

Lesson 2: Design a Device (Day 1)

Summary

The goal of this lesson is for teams to come up with designs for a magnifying device. The class brainstorms criteria for a good device, then groups work together to come up with a design. By the end of class, groups submit to teacher a design and list of desired materials. (If you approve their design and materials, they will receive building materials at the start of the *next* class.)

If this is students' first engineering design activity of the year, share the Engineering Design Process handout included at the end of this lesson.



Hi Tech option If your students have access to computer-aided design (CAD) software, they can design their device using CAD.

Next Generation Science Standards

Disciplinary Core Ideas

- ETS1.B Developing possible solutions.

Science and Engineering Practices

- Asking questions and defining problems
- Planning and carrying out investigations
- Constructing explanations and designing solutions

Cross Cutting Concepts

- Structure and function

Materials

Building materials (provided by teacher; additional materials may be brought by students) such as:

- ★ cardboard
- ★ cardboard tubes

- ★ plastic or paper cups
- ★ construction paper
- ★ tape
- ★ scissors
- ★ other materials you may have on hand such as foil, egg cartons, plastic tubing, wooden dowels (optional)

Safety: any additional materials students want to bring in must be approved by you.

- ★ Engineering Design Process handout (included at the end of this lesson)

Engage/Elicit (5 min.)

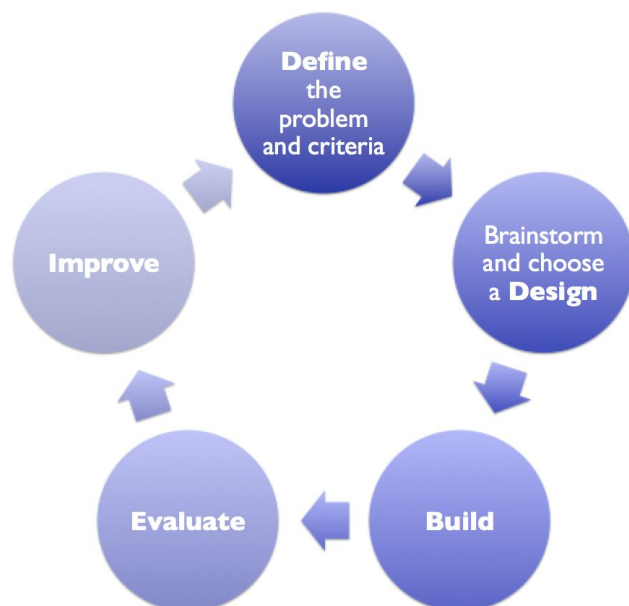
❖ What ideas did you have for a device that magnifies?

- Ask students to discuss their ideas with their partner. They will be working in partners to design a device today.
- Let students know they are just sharing their preliminary ideas. They will refine these after the group brainstorming. They shouldn't get too attached to their ideas, and they shouldn't worry if they didn't have many ideas.

Explore (15 min.)

Students use the engineering design process to design a device that magnifies.

- Share the Engineering Design Process.



- Review students' findings from their exploration with lenses.
- Ask how they might design a device that magnifies tiny objects so they can be seen better.
- As a class, brainstorm criteria. This is an important first step! e.g. it should be easy to use, it should be adjustable, it should allow you to have one hand free or both hands free, etc.

- ❖ Look at the materials that are available. Think about what you might use to build your device.
- ❖ Working on your own, sketch what you think the device might look like. Sketch one or two ideas.

- Pause and check in with students. Students should have sketched at least one idea. Now have them share with their partner and agree on a design.

- ❖ Show your design to your partner and explain it.
- ❖ Combine your ideas into one design that you both agree on.
- ❖ Does your design satisfy the criteria? If not, revise it until it does.
- ❖ Draw a diagram. Label it with measurements.
- ❖ List all the materials you will need to build it. Make sure your list is clear and complete.
- ❖ *You must turn in your design and materials list before the end of class. Your teacher will need to approve these before you can begin building tomorrow.*

You will need to approve each group's design and materials list and prepare the materials they will need for the next class period. Materials are limited to what you can provide and what students choose to bring in (approved by you for safety).

Safety notes: Any materials they choose to bring in must be approved by you. If students need something cut (other than paper or cardboard) you might consider cutting it for them.

- (Recommended) Gather the materials based on each team's materials list in bags or trays so you can place them on the tables at the start of class tomorrow. Alternatively,

one or two representatives from each group can come up with an approved materials list to gather what that group needs.

Explain (15 min.)

- If time, have one or two groups share their designs and explain the purposes of different features.

Elaborate (5 min.)

- Highlight how groups used the engineering design process.
- Unless you have enough lenses for all your classes, make sure students understand that they will have *only one class period* to build their devices. They will need to take them apart before the end of the period. They should come in ready to build.

Extend

Students might choose to do additional research, fine-tune their designs, or bring additional materials from home. It is NOT beneficial for students to follow instructions that they found in a book or online. This is following a recipe and not engineering design. However, they can incorporate new ideas to improve their designs.

Evaluate (5 min.)

- Review students' labeled drawings to determine whether they have a sufficiently clear plan to receive materials and begin building in the next class period.

Homework

- ❖ How did you use the Engineering Design Process today? What will you do next? **Students defined the problem and criteria, and designed a solution. Next they will build, evaluate, and think about how to improve.**

Students may look for additional materials to bring for use in building their device (optional).

Engineering Design Process

