will be the first interviewer and interviewee, and that you will prompt them to switch roles after 5 minutes.
		• Tell the students to write brief notes and/or sketches as they conduct their interviews, and record this in the box marked "Notes/Sketches."
		• After both interviews are complete, ask each student to think about what his or her partner said, and capture some thoughts in the box marked "Insights." Give the students 1 minute to capture insights.

REDlab
Research in Education & Design

8 min	Defining Needs	• Tell the students to turn to the next page in the handout. Explain that the goal of this part of the design thinking process is to build empathy for their partners' needs.
		• Have the students write the name of the person they interviewed in the box on the left hand side of the page. Ask the students to take 3 minutes to think about the interviews, and use the questions provided to help them reflect on what was important. Tell the students that they do not have to write answers to the questions, but use them as a thinking guide.
		• Tell the class that their next task is to write a "Need Statement." Explain that a Need Statement is a way to synthesize what they heard in their interviews, and that there are three main parts of a Need Statement: user, need, and insight. Tell the students that the need must be a verb, and the insight is something that stood out to them as something that was important to their partners with respect to the cafeteria experience. Read the examples given aloud. (Note: This part of the process can be difficult. Encourage students to try to capture a need- it doesn't have to be complex.)
5 min	Ideation	• Ask the students to turn to the next page in the handout. Tell the class that they are going to brainstorm possible solutions to meet their partners' needs. Explain that when you brainstorm you don't judge any ideas and you try to think of as many ideas as you can to meet your partners' needs. Tell the students that they have 5 minutes and should come up with 25 or more ideas! Ask the students to write or sketch their ideas in the space provided.

REDlab
Research in Education & Design

18 min	Prototyping & Testing	• Tell the students to turn to the next page in the handout. Ask the students to choose one of their ideas that they are most excited about and explain that they are going to build prototypes for their partners. Show them the materials in the Creation Station, and tell them that will use these materials to build their prototypes. • Tell the class that a prototype is not a model, but is a way to make an experience tangible. Explain that if they were going to build a new seating arrangement, instead of drawing a sketch, they might use the desks in the room. Remind them to think about creating something their partners can interact with. Give the students 8 minutes to build their prototypes. • After 8 minutes, tell the students that they are going to test their prototypes on their partners for 5 minutes each, and that you will tell them when it is time to switch. Review the right side of the handout so that the students are aware of how to capture feedback from their partners. Tell the students to fill in the four boxes provided to capture feedback.
6 min	Reflection	• Tell the students to turn to the final page in the handout. Ask each student to answer the questions.

SECOND DESIGN CHALLENGE – REDESIGNING WATER CONSERVATION AT SCHOOL

PART 1: SETTING UP THE BACKGROUND

> **Overview:**
>
> This lesson is the introduction to the second extended design challenge: *Redesigning Water Conservation at School.* Students will practice the steps of the design thinking process, and learn background information about water.

Learning Objectives:

Students will:

- Review and practice the design thinking process

- View videos

- Write notes/draw sketches to summarize information

Materials/Resources:

- Set up the *REDLab Curriculum Water Conservation Challenge* so that students can view it.

(Begin at Slide 105 and end at Slide 140).

Per Person

- Printer paper (Three sheets per person)

- Markers or pens (One per person)

Lesson Outline

Time	Activity	Description
5 min	Design Thinking Process Review	• Show the students slide 105 and tell them that they will be participating in a second design challenge. • Review the information in slides 106-114. You can read them aloud, ask the students to read them silently, ask the students to read them aloud or any combination of these options.
5 min	Empathy	• Show the class slide 115 and tell them that you are going to begin the challenge by focusing on empathy, which is the first step in the design thinking process. Ask the students to define empathy based on what they learned about their users in the *Redesigning Water Conservation at Home* Challenge.
1 min	Introduction to the Challenge	• Show the students slide 116 and tell them they will continue to learn new information that they can use to solve the design challenge for their users.

REDlab
Research in Education & Design

18 min	Building Background on Water Issues	• Show the class slide 117 that has instructions for viewing the videos. • Provide each student with two sheets of paper. Tell the class that they are going to be watching a series of short video clips on water. Ask the students to take brief notes and make sketches about their reactions and responses as they view the videos. Show the class the videos that are featured on slides 118, 119, 120,121 and 122. Pause for 2 minutes after each video to give students time to reflect on each video and capture their thoughts. Video 1 is 1:44, Video 2 is 1:02, Video 3 is 2:23, Video 4 is 2:18, and Video 5 is 2:30.
2 min	Review of Design Thinking Process	• Show the class slides 123-133 and review the information in each slide.
2 min	Empathy Tool Review	• Show the class slide 134 and ask them to describe the tools they know that help them build empathy for users.

10 min	Observation Skill Building	• Show the class slides 135 and 136. Ask them to describe their observations of the pictures in slides 137-139.
		
		• Ask the students to find a partner. Ask each student to draw a sketch of an imaginary scene of their choice. Give the students 3 minutes to sketch. Tell the first student to share his or her sketch with the second person. Tell the second student to describe the sketch. Tell the first student that he or she is not allowed to comment. After 2 minutes, repeat using the second students' sketches. Lead a class discussion using the following prompts:
		
		    o How did it feel to not be able to comment when someone was describing your sketch?
		
		    o How accurately did your partner describe your sketch?
		
		    o What new information or insights did you learn when your partner described your sketch?

2 min	Debrief	• Show the students slide 140 and ask them to describe 3 things that make a good observer.

REDlab
Research in Education & Design

PART 2: INTERVIEWING AND EMPATHY MAPPING

Overview:

This lesson, which continues the second extended design challenge: *Redesigning Water Conservation at School,* focuses on interviewing. Students will conduct user interviews and create an Empathy Map.

Learning Objectives:

Students will:

- Review and practice the design thinking process

- Conduct user interviews

- Analyze and synthesize interview data

- Create an Empathy Map

Materials/Resources:

● Set up the *REDLab Curriculum Water Conservation Challenge* so that students can view it.

   (Begin at Slide 141 and end at Slide 148).

●Review Empathy Map in the Teacher Guide prior to beginning the lesson.

Per Team (Each team has 4-6 students)

- ●Printer paper (3 sheets per note taker)

- ●Markers or pens (One per person)

- ●One large piece of chart or butcher paper

    Note: You may choose to create a blank Empathy Map with the four quadrants "Say, Do, Think and Feel" or have

    each team construct its own at the appropriate point in the lesson.

Lesson Outline

Time	Activity	Description
2 min	The Design Thinking Process: Empathy	• Show the class slide 141 and remind them that they are in the empathy phase of the design thinking process. • Show the class slide 142. Ask them if to share examples of things that they have learned that they have been able to get better at by practicing. Explain that design thinkers consider practice an essential part of improving their skills. • Go around the class and ask each student to come up with 1 tip for conducting a great interview. Show the students slide 143 and compare their suggestions with the 4 that are highlighted.

10 min	Interviewing Roles	• Divide the class into teams of 4-6 students. Tell the students that each team will conduct interviews. The interview subjects should be the teachers and student teachers. If you do not have one interviewee per group, you can have two groups interview one interviewee. If you do this, make sure that each team's main interviewers have an opportunity to ask questions. • Show the students slide 144, and review the instructions for the roles each team member will have during the interview. Give the teams 5 minutes to decide on the roles each member will take.
3 min	Interviewing Questions/Prompts	• Show the class slide 145, which has a list of interview questions. Tell the students that they should begin their interviews with these questions. After they ask these questions, they can build on what they have heard and ask additional questions.
15 min	Conducting Interviews	• Show the students slide 146. Have each team conduct its interview for 15 minutes.
20 min	Creating Empathy Maps	• Show the students slide 147. Tell the class that they are going to create an Empathy Map, and that this is a way for them to synthesize their interview data. Tell them that synthesizing data is an important part of being a design thinker. • Show the students slide 148, which featUres an Empathy Map. Review the four quadrants: "Say, Do, Think, and Feel." • Give each team a large piece of chart paper and ask them to draw the four quadrants of the Empathy Map. (You may also wish to do this in advance for them.) Tell the students to complete an Empathy Map based on their interviews. Visit each team to clarify any questions the students might have.

PART 3: THE POINT-OF-VIEW STATEMENT

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at School*. Students will review the define phase of design thinking process. They will create Point of View statements based on the needs they uncovered during their user interviews.

Learning Objectives:

Students will:

- Practice the define phase of the design thinking process
- Create a Point of View statement based on user needs

Materials/Resources:

- Set up the *Water Conservation Challenge* so that students can view it.
  (*Note: Begin at slide 149, and end at slide 152).*
- Review Define and the Point of View Madlib in the Teacher Guide prior to beginning the lesson.

  Per Team (Each team has 4-6 students.)

- Markers or pens (One per person)
- One large piece of chart or butcher paper

Note: You may choose to create a blank Point of View Statement for each team or have each team construct its own at the appropriate point in the lesson.

Lesson Outline

Time	Activity	Description
2 min	The Design Thinking Process: Define	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at School.* • Show the class slide 149 and tell them students that they are working in the "define" phase of the design thinking process.
8 min	Point of View Statement Refresher	• Show the students slide 150 and tell them that the next thing they are going to do using their interview data is to construct a Point of View Statement. Remind the class that the purpose of a Point of View Statement is to synthesize their interview data, and that they will use this statement to help solve the design challenge for their users. Go around the class and ask each student to share 1 tip for creating an effective Point of View Statement. • Show the students slide 151, which highlights the structure of a Point of View Statement. Review the three parts of a Point of View Statement: a user description, a need, and a surprising insight. Remind the students that they will get the information to create a Point of View Statement from their interviews of their users.
15 min	Creating Point of View Statements	• Have the students work in their challenge teams and tell them that they are going to create Point of View Statements for their users. Give each group a blank piece of chart paper and have them fill in the three parts of a Point of View Statement from slide 151. • Give the students 15 minutes and tell them to create 2-3 Point of View Statements. As the students work, go to each group and clarify any questions the students might have.

15 min	Sharing & Critiquing Point of View Statements	• Have each group share its Point of View Statements with the entire class. Discuss the statements using the following questions:
		   o Could we think of many solutions to meet the need that is described in the Point of View Statement?
		   o Is there a clear description of the user, the need and the insight?
		• Ask each group to choose one Point of View Statement that they will use to create How Might We?s in the next phase of the challenge.

5 min		• Show the students slide 152. Ask them to write or sketch a response to the following prompt: o What does it mean to be a people-centered problem solver?

REDlab
Research in Education & Design

PART 4: IDEATION (BRAINSTORMING)

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at School*. Students will learn about the ideate phase of design thinking process. They will review the rules of brainstorming and brainstorming techniques, and participate in a brainstorming session.

Learning Objectives:

Students will:

- Learn the ideate phase of the design thinking process
- Review the rules of brainstorming
- Review brainstorming techniques
- Participate in a brainstorming session

Materials/Resources:

- ●Set up the PPT/PDF/KEYNOTE *REDLab Curriculum Water Conservation Challenge* so that students can view it.
    (*Note: Begin at slide 153, and end at slide 164).*
- ●Review Ideate Mode, Brainstorm Rules, and How to Facilitate a Brainstorm in the Teacher Guide prior to beginning the lesson.

    Per Team/Person (Each team has 4-6 students)

- ●1 Sharpie marker per person
- ●A Copy of the team Point of View Statement

●One large piece of chart or butcher paper for writing "How Might We Questions"
●One pack of Post-it notes per person in team spaces

Lesson Outline

Time	Activity	Description
2 min	The Design Thinking Process: Ideate	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at School*. • Show the class slide 153 and tell them students that they are going to begin the "ideate" phase of the design thinking process. Explain that ideation is a way for them to generate many possible potential solutions to meet the needs of their users.
5 min	Brainstorming Mindsets	• Show the students slide 154 and explain to the class that brainstorming is built upon mindsets, and that mindsets are a "road map" for how things are done. Go around the class and ask each student to share 1 tip for an effective brainstorming session. • Show the students slides 155-161, which feature the fundamental mindsets that underlie • the ideation process in design thinking. Clarify any questions students might have as they view each slide.

REDlab
Research in Education & Design

15 min	Creating "How Might We?" Brainstorming Prompts	• Have the students place their Point of View Statements on a wall where everyone on the team can see them. Tell the students that they will be brainstorming solutions to meet their users' needs as they are expressed in the Point of View Statements. • Review how to generate a "How MIght We?" question for the class. A "How Might We?" is a way to get from a Point of View Statement to a brainstorming prompt. Use the examples on slide 162 to practice. Read the Point of View Statement, and then ask the class to turn it into a "How Might We?"question. • Review each group's Point of View Statement. As a class, come up with a question in the form of "How Might We?" to use as a brainstorming prompt. Have each group write its "How Might We?" prompt on a piece of paper and place it in the team space where everyone can see it.
5 min	Brainstorming Rules & Modeling	• Show the students slide 164, which contains a list describing "How to Brainstorm." • Ask for 4 volunteers to demonstrate how to conduct a brainstorm. Use one the following topics for your brainstorm: "How to Have a Great Birthday Party", "How to Keep From Being Bored," or "How to Be a Great Friend." You can also ask students to choose a topic for the brainstorm.
15 min	Brainstorming	• Tell the students that they are going to brainstorm solutions based on their "How Might We?" questions. Remind them that they are coming up with as many ideas as they can for user-centered solutions. Tell the students to come up with a minimum of 35 ideas and to set a goal of generating more than 50 ideas. • Give the class 15 minutes to brainstorm. Play upbeat music during the brainstorming session to keep the energy level high.
3 min	Debrief	• Ask the students to share their brainstorming experiences with the entire group by responding to the phrase "I like_____" or "I wish _____."

REDlab
Research in Education & Design

PART 5: IDEATION & PROTOTYPING

Overview:
This lesson continues the design challenge *Redesigning Water Conservation at School*. Students will learn about the ideate phase of design thinking process. They will cluster the ideas they have generated in themes. After an idea is selected, they will build prototypes.

Learning Objectives:

Students will:
- Cluster ideas thematically
- Select ideas
- Build prototypes

Materials/Resources:

- Set up the *Water Conservation Challenge* so that students can view it.
  (*Note: Begin at slide 165, and end at slide 173.*)

  Per Team/Person (Each team has 4-6 students)

- 1 Sharpie marker per person
- Creation Station

Lesson Outline

REDlab
Research in Education & Design

Time	Activity	Description
2 min	The Design Thinking Process: Ideate	• Tell the students that they will be continuing the design challenge *Redesigning Water Conservation at School.* • Show the class slide 165 and tell them students that they continue working on the "ideate" phase of the design thinking process.
5 min	Idea Clustering	• Show the class slide 166 and tell them students that they are going to cluster their ideas into themes. Have them do this by rearranging their post-it notes.
8 min	Idea Selection	• Show the class slide 167. Tell the students that they are going select their favorite ideas that would like to build for their users. • Tell the students that each person has 3 votes, and that he or she should choose their top three favorite ideas and indicate them by placing a check mark on the post-it containing that idea. Discuss the different possible ways to choose a favorite. These might include an idea that is easy to build, a crazy idea, or an idea that they are really excited about building. • Have each group tally its 3 favorite ideas. • Show the students slide 168 and have each group choose its favorite idea to prototype.
3 min	Prototyping Refresher	• Show the students slide 169. Tell the students that they are working in the prototyping phase of the design thinking process. Ask each student to share 1 tip for building a good prototype. Show the class slide 170 and review characteristics of prototypes.
12 min	Prototype Building	• Divide the group into subteams of 2 or 3 students. Remind the students that they are going to build prototypes for their users. • Have each subteam build 2 different versions of the idea that was selected by the entire team. This means that each team will have 2 different prototypes of the same idea to test on their user. Show the students slide 171 which instructs them to begin building.

REDlab
Research in Education & Design

| 15 | User Testing | Show the students slide 172, and tell them that they are going to move into the "Testing/Feedback" phase of the design thinking process. Show the students slide 173, and explain that they are going to test their prototypes on their users and capture feedback. Ask each group to copy the questions on slide 173 and record the feedback from their users. Have each user divide the time so that he or she can test each of the group's two prototypes. Each subteam should watch as the other conducts user testing. |

ROBOT HELICOPTER BUILDER

Overview:
This lesson highlights STEM Careers. Students will watch a TED Talk that features Vijay Kumar, who builds small, agile, cooperative flying robots. They will participate in guided discussion and brainstorm potential uses for robots based on what they have learned.

Learning Objectives:

Students will:

- Learn about STEM careers
- Learn about robotics
- Learn about those who work in the field of robotics
- Participate in a whole class discussion
- Create a graphic organizer l highlighting what they have learned

Materials/Resources:

- Projector
- Computer

   Per Student

- Two sheets of writing paper
- One large sheet of construction paper
- Markers or pens

Lesson Outline

Time	Activity	Description
20 min	View video	• Ask the students if they have any questions about the design thinking process. • Show the class the TED Talk at http://www.ted.com/talks/lang/en/vijay_kumar_robots_that_fly_and_cooperate.htm
10 min	Guided discussion	• Engage the students in a discussion about the video. Use the following questions as prompts: o What did you think of his talk? o What did you learn? o What surprised you? o Do you think the work he is doing is important? Why or why not? o Can you think of new potential uses for robots?
15 min	Graphic Organizer	• Ask the students if they have created graphic organizers. Clarify that a graphic organizer is a visual and spatial representation of information. Show the students examples of graphic organizers at the following link: http://bit.ly/M15tNb • Have the students work in teams of 3 to create a graphic organizer based on what they have learned from the TED Talk. • Have each group present its graphic organizer to the entire class.

REDlab
Research in Education & Design