

Lesson 1: Lenses

Summary

Students explore with lenses as an introduction to how microscopes work.

Next Generation Science Standards

Disciplinary Core Ideas

- ETS1.B Developing possible solutions.

Science and Engineering Practices

- Using mathematics and computational thinking
- Obtaining, evaluating, and communicating information

Cross Cutting Concepts

- Scale, proportion, and quantity

Note: The physics of how lenses work is not part of the standards for this grade. Diagrams and discussions do not need to include light rays.



Vocabulary

lens

magnify/magnification

Materials

- ★ Hand lenses (1 per student, plastic is fine)
- ★ Rulers, preferably metric
- ★ Something small to project for the Engage activity: feather, ants in a petri dish, etc.
- ★ pieces of paper with words printed on them (e.g. old worksheets or magazines; groups can cut up and share)

- ★ a word wall for words that students will be learning in this unit (recommended for all students, and especially for English language learners)
- ★ a reading or video clip about the invention of the glass lens (optional, as an Extension)

Engage/Elicit (5 min.)

Elicit

OPENER

- ❖ Have you used a hand lens before? What did you look at?

→ (Optional) Based on the Elicit answers, consider letting students explore with a hand lense in the school garden or other setting.

Engage:

- Project something small, such as ants in a petri dish, on the projector.
- **EL** Particularly for English learners, demonstrate and explain the words **lens** and **magnify**. Set up a word wall for the unit and add these words.

- ❖ Why is it helpful to magnify something? Give an example of when it might be useful to see something magnified.

Explore (15 min.)

→ Let students explore with a hand lens, looking at words on a page. You might choose to just let them answer these questions verbally with their group, without writing them down.

1. Investigate with the hand lens. Share ideas with your group.
2. How large can you make the letters appear? **Answers will vary depending on the lenses used. Sample answer: around 2-3 times as big; a letter that is 5 mm tall with the eye might be 10- 15 mm tall with a hand lens.**

3. Can you make the letters appear upside down? Yes, if you move the lens farther up from the paper, the letters will become blurry first, and then will appear upside down. For example, at 5 cm above the paper the letters might be larger, but at 12 cm above the paper, they might be upside down.
4. How can you make the letters appear even larger? Moving the lens up from the page enlarges them, up to the point at which they become blurry. Students might also discover that they can use 2 hand lenses for greater magnification.
5. What distances (from the object to the lens, from the lens to your eye, etc.) make the letters appear the largest? Answers will vary, but for example around 5 cm from the paper to the lens and around 30 cm from the lens to their eye works well.

- Pause and check in with groups. Have groups share interesting findings.
- Partners may discover that they can combine their two hand lenses, essentially using one to magnify the other. Have them report and explain. If no one has discovered this, challenge students to think of a way to make the letters appear even larger.
- Give students a few more minutes to explore.

Explain (15 min.)

- Discuss as a class. Have students write their answers to these questions.

6. How much are you able to magnify the letters using two lenses? (for example, twice as large? ten times as large?) How can you figure this out? You need to measure the original and the magnified image. For example, if the letter is 2mm wide and you magnify it to 6mm, you have magnified it by a factor of $3\times$.
7. What are the optimal distances (the distances that magnify the letters the best)? Answers will depend on the lenses used. To make the image as large as possible, the lens might be around 5 or 6 cm from the page. Beyond this there might be blurring or rainbows around the edges. Around 12 cm from the page, the image is larger but appears upside down.

- See if students can explain their answers to the first question, which is about [scale](#). In order to know how much you are magnifying something, you need to measure the original and the magnified image. For example, if the letter is 2mm wide and you magnify it to 6mm, you have magnified it by a factor of 3x. They will investigate magnification power further after they are introduced to the microscope.

Elaborate (5 min.)

8. DRAW A DIAGRAM and explain what you did. Draw at least two of your arrangements. Label your diagram with all the important measurements.
9. By what factor did you magnify the letters? **Depending on the lenses used, the answer will probably be 4x or 5x at most.**

Note: The physics of how lenses work is not part of the standards for this grade. Diagrams and discussions do not need to include light rays.

Extend

EXTENSION

- ❖ Are more lenses better? Why or why not? **Possible answers: Yes, because you are able to magnify the image more; for example with one lens you might get 2x or 3x, but with two lenses you might get 4x. If students experiment with three or more lenses, they will find that there is not much improvement due to distortion.**

- (Optional) Bring in history/ READING about the invention of the glass lens.

Evaluate (5 min.)

- Collect students' diagrams, or look at them before students leave, to gauge how well they can explain what they did and **communicate** the difference between 2 different arrangements. Also note how well they can diagram. This is an important skill that will be built up in the next few lessons and as the year goes on.

Homework

(In preparation for the next lesson)

HOMEWORK

- ❖ In the next lesson, you will design a device that makes the words appear as large as possible. Imagine how you might build this device and what features you would like it to have. List or draw some of these features.
- ❖ If you wish, bring in materials to build the device. (Your teacher will provide materials you can use. With your teacher's permission, you may bring in additional materials.)