



A Lesson From CAP's Astronomy Activity Booklet Building a Telescope –PVC Pipe and Paper Towel Roll

Credit for this lesson: Bouchet Outreach and Achievement in Science and Technology (BOAST) in Illinois

Next Generation Science Standards Correlations: Relationship to A Framework for K-12 Science Education Practices, Crosscutting Concepts, and Core Ideas

Objectives: Students will learn the parts of a telescope and how they work together to view an image by constructing a telescope.

Practices:

- 2. Developing and using models
- 4. Analyzing and interpreting data

Crosscutting Concepts:

- 3. Scale, proportion, and quantity
- 6. Structure and function

Core Ideas:

- PS4.A: Wave properties
- PS4.B: Electromagnetic radiation
- PS4.C: Information technologies and instrumentation



Background Information:

There are two main types of telescopes: refractor and reflector. A refractor telescope uses two lenses to magnify distant objects. A reflector telescope uses a series of mirrors. The purpose of a telescope is to make objects that are far away seem closer, so they can be seen well. Telescopes have two main parts: the first lens and the second lens. The first lens is called the objective lens and the second lens is called the eyepiece.

Materials:

- Copy of the Telescopes chapter of this book and copy of the parts of the Celestron FirstScope telescope.

PVC Pipe Telescope

- One 38 mm (3.75 cm) thick double convex lens (Nasco item #SB10480M) (Nasco is an educational supply company – website is at <http://www.enasco.com/science/>)
- One 38 mm (3.75 cm) thin double convex lens (Nasco item #SB10476M)
- 2 pipe adapters (1" by 1 ¼ ")
- 2 pipe couples (1 ¼ ")
- 35 cm length of 1 ¼ " diameter PVC pipe (schedule 40)
- Ruler with metric scale



Paper Towel Telescope

- One 38 mm (3.75 cm) thick double convex lens (NASCO item #SB10480M)
- One 38 mm (3.75 cm) thin double convex lens (NASCO item #SB10476M)
- Clear polyvinyl tape
- One 5" by 9" sheet of black construction paper (15 x 22 cm)
- Paper towel roll
- Stickers (or bright colored crayon or marker)



Procedure:

1. Students should receive a set of materials and discuss the background information included in this lesson.
2. Students should be given a copy of the parts for the Celestron FirstScope to compare to the parts of each telescope that they will make in this activity.

PVC Pipe Telescope

Students should:

1. Press a pipe adapter into the pipe couple. Make sure that the adapter goes all the way into the couple. You may need to push the couple against a table or the floor.
2. Repeat this procedure for the other pipe adapter and couple.
3. Place one lens through the opening of the couple (it doesn't matter which lens you put in which end because you can always turn the telescope around and use the opposite end). Note: Be sure to label the lenses so you know which end is the thick lens and which end is the thin lens. The lens should rest inside the couple, against the rim of the adapter.
4. Place the couple on the floor with the adapter side down. Be sure the lens is resting flat against the adapter inside the couple.
5. Push one end of the PVC pipe into the couple. Keep pushing until it will not go any further.
6. Gently shake the pipe. If you hear or feel a rattling, you need to push the pipe further into the couple to secure the lens.
7. Place the second lens in the other couple as described above.
8. Push the other end of the PVC pipe into the second couple and check for rattling.
9. You are now ready to use your telescope!
10. The thick lens of the telescope is the eyepiece, the lens you look through. Look through the thick lens to magnify objects.

Remember: Never look at the sun with a telescope! It can damage your eye!

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Paper Towel Roll Telescope

Students should:

1. Place the thin lens inside one end of the paper towel roll. The lens should be even with the end of the paper towel roll. Note: All paper towel rolls do not have the same diameter. If the diameter of the roll is larger than the diameter of the lens, you may need to roll a piece of construction paper and insert it into the paper towel roll.
2. Tear off a few inches of polyvinyl tape. Cut small tabs into the tape so that it curves with the lens and paper towel roll.
3. Place the tape on the paper towel roll and on the lens. Try to cover the surface of the lens as little as possible for optimum visibility.
4. Roll the 5" by 9" piece of construction paper into a tube that is just slightly smaller than the paper towel roll.
5. Insert the construction paper tube into the paper towel roll. Be sure that the construction paper tube can be moved in and out of the paper towel roll.
6. Tape the construction paper tube so that it stays rolled.
7. Place the thick lens into one end of the construction paper tube you just made.
8. Tape the lens to the construction paper tube the same way you secured the other lens.
9. Place the open end of the construction paper roll into the open end of the paper towel roll. Note: There should be a lens showing at each end of the telescope.
10. A tab must be added to the construction paper tube so it does not completely slide into the paper towel roll. To make this tab, tape two pieces of polyvinyl tape to each other. Fasten this tab to the construction paper tube.
11. Look through the thick lens of the scope. To adjust the focus of the telescope, slide the construction paper tube in and out of the paper towel roll.
12. When you have found the best focus (which should be about 35 cm, with the lenses used in this activity), place a sticker or make a mark on the construction paper roll where the construction paper enters the paper towel roll. This will indicate the best position to view objects.

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Summary:

This activity allows students to construct and use a homemade telescope. Comparing and contrasting each type of homemade telescope with the Celestron FirstScope furthers understanding of the telescope and its parts.

Evaluation:

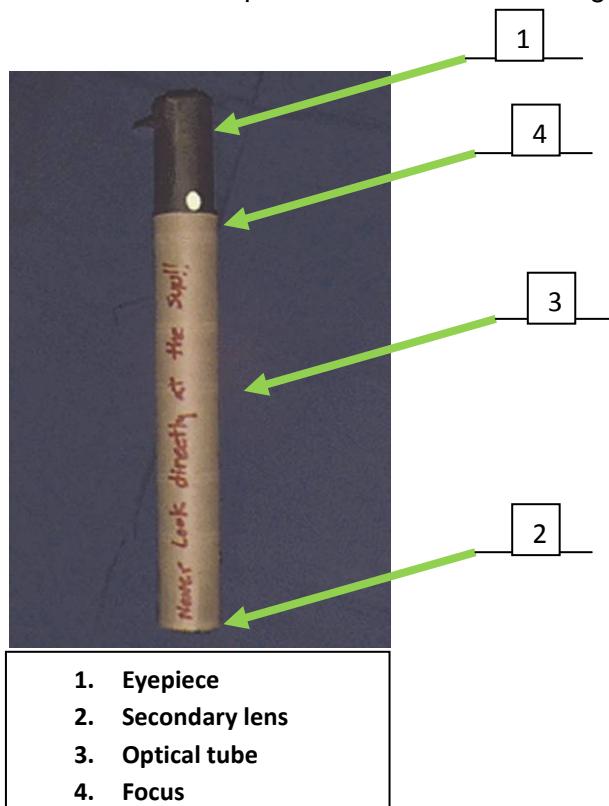
Students should successfully complete the telescope comparison worksheet. Note: The major difference between the telescopes that students assemble in this activity and the Celestron FirstScope is that the built telescopes use lenses and the Celestron uses mirrors.

Additional Resources and Enrichment:

1. The youtube video at <http://www.youtube.com/watch?v=uZeF1KETaU4> tells how to build your own refracting telescope out of everyday materials.
2. Kits can be ordered from vendors such as Science First on How to Make and Use a Project STAR Telescope. Science First's website is www.sciencefirst.com.

Answers for Student Worksheet

1. Answers will vary.
2. The telescopes that the students built are refracting telescope with lenses. The Celestron FirstScope is a Dobsonian reflecting telescope that uses mirrors.



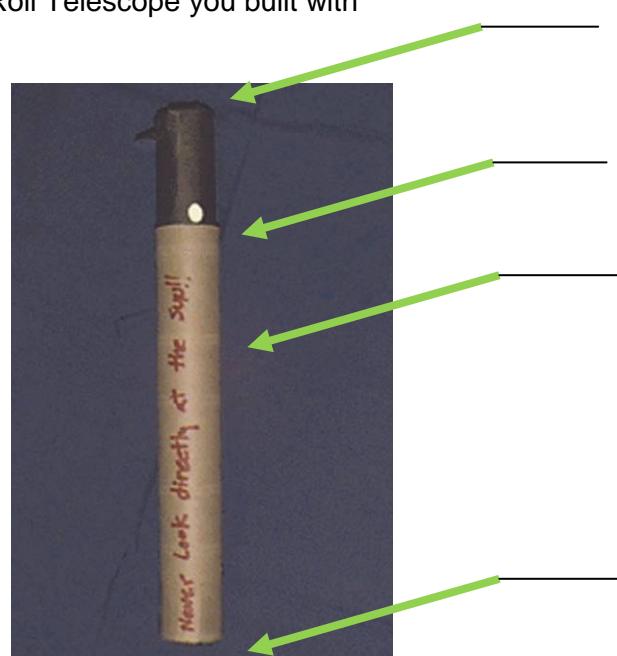
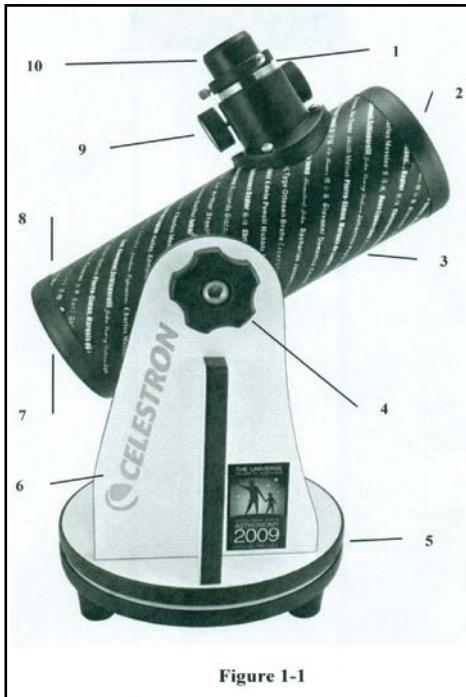
Activity One: Worksheet for Building a Telescope

Name: _____

1. Look at three objects at three different distances with each telescope that you built. Draw a diagram of each view.

Distances	Distance #1 _____ m(yd)	Distance #2 _____ m(yd)	Distance #3 _____ m(yd)
PVC Telescope			
Paper Towel Roll Telescope			

2. Compare the telescopes you built with the Celestron FirstScope. What type of telescope is each and what are the parts? (Use back of paper to explain.) Use the diagram of the Celestron FirstScope below to label the Paper Towel Roll Telescope you built with similar parts.



- | | |
|---|-----------------------------|
| 1. Focuser | 6. Arm |
| 2. Secondary (Diagonal) Mirror-- inside | 7. Tube End |
| 3. Optical Tube | 8. Primary Mirror -- inside |
| 4. Lock Nut | 9. Focus Knob |
| 5. Base | 10. Eyepiece |
- 1. Eyepiece
 - 2. Secondary lens
 - 3. Optical tube
 - 4. Focus

1. Focuser	6. Arm
2. Secondary (Diagonal) Mirror-- inside	7. Tube End
3. Optical Tube	8. Primary Mirror -- inside
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5. Base	10. Eyepiece