Wizards of Wright

Lesson: Design Thinking, Real-World Problem Solving

Use WOW! Lesson Intro to begin.

Background Info for Wizards:	Design Thinking is a process used by engineers and designers to help them solve complex problems and create solutions & products that meet people's needs. It's solution-based thinking that starts with a general goal, not just a specific problem. Design Thinking focuses on empathy, students trying to solve problems that affect people. Those people might be fictional characters in a novel, or they might be their community's very real homeless adults. The process requires students to ask themselves what it's like to be that person, the client or "end user." It's the idea that students are attempting to solve problems—real problems—and serve the needs of others. This activity uses the City X Project. *This lesson is written for* **4th-8th grade students**.
Wizard Information for Student Activity:	**Understanding the City X Project** "The City X Project helps youth learn the value of empathy, creative thinking, and problem solving, in the context of a society whose citizens face real-world challenges." The City X Project comes from IDEAco, The Coalition for Innovative Development, Education and Action. http://www.kidscodemarin.com/uploads/7/0/1/0/7010842/cityx_instructor_guide.pdf The City X Project is an international education workshop designed for students between the ages of 8 and 12. We will be using several parts of their workshop in hopes of helping students experience some creative problem solving. Their workshop takes the project several steps further, teaching the students to use 3D technologies in truly creating their final product. "The instructional model for the City X workshop is called The Design Process. This six step method is an adaptation of the "Design Thinking" process used by the Stanford d.school. The process teaches students to understand a challenge and the people it affects, generate possible solutions, and develop a final product that not only solves the problem at hand, but can be shared with the world." http://www.kidscodemarin.com/uploads/7/0/1/0/7010842/cityx_instructor_guide.pdf

	1. Empathize - Develop an understanding of the people who are facing the challenge at hand. 2. Define - Frame the problem in clear terms, understanding the larger social issues it relates to. 3. Ideate - Generate multiple ideas for solving the problem. 4. Prototype - Build a quick sample, based on one of the ideas for solving the problem. 5. Test - Testing reveals what works, what doesn't, and how a prototype can be improved. 6. Share – Using the final product, explain the invention in a way that allows others to make use of it. "Objectives of the City X Project: Throughout the workshop, students will learn literacy, problem solving, creativity, critical thinking, 3D technology and STEM skill sets." http://www.ideaco.org/2013/07/standfords-design-process-for-kids-teaching-big-picture-problem-solving/
Materials:	- Philippines map - Guatemala map - *Plastic Bottle Schools* packets - Design Thinking graphic - Travelers Cards - Student Sheets - Items to build with… Bunch-ems, Legos, STEM Master Building Toys, Magnetic Sticks, Connectagons, Picasso Bristle Tiles, clay, popsicle sticks, straws, aluminum foil, pipe cleaners, toothpicks
Lesson Time: ***60-90 minutes***	Introduction: 5-10 minutes Guided Lesson #1: 5-10 minutes Guided Lesson #2: 5-10 minutes Guided Lesson #3: 10 minutes Student Activity: 30-45 minutes Conclusion: 5 minutes
Learning Targets:	Students will understand the importance of considering the end user when using Design Thinking and the Engineering Design Process.
Introduction for Students: 5-10 minutes	**Ask students**: What do you already know about the Engineering Design Process? When Engineers begin to build something new, or create a solution to a problem, they use a process. 1. Identify the problem. 2. Identify requirements and limitations. 3. Brainstorm possible solutions, ideas and possibilities.

	4. Select a solution. 5. Build a prototype. 6. Test and evaluate. 7. Redesign, make changes, and improve the prototype. Many things are created in order to specifically solve a problem; whether it's a product, or a machine – a system, or a building. Whatever it is, it has to be designed and planned first. Today we're going to talk about Design Thinking – a way to focus on the **people** the products (or machines or buildings) are being created for. When you consider how a product will be used it leads to better products and services. When solving a problem, Engineers have to think about who needs the solution, and does it actually meet their needs. - If the problem was "What should we have for dinner?" and the solution was "Cheese Pizza", but you are allergic to dairy products…then that's not a good solution. - If the problem is "How will our clients and customers get to our office on the third floor?" and the solution is to "We'll put in several flights of stairs" ….that's not a good solution if any of your customers have health issues that makes climbing stairs difficult. The solution has to work for the end user.
Guided Lesson #1: 5-10 minutes	The Design Thinking process is very similar to the Scientific Method and the Engineering Design Process, but with the person/user as the key to this process, so we start a little differently. This is really about understanding the needs of the people you design your solution for. (show graphic) 1. The first step is to Empathize. We need to know our user/customer. What do they like? What do they need? Are there emotional and physical needs? 2. Using your empathy research you figure out who they are, and you can now answer "What do they really need?" and define the actual problem. 3. Then we have to learn about requirements and constraints. - a requirement is something that we need or is necessary - a constraint is a limitation 4. The next step is to think and brainstorm potential solutions. Come up with as many as you can. Sometimes if you start narrowing it down too quickly a good idea is missed.

	Think about who will use your solution, and how they will use it. 5. After deciding on a solution, it's time to build. Making a prototype takes your idea from paper to the physical form. Using the prototype helps you learn what improvements need to be made. 6. The final form needs to be tested, observations need to be recorded, your customer needs to be consulted, and redesigning can begin.
Guided Lesson #2: 5-10 minutes	We need to consider if different people will use our creation differently, or will different people need different solutions; *and we need to remember that our ultimate goal is to create something that solves a problem, by helping others*. Let's practice by talking about **a special example** – a creative and original design for a school. Schools are some of the most important buildings ever put up around the world, but they often aren't built because of a lack of materials or lack of money. What material do we not lack around the world? Plastic bottles. There was a shortage of schools in the Philippines (show map) and in seeing a need, people looked for a solution. Pepsi partnered with the My Shelter Foundation to build a school house made of 9,000 plastic bottles in San Pablo, Philippines. Thousands of volunteers recruited by Pepsi collected the used bottles, helped to raise awareness of the Philippines classroom shortage and participated in building the structure. Students in Guatemala (show map) got a plastic bottle school too. (show pictures) Designing and building a solution like this, with an end-user or group of users in mind, encourages us to ask "Who will use this?" and "What do we need to know about how they will use it?' It was important to start with the same question: What is the problem? (But maybe the problem or need was different in the two countries since the solutions seemed to be a little different.) When the groups began to propose solutions, they needed to acknowledge the different requirements and restraints that would affect the build. (Was it just a school or was it for community groups as well? Did temperature/climate, area, and sustainability affect the design?)
Guided Lesson #3: 10 minutes	Lead a discussion asking the students to discuss the following: ○ What problems are being solved by building these structures? *(Maybe the problem or need was different in the two countries since the solutions seemed to be a little different.)* ○ What types of engineers might have contributed their expertise in these designs? ○ Why do you think the engineers chose the material they used?

	○ What are some similarities and differences in the solution they used to build a Bottle School in the Philippines and in Guatemala? ○ What do you think some of the requirements and constraints might have been for these schools? What would the engineers need to know about the location, environment, and the materials? *(Was it just a school or was it for community groups as well? Did temperature/climate, area, and sustainability affect the design?)* ○ What did the engineers need to keep in mind about the end users?
Student Activity:	**<u>The Story</u>** Let me tell you a story about adventure, possibility, and invention. Earth has sent a group of travelers to create a new city on a new planet. But, building a new city is difficult and they've started to identify some problems that are affecting everyone, and these problems could stop all of their progress, and ruin the possibility of creating a community on this other planet. They are coming across some challenges that relate to things like health, safety, communication, and transportation. These are problems that they need help solving. Our travelers are able to communicate with us here on Earth, and they've begun to tell us the troubles they are running into. It's up to you to help solve them. You are our designers and engineers and we need you to invent solutions to their problems. You'll need to learn about our travelers, understand their challenges, brainstorm solutions, and ultimately design inventions so that our new community can flourish. *Discuss with the teacher if students are best to work on their own, or in a small group of 2 or 3.*
Student Activity: 30-45 minutes	**<u>The Project</u>** 1. Randomly distribute one **<u>Traveler Card</u>** to each student (or small group). Tell the students that their job is to understand and solve that Traveler's problem. Ask a few students to share their Traveler's problems with the class. 2. **<u>Introduce the first step of the Design Process, "Empathize</u>**". Talk about the definition of "empathy" – the ability to understand and share the feelings of someone else.

	Explain how, in order to make a great invention, you have to start by understanding the person you're trying to help. Try to use real world examples to help the students think of types of feelings. 3. **Explain the second step of the Design Process, "Define".** Talk about using the information gathered during Empathize (knowing who the person is and how they feel) to figure out what they really need. This defines the problem. Explain the difference between personal problems and social problems: - Personal problems affect one person. - Social problems affect a group of people or community. Use examples to help students understand personal vs. social problems (e.g., "I'm hungry." = personal problem; "How do we find food for our city?" = social problem) 4. Pass out the **Student Sheet** to each student or small group. Instruct the students to: a. fill in their Traveler's name, b. circle the feelings they believe their Traveler is experiencing c. circle the social problems that their Traveler's personal problem relates to 5. Introduce the concept of **ideation**. Have your students **brainstorm** to start listing or sketching some of their ideas. (Even if they are working on their own, they can brainstorm in a group, and help each other come up with ideas.) Tell your students the brainstorming guidelines: - Accept all ideas. (no idea is a bad idea in brainstorming) - The more, the better. (come up with as many ideas as you can) - Expand on each other's ideas. - Think outside the box. (sometimes the craziest ideas are the best) 6. Introduce the concept of **prototyping** and why it's important for making good inventions. Have your students choose the invention idea they like the best and circle it. Have your students create a prototype of their favorite invention. Show them the materials that will be available. A prototype is a model of one of your ideas. Prototypes give you the opportunity to test your ideas and improve on them, to make sure you have the best invention possible. Explain that prototypes aren't meant to be perfect. 7. Divide the students into pairs or small groups to **test their prototypes**. Have them take turns presenting their ideas and giving feedback to each other.

	Explain the kind of feedback you want: - Be Positive. (What you like about an invention.) - What do you still need to know? (What you didn't understand about the invention.) - What ideas do you have? (Ideas for things to change to make the invention better.) Explain why testing is important. We want to let the people who will be using our inventions look at them and try them out. On their **Student Sheet**, have them write down at least one change they can make based on the feedback they received. *8.* Explain to students that if there were more time, they would take the feedback and their own ideas, and **redesign** their prototypes to improve their inventions. Perhaps they can complete this with the teacher.
Conclusion: 5 minutes	Ask students: What is an end user? Why is it important to think about the needs of users when designing a solution to a problem?

information and ideas credited to: https://insteading.com/blog/plastic-bottle-schools/; https://www.nationalgeographic.org/media/nasa-kids-intro-engineering/#:~:text=An%20engineer%20is%20a%20person,a%20specific%20branch%20of%20engineering.; https://leftbraincraftbrain.com/design-thinking-challenge-for-kids/; https://leftbraincraftbrain.com/wp-content/uploads/2015/11/Design-Thinking-Challenge-Prompts.pdf; http://neatoday.org/2018/04/19/design-thinking-in-the-classroom/; https://www.makersempire.com/research-study-spatial-reasoning-skills-improve-future-stem-success/; http://ajjuliani.com/project-based-learning-activity-can-work-classroom/; http://www.cityxproject.com/workshop/; http://www.ideaco.org/2013/07/standfords-design-process-for-kids-teaching-big-picture-problem-solving/; http://www.kidscodemarin.com/uploads/7/0/1/0/7010842/cityx_instructor_guide.pdf; https://www.pinterest.com/pin/199847302191456954/; http://www.kidscodemarin.com/uploads/7/0/1/0/7010842/cityx_instructor_guide.pdf; https://www.modrobotics.com/education/lesson-plans/high-school/a-a-7-design-thinking/; https://www.modrobotics.com/education/lesson-plans/middle-school/a-m-10-design-thinking/