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Design a Lantern and Light It Up!

Using the engineering design process, students will prototype, design, and refine a paper lantern. Students will then create a circuit to light it up.

Grade Span

2-6

Program

Fab@School MAKER STUDIO™
Creatively Designed by DR. PEGGY HEALY STEARNS AND FABLEVISION STUDIOS

www.fabmakerstudio.com

Deliverables

A paper lantern with circuitry to control light.

Resources

- Examples of paper lanterns
- Video: Fab@School Maker Studio Tutorial: Getting Started
- Video: Fab@School Maker Studio Tutorial: Shapes
- Video: Fab@School Maker Studio Tutorial: Cut Fold Tab

Big Idea

Perseverance is critical to solving problems.

Driving Question

Is there always only one "right" answer?

Author

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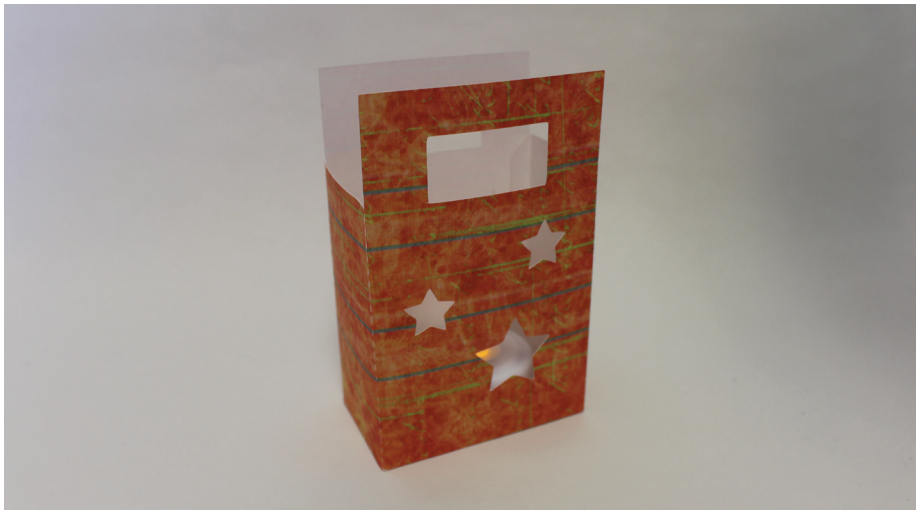

From wintry December to steamy July, flickering candles to fireworks, light transforms the mundane to magical. The Fab@School Maker Studio lighted lantern challenge introduces the concept of 3D design and developing circuity.

Objectives

- Students will use the engineering design process to define a challenge, criteria and constraints, and brainstorm, design, evaluate, and improve a solution.
- Students will use appropriate math practices and tools to attend to precision while addressing measurement and geometry standards.
- Students will use Fab@School Maker Studio tools including **Shapes**, **Tabs**, **3D Viewer**, and **Math Tools** to create a digital design for a paper lantern.
- Students will take their digital design one step further and fabricate the lantern net with a digital cutter.
- Students will design a basic series circuit using copper conductive tape, an LED light, and a coin cell battery.

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Materials

Lantern

- Fab@School Maker Studio
- White or color cardstock (65 lb. recommended)
- Glue or tape
- Printer or colored pencils or markers (optional)

Circuitry Materials

- Copper conductive tape
- 3mm LED lights
- 3V coin cell batteries

Alternative Light Source

- LED tea lights

Aligned Standards

CCSS

- CCSS.MATH.PRACTICE.MP1, MP5, MP6
- CCSS.MATH.CONTENT.2.MD.A.1
- CCSS.MATH.CONTENT.2.G.A.1
- CCSS.MATH.CONTENT.5.G.B.3
- CCSS.MATH.CONTENT.6.G.A.4

NGSS

- Engineering Design: ETS1, ETS1.A, ETS1.B, ETS1.C
- Physical Science: PS3.B, PS3.D

Massachusetts DLCS

- 3-5.DTC.a.3
- 3-5.DTC.b.2

Challenge

Design a paper lantern and the circuitry to light it.

Criteria

Ask students to define criteria for success — e.g., the lantern must be large enough to incorporate circuitry or house an LED votive. What else? Explain that sometimes it's not possible to satisfy all criteria. Ask students to decide which criteria are most important.

Constraints

Show students what materials are available. Ask them to help define constraints — e.g., limits on time and materials.

Workshops

Part 1- Make the Lantern

Brainstorm Solutions

1. Break students into small groups to brainstorm solutions. Encourage students to search for images of lanterns online and share them.

2. Ask students to sketch design ideas on a piece of paper.

3. Tell students to evaluate their designs based on the stated criteria and constraints and personal preference. Tell students to choose and refine their favorite design to create in Fab@School Maker Studio.

Design and Fabricate

1. Have students use Fab@School Maker Studio to design their prototype. Older students and those comfortable with Fab@School Maker Studio may design their lantern from scratch. Those less comfortable with the software can start with the Lantern template found in Ready-Made projects and modify the design.

2. Remind students to use Fab@School Maker Studio's Math Tools - **Grid**, **Manipulative Ruler**, **Manipulative Protractor**, **Dimensions**, and **Scale** - to be sure their design meets criteria.

3. Have students fabricate their lanterns.

Evaluate and Improve

1. Ask students to evaluate their prototypes. What do they like best? What needs improvement? Encourage students to share with each other to elicit more input.

2. Have students use feedback to develop ideas for improving their lanterns and return to Fab@School Maker Studio to refine their designs. ***Note:*** *If students plan to add circuitry, they will need to deconstruct their lantern later to work with the flat pattern or create a new net.*

Fab@School Maker Studio Tips

Magnetize: If you want shapes to automatically snap and create fold lines when you drag them together, be sure **Magnetize** tool is on. To learn more about the tool, have students watch the Fab@School Maker Studio Shapes Tutorial video.

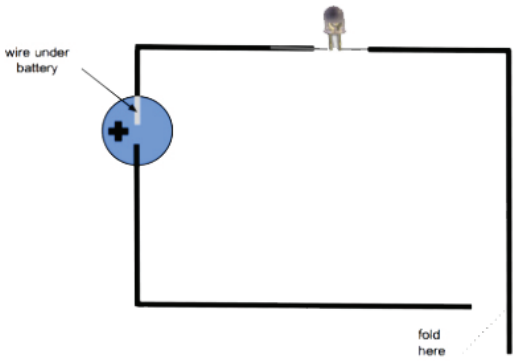
Resizing Shapes: When creating nets or flat patterns, it's easiest to resize shapes before you snap them together. If you resize a shape that's already snapped to another, you will need to drag the shape away and resnap it to maintain the fold line. To learn more about shapes, have students watch the Fab@School Maker Studio Shapes Tutorial video.

Tabs: Tabs are used to facilitate construction and are handy to finish package flaps. To learn more about tabs, have students watch the Fab@School Maker Studio Cut Fold Tab Tool Tutorial video.

3D View: Expand the 3D viewer in the lower right to preview your folded construction. Note that the first shape you place will be the base and the construction will fold from that plane. Tabs don't show in 3D viewer.

Part 2 - Light the Lantern

Design, create, and test a series circuit with a switch using copper conductive tape, a coin cell battery, and an LED light. The two images below provide ideas for simple circuits that can be applied to this activity. Ask students to help define criteria and constraints.



Brainstorm Solutions

1. Have students use a schematic, like the ones above, as a guide to design a series circuit for their lantern. Encourage them to illustrate where they will place the copper conductive tape, coin cell battery, LED light, and switch. For more information and tutorials about circuits visit, Learn.SparkFun.com

2. Instruct students to choose a design and sketch the schematic directly on the back (inside) of their unfolded lantern.

Create

1. Give each student copper conductive tape, a 3V coin cell battery, and a 3mm LED light to create their series circuit. Suggest they test their LED and battery by pressing the longer positive pin against the positive (top) side of a coin cell battery and the shorter negative pin against the negative side of the battery. If the bulb lights, LED and battery both work.

2. Have students use their schematic to place the copper conductive tape, battery, and LED. Tell them to fold the copper tape around corners (rather than cut the tape) to be sure the circuit is continuous.

3. Test the circuit by pressing the switch. If the LED lights, secure the battery and LED in place. If the LED doesn't light, use the troubleshooting tips below.

4. Once your circuitry is complete, be sure all the circuit elements are secure and tape your lantern together.

Troubleshooting

- Be sure the battery and pins of the LED contact the top of the copper conductive tape which is more conductive than the sticky bottom side.
- Be sure the top side of the copper conductive tape contacts the positive (top) side of the battery at one end and the negative (bottom) side of the battery at the other end in order to create a complete circuit.
- Be sure the longer positive pin runs to the positive side of the battery and the negative pin runs to the negative side. If you reverse the direction, the LED will not work.
- Be sure closing the switch completes the circuit. Check, for example, that the tape securing the battery does not cover contact points.

But Wait, There's More

Now that your students have created lanterns and learned about circuits, encourage them to explore other options. Your students could:

- Design and decorate lanterns to celebrate specific holidays or occasions.
- Use similar construction techniques to design tree or party ornaments.
- Create a parallel circuit that lights multiple LED bulbs with when you press the switch.
- Design homes, buildings, and other constructions and create circuitry to light them.
- Build a car with working headlights.
- Develop an amusement park that uses solar energy to power their lights.