Teacher's Guide for Paper Prototyping

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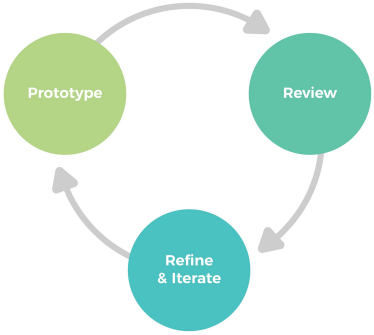


Description

In this workshop, students will learn how to communicate and develop their ideas using physical 3D modeling. Students will learn basic paper craft skills and use those skills in hands-on activities that will introduce them to prototyping, iterating, and the design process. They will be led through a scaffolded paper airplane prototype activity before being introduced to prototyping and design process concepts. Next, they will be introduced to paper crafting techniques. Finally, students will develop and prototype their own solution to one of several different design prompts that will challenge them to think critically and creatively, applying these newly taught concepts.

Logistics

Time: 1 - 1.5 hours
Materials: Any kind of paper (required), scissors and tape (optional)
Suggested age: 12-18
Prerequisite experience: None required

Learning goals

Students will:

- Learn to communicate and develop their ideas using 3D models, and feel empowered to do so
- Practice creative thinking and problem solving skills
- Get comfortable with failing and learning from failure
- Gain a basic understanding of what prototyping and iterating are
- Practice new techniques to develop a project using paper
- Understand and be able to apply different folding techniques
- Learn new ways to cut paper without scissors

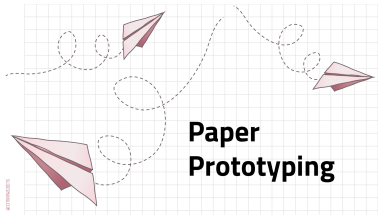
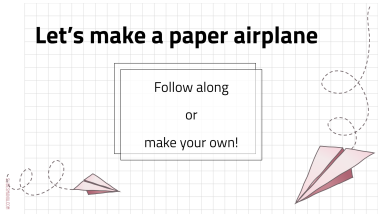
Suggested notes and tips for running the workshop

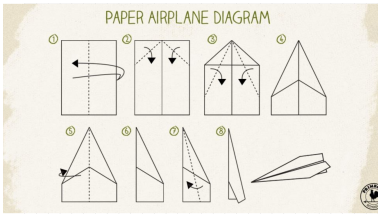
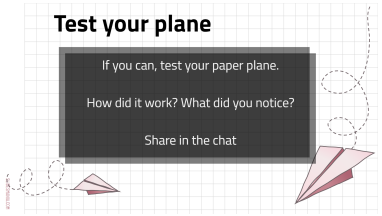
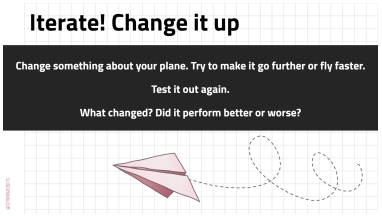
- Make sure to have paper; scrap, printer, construction, colored, or loose leaf all work fine.
- If you are working remotely, make sure you have an adequate camera setup. Show the entire piece of paper in frame with room to spare around the edges. Make sure not to block the paper with your hands too much. If you are in-person, have the students gather around a central desk.
- If you are showing your paper on camera, prepare your set up beforehand. Make sure that there is enough contrast to see where you've made your creases and folds.
- If you have scissors or tape, you can use them however the lesson is designed such that every activity can be done with only paper.
- Walk the students through the steps with you and redo any steps after you show them the first time to help them get a better understanding, especially because students may not feel comfortable asking for help/you to slow down.
- Make sure the discussion is relatable to how paper materials can be useful.

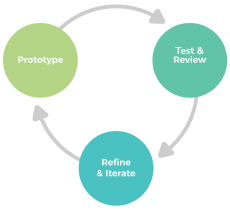
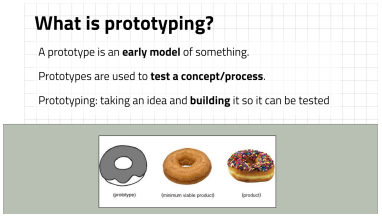
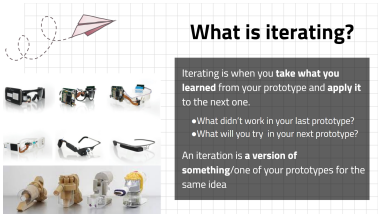
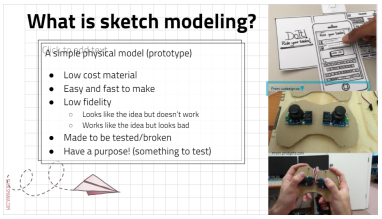
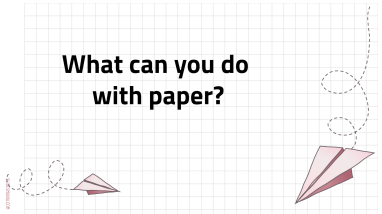
Please use these materials and tailor them to your students!

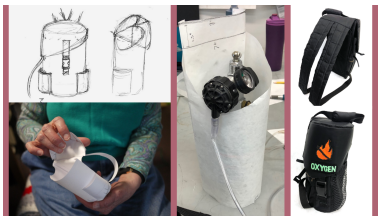
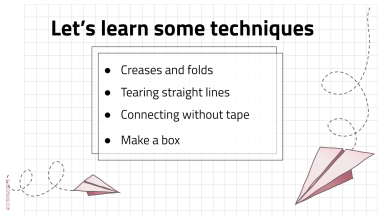
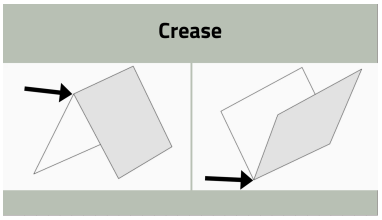
We encourage you to use these materials, editing and modifying them as appropriate for your students! When you use, share, incorporate, or modify these materials, please keep the license notice (from the footer) and credit "Olin College's course on Mathematics/Engineering Outreach for Adolescent Learners." We also humbly request that you email sarah.adams@olin.edu if you use these materials, as we are tracking their impact and how far they travel!

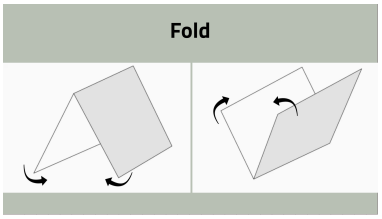
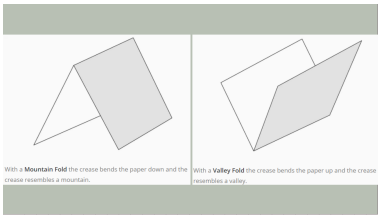
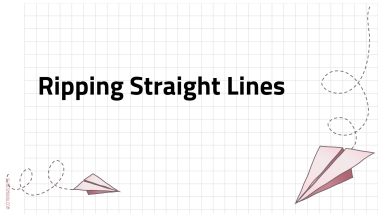
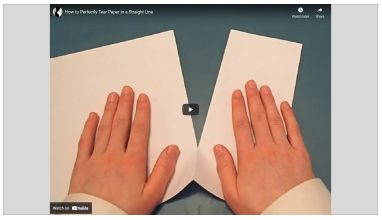
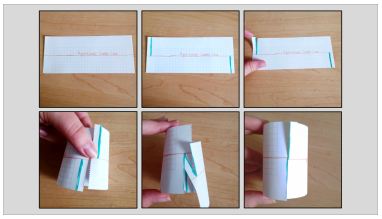
Slide notes

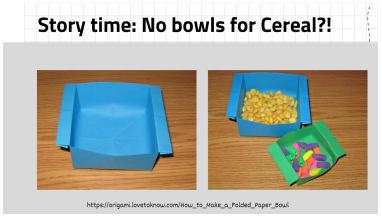
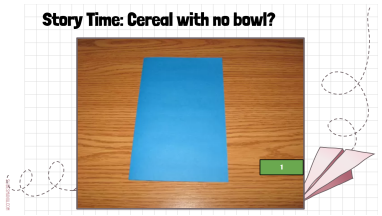
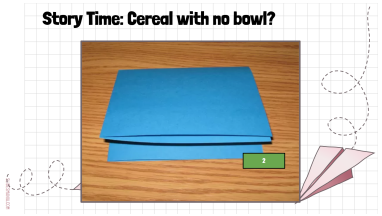
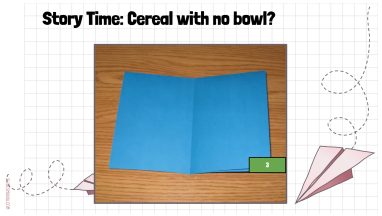
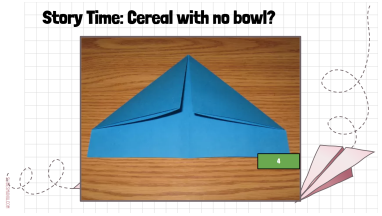
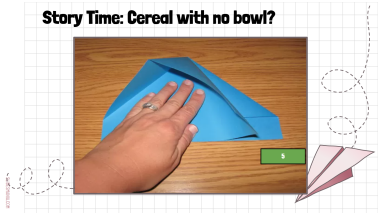
Link to workshop slides:	https://docs.google.com/presentation/d/1AfthgK15aS7QGgZ5tCje_m99_qP0jPQ_UbExxoyGcgE/copy
Slide 1 	• Example way to get students excited: "Today we are going to learn about the process designers and engineers use to communicate ideas and invent new things. We will learn about iterating, prototyping, and how to do this with paper!"
Slide 2 	

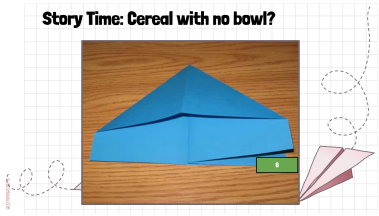
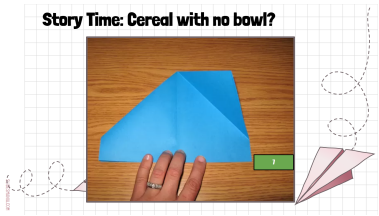
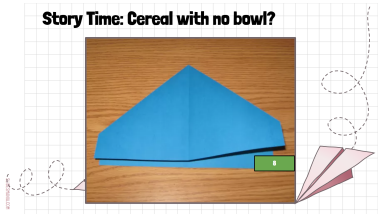
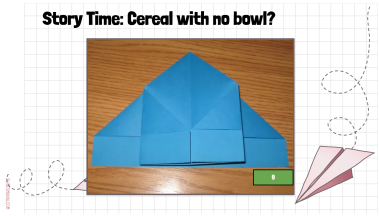
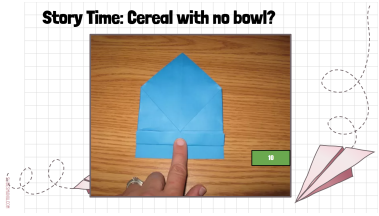
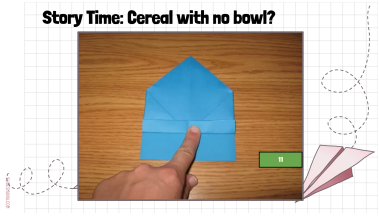
Slide 3  	• Leave this slide up for students to see as you do a live demonstration, walking through it step by step. Go slowly and move through the step several times, showing both the before and after. • Make sure not to cover your hands and make sure that the orientation of your plane is the same as the slides when you show it to the students to help prevent confusion. • Image from primroseschools.com
Slide 4  	• Give the students time to reflect and think about the characteristics of their own plane. Planes can perform slightly differently depending on how clean the folds are. • Give the students an opportunity to share how their plane did.
Slide 5  	• Give some examples of a task or something for their plane to be able to do that it wasn't after slide 4. • For example, ask them to try making their plane turn left, spin as it flies, fly further, prevent a nosedive, etc. • Also, give some examples of characteristics of their plane that they could change. • For example, you could add little flaps to the tips of the wings, either on one or both sides. You could shorten the length of the nose of the plane. You could fold the wings over themselves again. • Give the students an opportunity to share how their plane did.
Slide 6 	• Show the students some real world examples. It will help ground the activity and what they just learned/are about to learn in something real, meaningful, and "adult" (tell them how they went through the same steps that real designers/engineers do). • Examples like the one in the top or bottom left have shapes that you could easily make into a paper airplane. Doing this helps to reinforce that this type of process is actually used and not just reserved for students like them. • Images, top left to bottom right, are from: researchgate.net, kitplanes.com, spectrum.ieee.org, and Tommy Lewandowski on Pinterest

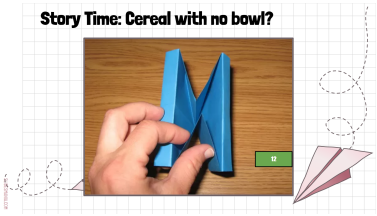
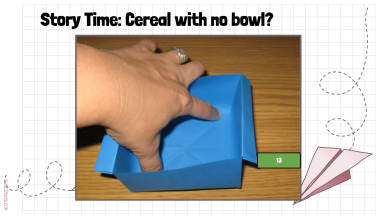
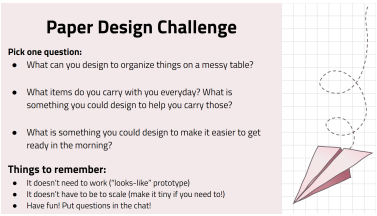
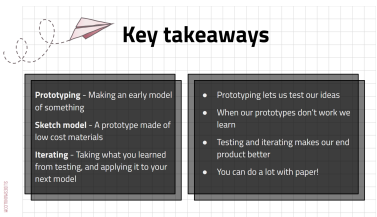
Slide 7 	• Reinforce the steps of the process they just performed. • First, the students built a first prototype, the plane that you walked through folding with them. Then, they tested it and observed how it performed. Did it fly straight? Did it take a nosedive? Then, they refined and iterated on that first prototype, coming up with an objective such as making it fly further, and making changes to try and accomplish that goal. • Image from uxdesign.cc
Slide 8 	• Introduce the new concepts and give examples about how they are important. • Prototyping is used to test an idea that you have. A prototype is an early version of what you're trying to make. • It doesn't have to be perfect. What you learn from testing and failing with your prototype informs your decisions so that the final product is better. • Image from uxdesign.cc
Slide 9 	• Introduce concepts of iteration. • Give real examples of what iteration is, real products, and how they were improved over their various iterations. • Google Glass (picture on top left) is a hands-free smartphone in the form of glasses. You can see six iterations of Google Glass starting with a prototype made of safety glasses and a cell phone. Each iteration gets a little better until the final product is reached. • Images, from top to bottom, are from dailymail.co.uk and Wenchien Wu on Pinterest.
Slide 10 	• Introduce sketch modeling concepts. Narrow the scope on paper and how its use fits into prototyping skills/tools. • Images, from top to bottom, from uxdesign.cc and phidgets.com
Slide 11 	

Slide 12  	• Share some kind of anecdote or real example of paper prototyping and iteration to make it feel like these processes are important and actually used in real projects. You don't want to make it feel "dumbed down" because you're using paper. • One example from an Olin College student: They were working on a project where they were designing a bag for a woman's oxygen tank. They had an idea for it which they made a sketch of, and they showed her this sketch. However, she couldn't understand what they were describing or what the sketch was trying to show. Someone on the team made a small, hand-sized paper prototype that the woman could hold. That prototype helped her understand how the bag would work, and she was really excited about it. So, the team made another prototype for the bag that was the right size, so they could test different things before they made the final product.
Slide 13  	• Introduce the techniques you're going to teach so that students have an idea about what is going on. Knowing what is coming really helps the students. • This is also to build up a foundation and a level of confidence in their abilities so that when they get to the final design challenge, they have some ideas on how to start. • This also gives them concrete skills that they can walk away with that they can use in the future.
Slide 14  	• The difference is important, especially for following along with the more complicated examples that will follow. • Having crisp lines is important for making your model as clean as possible. • By making the correct fold (important, but out of the scope of this workshop), your model will naturally move into position.
Slide 15  	• Crease refers to the line or the mark that you make in the paper. • Images from origami.me

Slide 16 	• Fold refers to how you bend the paper over on itself. The act of folding creates a crease in the paper. • Images from origami.me
Slide 17 	• By the time you leave this slide, make sure that you've made the difference super clear. • Images from origami.me
Slide 18 	• This is important because if you're out somewhere and need to convey your idea to someone else, you might not have scissors or a knife with you. • Knowing how to tear a straight line without those tools will help you to make paper prototypes without any tools.
Slide 19 	• Video from "Tearing Paper" on YouTube.
Slide 20 	• Important for the same reasons as ripping straight lines without scissors. You will not always have tape with you when you need to make a paper model to convey your idea to someone.
Slide 21 	• Make it clear that this doesn't have to be used with just a tube and that it can be applied to any other scenario.

Slide 22 	• Images from this slide, 23, to slide 35 are from origami.lovetoknow.com
Slide 23 	• Walk through the process step by step. Show the slide for each step and like the paper airplane activity, go slowly, show the before and after, and redo steps even without being asked.
Slide 24 	• Fold the paper once Vertically and then horizontally. • Then unfold
Slide 25 	• Fold on the horizontal crease then fold the vertical crease away from you so it looks like a book.
Slide 26 	• Fold the top corners to the center crease line.
Slide 27 	• This is where students may get lost. Take extra time on this step. • Grab the upper corner of the left side and open it up. • When open, make sure the corners meet with each other and fold down flat.

Slide 28 	• Flip the top layer on the right side to the left side.
Slide 29 	• Flip up the corner of the right triangle you made from the corner in step 4.
Slide 30 	• Fold the triangle inware between the two layers (this may be a bit difficult for the students to understand). Take extra time here.
Slide 31 	• Fold the left and right side of the top lay to the center crease (it is ok if they are not the same height, they just have to be on the center crease). • Repeat on the other side.
Slide 32 	• Fold the bottom of the layer up to the corner of the inner triangle (If they are asymmetrical, fold to the higher triangle). • Repeat on the other side.
Slide 33 	• Do the last fold again one more time on the fold itself and repeat on the other side.

Slide 34 	• Face the bottom of the paper and open the inside.
Slide 35 	• Make sure you have a flat surface to open it on and press the inside down flat on the table.
Slide 36 	• Introduce the final design challenge • Remind the students of key concepts before starting, especially those about the fidelity and functionality of their prototype. Their prototype doesn't have to be the same size as what the "final product" would be, it doesn't have to look amazing, it doesn't have to be durable. All it has to do is test or communicate their ideas. • Tailor the prompts to your population of students. What kind of experiences have they had? What can they relate to? What kinds of questions would they be? • Give them a choice with around 2-3 prompt options. You want creativity, but you don't want to overwhelm them with the number of choices available. • You could extend this activity as a homework assignment to give students more time; do a share-out the next class meeting.
Slide 37 	• Drive home the final key takeaways one last time. • Prototyping - Making an early model of something • Sketch model - A prototype made of low cost materials • Iterating - Taking what you learned from testing, and applying it to your next model • We make prototypes so we can test our ideas and see what does and doesn't work. • We learn the most when they don't work. When we iterate and apply what we learned, it makes our final product better. • With just some paper and a few techniques, we can model and test our ideas.

Slide 38