



DESIGN THINKING

Inefficiencies, distractions, and time wasted on over complicated tasks are part of the grown-up experience. But do they have to be? In this apprenticeship, students use design thinking to answer this question with a resounding “No!” The lessons in this unit focus on easing the strain of one part of the day, the morning routine! They will promote the kind of thinking that will enable students to design their way out of those inefficient tasks, eliminate distractions, and remove unnecessary complications to everyday tasks.

This unit asks students to build things based on a number of RAFT kits (<http://www.raft.net/>), which will give students some technical training with physical materials. Students will use the skills learned in these design challenges to develop a solution for a large-scale and relevant challenge: “Design something to solve a problem during morning preparations for school or work.”

Unit Standards and Objectives 21st Century Skill: Innovation

Innovation Standard #1: Citizen Schools students will generate an idea or product that suits a practical or artistic purpose.

Lesson Objectives:

- Clearly describe the problem you are trying to solve
- Generate a list of possible solutions to more than one problem
- Create a small list of usable ideas to suit a purpose.
- List one advantage and one limitation for each idea.
- Categorize ideas based on feasibility and eliminate two of five ideas
- Assess the advantages and limitations of proposed solutions to more than one problem
- Assess the solution to a problem from the user’s perspective
- Select the most advantageous problem-solution pair

Innovation Standard #2: Citizen Schools students will use a design process to create ideas or products.

Lesson Objectives:

- Name the steps in the design process
- Create a plan for building your prototype that is likely to succeed
- List the tools and materials you will need to build your prototype
- Reflect on the performance of your prototype and improve its design
- Create a plan for field testing your prototype

Innovation Standard #3: Citizen School students will realize a product or idea that suits a given purpose.

Lesson Objectives:

- Create a piece of work (product, art, model, etc.) that meets a predetermined purpose

Essential Question

- How can getting ready in the morning be easier?



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Performance Task Assessment (WOW!)

Getting ready in the morning can be such a hassle. For this apprenticeship, you will try to make this morning preparation a little easier. Your goal is to design a product that makes getting ready for school every morning less of a hassle. As someone who has to get up and get ready for school, you should try to think about what grown-ups have to do that is similar to what you do when they get ready for work. A good design will be useful for your peers getting ready for school and for grown-ups who have to get ready for work.

Goal: Create a product that makes morning routines easier for kids and adults.

Role: You are yourself designing something that helps with a common morning task you think a lot of people could use some help with.

Audience: Anyone who wants to make getting ready in the morning easier.

Situation: It's a hassle to get ready for school and work. You want to make at least part of it easier.

Product: A product others find useful in getting ready for school or work.

Standards: You will convince a group of peers and interested adults that your product will make their mornings easier. You will present the problem you are aiming to solve, the product you propose will solve it (a blueprint or prototype of the product), and demonstrate how your innovation makes the morning easier (e.g. how it saves time). Your product will be original and meet a practical purpose. You will also follow a design process to create your product. Work will be assessed on Citizen Schools' 21st Century Skills [Innovation Rubric](#).

Students will also record their ideas, designs, reflections, and revisions in Design Journals.

Lesson Plans At-A-Glance

Lesson Plans are available [here](#)

Week	Lesson Objectives	Agenda	Outcomes & Work Products
1	<ul style="list-style-type: none"> Name the steps in the design process. 	<ul style="list-style-type: none"> Hook: Mini-Design Challenge Mini-Lesson: Unit Overview Activity 1: What is Design? Activity 2: Know/ Need to Know Activity 3: Construct Journals Check for Understanding: Exit Ticket 	<p>Students will learn about the overall question "What can we design that will make it easier to get ready in the morning."</p> <p>Students will also learn today how to make things move along the ground.</p>
2	<ul style="list-style-type: none"> Create a small list of usable ideas to suit a purpose. List one advantage and one limitation for each idea. 	<ul style="list-style-type: none"> Hook: Identify the Challenge Mini-Lesson: Summary of Day & Transition Activity 1: Idea Generation Activity 2: Design Activity 3: Create, Test, Evaluate, Redesign Check for Understanding: Exit Ticket 	<p>Students will learn how to send things flying through the air to deliver objects. Students will analyze their morning routine and list potential products to make it easier.</p>
3	<ul style="list-style-type: none"> Create a plan for building your prototype that is likely to succeed. Reflect on the performance of your prototype and improve its design. 	<ul style="list-style-type: none"> Hook: Identify the Challenge Mini-Lesson: Summary of Day & Transition Activity 1: Idea Generation Activity 2: Design Activity 3: Create, Test, Evaluate, Redesign Check for Understanding: Exit Ticket 	<p>Students will learn how to protect things. Students will brainstorm product ideas.</p>



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4	<ul style="list-style-type: none"> Clearly describe the problem you are trying to solve. Categorize ideas based on feasibility and eliminate two of five ideas 	<ul style="list-style-type: none"> Hook: Bridge Building Mini-Lesson: Summary of Day & Transition Activity 1: Identifying the Problem Activity 2: Brainstorm Activity 3: Narrow it Down Exit Ticket 	Students will race against the clock to apply the design process and build a better bridge. Students will begin the first phase(s) of their final design project.
5	<ul style="list-style-type: none"> List possible solutions to more than one problem. Assess the advantages and limitations of proposed solutions to more than one problem. 	<ul style="list-style-type: none"> Hook: Design Challenge Mini-Lesson: Summary of Design Process & Transition Activity 1: Comparing Solutions Activity 2: Discussion Activity 3: Decisions Exit Ticket and Share Out 	Students will generate a list of possible products to make their mornings easier.
6	<ul style="list-style-type: none"> Assess the solution to a problem from the user's perspective. Select the most advantageous problem-solution pair. 	<ul style="list-style-type: none"> Hook: Quick Decisions Mini-Lesson: Summarize Day & Transition Activity 1: Ranking Activity 2: Elimination Round Activity 3: Drafting Design Assessment: Share Out 	Students will finalize the solution to their problems.
7	<ul style="list-style-type: none"> List the tools and materials you will need to build your prototype. Create a plan for field testing your prototype. 	<ul style="list-style-type: none"> Hook: Prototype Challenge Mini-Lesson: Prototyping Activity 1: Sketching Plans Activity 2: Construction Activity 3: Clean Up Assessment: Gallery Walk 	Students will prototype their final designs.
8	<ul style="list-style-type: none"> Build the first version of the prototype. Test the prototype. Reflect on the performance of your prototype and improve its design. 	<ul style="list-style-type: none"> Hook: Identifying Variables Mini-Lesson: Summarize Construction & Testing Activity 1: Construction & Testing Activity 2: Journaling Assessment: Exit Ticket 	Students will continue working on their final projects.
9	<ul style="list-style-type: none"> Test the prototype. Reflect on the performance of your prototype and improve its design. Build the next version of the prototype. 	<ul style="list-style-type: none"> Hook: Prepare Room Mini-Lesson: Evaluating & Redesigning Activity 1: Build, Test, Evaluate, Redesign Activity 2: Clean Up Activity 3: Journaling Assessment: Exit Ticket 	Students will finalize their designs.
10	<ul style="list-style-type: none"> Practice the WOW! presentation. You create a piece of work (product, art, model, etc.) that meets a pre-determined purpose. 	<ul style="list-style-type: none"> Hook: One Brave Soul Practice Mini-Lesson: Presentation Basics Activity 1: Practice Activity 2: Reflect Activity 3: Practice Assessment: Reflect 	Students will demonstrate their final designs and practice a miniature WOW!.

Lesson Elements

Hook Opening ritual used each week to build excitement	The opening hook will generally involve the students starting to work with their hands to design and construct a basic object to get in the mindset of the challenge.
Assessment How you will measure student learning (i.e., exit tickets, student writing, student presentations, etc.)	The closing ritual will vary between exit tickets to check for understanding when students do not have much to share and gallery walks when there are physical artifacts to display.
Structures	The students will repeatedly record their activities in an "engineering design journal" that they can later refer to and present.



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Learning structures, tools or student grouping strategies	Note that lessons build on one another, but not necessarily in direct sequence: Lesson 2 → Lesson 5 → Lesson 6 Lesson 3 → Lesson 8 → Lesson 9
Procedures Special procedures used each class (ie handing out folders, rearranging seating, etc.)	Lesson procedures will vary week to week based on the content. Many lessons will include a process for experimenting with materials, building a design and then reflecting on it as a group. Every lesson will include the a closing ritual. This will vary between exit tickets to check for understanding when students do not have much to share and gallery walks when there are physical artifacts to display.

Implementation Notes

Supplies Materials, tools, technology	<p>Most of the materials we will be using are meant to mimic those found in these RAFT kits. If additional funds are available, you can purchase RAFT kits, but they are not necessary for teaching the unit.</p> <p>Lesson 1: Car on a Roll: \$3.99 per kit * 5 teams = \$19.95 http://www.raftstore.net/car-on-a-roll-single Alternatives: Wheels: Recycled packing materials, air filters, or other sources of foam (FREE if recycled, or http://goo.gl/if7Gua, \$3.77 per sheet, 1 sheet cut into circles for the wheels should be enough) 4 per team Axles: Skinny drink straws (https://goo.gl/SsTKfS, \$6.08 for 1000 straws) 2 per team Chassis: Recycled heavy gauge paper cut into small rectangles (FREE if recycled) 1 per team Binders: ½" 3-ring binders (http://goo.gl/vH3mOE, \$3.49) 1 per team</p> <p>Lesson 2: Puff Rocket: \$3.99 per kit * 5 teams = \$19.95 http://www.raftstore.net/puff-rocket-single Alternatives: Launcher: Recycled SOFT PLASTIC empty water bottle WITH CAP (e.g. Aquifina, Desani, etc.) (FREE if recycled) 1 per team Launcher Shaft: GIANT (0.219" diameter) drinking straw (http://goo.gl/5jmtc2, \$2.69 for 300) 1 per team Rocket Body: COLOSSAL (0.296" diameter) drinking straw (http://goo.gl/OrvxxK, \$4.72 for 50) 1 per team Rocket Fins: Recycled paper (FREE if recycled) Several small pieces per team Rocket Nose: Silly Putty (http://goo.gl/e4SxBT, \$5) 1 almond-sized piece per team</p> <p>Lesson 2: Fizzy Rocket: 10 pack = \$10.99 http://www.raftstore.net/fizzy-rockets?filter_name=fizzy%20rocket Alternatives: Rockets: Recycled film canisters; most photo shops (especially those inside another store like CVS or Wal-Mart) will give these away if you ask (FREE if recycled) 1 per team Fuel: Tap water AND Generic antacid Tablets (http://goo.gl/PYbWvt, \$4.49 for 36) 6-12 per group Modifications: Recycled paper (for fins and nose cones), recycled foam (for weight and air resistance), or purchased foam (http://goo.gl/if7Gua, \$3.77 per sheet)</p> <p>Lesson 3: Egg Drop: \$9.99 per kit * 5 teams = \$49.95 Alternatives: Eggs: Eggs (\$1.50 per dozen) 3 eggs per team. Vehicle: Recycled materials such as paper, plastic bags, string, cardboard, foam, etc. (FREE if recycled)</p> <p>Lesson 4: Popsicle Sticks (http://goo.gl/hwQOVS, \$4.59 for 100) 30 per group Weight: 100 pennies (\$1) 12-inch rulers (1 per group)</p> <p>Lesson 7</p>
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	<p>Basic Legos (multiple sizes and colors) (http://goo.gl/Wu9OYQ, \$12.10, ~10 blocks per student.</p> <p>General Materials: Scotch Tape (http://goo.gl/lkr8U1, \$3.49) 1 per group Paper Towels (http://goo.gl/bP68wc, \$4.97) 3 rolls</p>				
Budget	Total cost of apprenticeship:				
	1 group	2 groups	3 groups	4 groups	5 groups
	\$ 50.59	\$ 57.57	\$ 43.29	\$ 51.27	\$ 56.26
Supporting Materials & Resources handouts, books, materials	<p>Handouts will be printed and copied. They can be found in each lesson guide. Copies will need to be three-hole punched.</p>				
Location Tables/desks, or classroom, gym, kitchen, outside, etc.	<p>When possible, students will need clear, flat work spaces. Most activities will get messy, so a space that is durable and easy to clean is best.</p> <ul style="list-style-type: none"> - If possible, Lesson 2 should take place outside. - Lesson 3 should take place outside if there is access to a significant height (10 feet or more) or in a stairwell. 				
Choice and Voice Key decisions students make	<p>Students will have near total control over the product they develop for the morning routine. These choices will drive how the WOW! will need to be formatted. You will need to decide how to best show off each student's product after they are all developed.</p>				
Modifications for Student Needs Supports and changes to help meet the needs of all learners	<p>Group work is strongly encouraged for this apprenticeship as it saves on material costs. However, group work may be an impediment to the learning of some individuals. As cost and space allows, permit students who work best independently independence.</p> <p>There are several instances of wide-open design choice for students. Some students may find this overwhelming and have difficulty starting. For these students provide a list of choices (e.g. in Lesson 4 students are given popsicle sticks and just told to build a bridge. If this is overwhelming to some students, provide pictures of three kinds of bridges and let them choose from those).</p>				
Student Background Knowledge and Skills Needed Academic skills, social emotional skills or developmental milestones needed	<p>Students should come to the apprenticeship with an interest in innovation, design, and problem solving.</p> <p>Students should be able to work with their hands.</p>				
College and Career Readiness Connections to college and career	<p>This apprenticeship casts aspirations towards careers in engineering, design, architecture, marketing, and business.</p>				
Co-Teaching Roles Recommendations for co-teaching and planning	<p>Co-teaching will oscillate between Parallel, Station, and Team Teaching. Although there will be times where one adult is teaching and the other is supporting (One Teach, One Assist), it is not intended that one teacher always be the "lead" and the other be "support."</p>				
Special Resources Field trips, excursions, guest speakers	<p>Students will be designing products that could have wide appeal. In addition to the teachers in the room, if other adults could come in ready to either talk about the most frustrating parts of their morning routines or to serve as "focus groups" for ideas students have, students will be able to hone their ideas.</p>				
Road Map to WOW! Visual overview for students of their 10 week apprenticeship	<p>Note to CT/TL: Create a poster-sized visual of the information listed below, display and reference it weekly in your classroom.</p> <p>Visual overview for students of their 10-week apprenticeship:</p> <p>Week 1: Learn the steps to the design process. Week 2: Tell the difference between good solutions and bad ones. Week 3: Build a prototype and learn from its performance.</p>				



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Week 4: Identify aspects of the morning routine that could be made better.
Week 5: Pick your product.
Week 6: Refine your solution.
Week 7: Plan your build!
Week 8: Build it, test it.
Week 9: Refine your design.
Week 10: Practice showing it off.
WOW!



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Co-Teaching Structures Guide



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Teaching Model	Description	Why should we use it?	When should we use it?
Parallel Teaching 	Class is split into two (or more) small teams. <u>Same</u> content is taught to each team.	<ul style="list-style-type: none"> ·Low student-teacher ratio ·Greater proximity to high-risk students ·Co-teachers have equal presence and responsibility in the classroom 	<ul style="list-style-type: none"> ·We can plan effectively together to ensure we teach the same content to each group well. ·Classroom's physical structure permits it. ·Lessons with heavy independent work ·Need to provide a lot of individual attention
Station Teaching 	Class is split into two (or more) small teams. <u>Different</u> material taught to each group simultaneously and then teams switch or teachers switch.	<ul style="list-style-type: none"> ·Low student-teacher ratio ·Co-teachers have equal presence and responsibility in the classroom. ·More variety in teaching methods for teachers and students 	<ul style="list-style-type: none"> ·When a lesson can be split into two mutually exclusive and equally timed parts (e.g. using a camera/ critiquing a photo, chopping vegetables/ measuring ingredients) ·Classroom's physical structure permits it ·Lessons with a lot of knowledge or skill-building
Team Teaching 	Both teachers actively teach the material taking turns during the lesson to lead teach. While one teacher is lead teaching the other goes around to groups or individual students.	<ul style="list-style-type: none"> ·One teacher can pay attention to high-risks students while one teacher leads the full class. ·Co-teachers have equal presence and responsibility in the classroom. 	<ul style="list-style-type: none"> ·When it's difficult to effectively split a lesson into two stations ·When a lesson has lectures and independent practice time ·If most SPED students can follow whole-group instruction ·Best with well-developed co-teaching relationship ·Lessons with a lot of group work
Alternative Teaching 	One teacher remediates a small group of students (pre-teach, re-teach, supplement, or enrich) and catches them up for the main lesson being taught by the other teacher.	<ul style="list-style-type: none"> ·Low student-teacher ratio. ·To remediate in class for a small group of students. ·To catch students up who may not have understood/missed previous lesson. 	<ul style="list-style-type: none"> ·When the benefits from a few minutes of remediation/ pre-teaching will pre-empt greater misunderstandings for the lesson. ·Classroom's physical structure permits small group in one part of the room. (CTs should not be left alone in the classroom with students.)
One Teach, One Assist 	One teacher lead teaches the whole lesson and the other teacher works with individual students.	To redirect behavior from an especially low functioning student. To pay greater attention to a student who needs one-on-one interaction in order to keep up	<ul style="list-style-type: none"> ·If there is a particularly high-needs student(s) in the classroom that need specific support. ·During direct-teach sections of the lesson



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The Pitch

To pitch this apprenticeship you want to get students excited about developing a product that makes life easier. Start by asking the students about things that make their lives easier in general (e.g. cell phones, elevators, cars). Ask what kind of problems these products were designed to solve. Point out that it is easy to forget that the reason we have a lot of the items we use daily is because life was hard without them. Designers eventually said “enough!” and came up with a solution to simplify life.

Ask the students to think about their morning routine. Have them turn and talk about all the little tasks they need to do between waking up and walking out the door on a school day (getting out of bed, making the bed, getting dressed, combing their hair, brushing their teeth, etc.). Ask for some examples of tasks that are frustrating because they are too hard, too boring, or take too long. Write these examples on the board.

Connect these examples to the problems and the products you mentioned earlier (“it used to be a pain to walk up lots of stairs in tall buildings, then someone invented an elevator,”). **Say:** “Wouldn’t it be cool to invent something that makes YOUR life easier? How much cooler would it be if that invention made EVERYONE’s life easier?”

Say: “In this apprenticeship we are going to revolutionize getting up, getting ready, and getting out the door in the morning. We’ll learn how inventors and designers innovate to solve problems lots of people share. While our main focus will be to design a product for the morning routine, we’ll be building bridges, dropping eggs without breaking them, designing and launching rockets, and using our imaginations to design solutions to all sorts of problems. If you love solving problems, if you love building things, and if you want to make the world better for everyone, this apprenticeship is for you!”

Materials Needed for Pitch Day

1. Flossing stick



2. Toothbrush timer

3. Other time-saving or convenience-adding products for the morning routine.

Apprenticeship in Action

“During the WOW! event, seeing the kids coming up to me and want to interact outside of the classroom made me realize the impact I had made. It was a great feeling watching them share their work with their parents and the pride they had... seeing the class focus on their work makes me so inspired. It is the feeling that you help to educate and inspire new talent for the future.

One of the students, someone who struggled most days to simply sit in his seat and engage, upon being given a second chance to complete a design challenge, did so and was successful as a result. The fact that we were willing to give him a second chance (being amateur teachers) resonated with him and perhaps made him believe that we believed in him. Later in the apprenticeship, he was having another rough day and I took him outside into the hallway, gave him a chance to get something off his chest, and because he once again had a chance to reset and clear his head, was successful in completing what he needed to. I'll likely always remember how someone who probably doesn't get many second chances responded favorably when he did.”

-An Intuit Citizen Teacher, Survey, Fall 2015



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Apprenticeship Description for WOW! Communications

The WOW! is a product showcase where students will show off their solutions to common morning preparation woes. Students will be demonstrating their products, explaining how they work and the purpose they serve, and trying to build interest in what they have made.

Apprenticeship Acknowledgements

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