Activities To Go

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In every issue of The Science Reflector look for this new section including activities you can use in your classroom tomorrow. If you have activities you would like to share please email the editor.

Build a Virus - Use this 5E Lesson to build an icosahedral virus model.

Build a Telescope - Learn about lenses as you create your own simple refractive telescope.

Build a Virus

from Nanoscale Science by Gail Jones, Michael Falvo, Amy Taylor and Bethany Broadwell
Download the sample chapter containing this activity, background information and the virus capsid pattern.

Materials

Each individual will need:

- Virus capsid template
- 10 meters of yarn
- Tape

Optional materials

- 3 pipe cleaners
- 1 pencil

Note: Copy virus capsid pattern on card stock for best results

Engage
Ask students to work with a partner to brainstorm as many names of different types of viruses as possible. Ask them, What viral diseases have you heard of? Show the class a series of photographs of different types of viruses. Ask them to describe the shapes of the different viruses. A great source for images of viruses is the The Big Picture Book of Viruses available online at www.virology.net/Big_Virology/BVHomePage.html. Viruses are not only beautiful to look at but they have amazing details and configurations.

Explore
Explain to the students that they will create a model of an icosahedral virus—a biological nanomachine. The icosahedral shape is very common and includes viruses such as the polio virus, adenovirus (common cold) and the virus that causes hepatitis A. Review the characteristics of viruses and the morphology of viruses. Point out the 20 triangular faces and 2-fold, 3-fold and 5- fold symmetry axes found on the icosahedral virus. Note that DNA or RNA is found in the center or the core of the virus capsid.

Instructions For Building An Icosahedral Virus

1. Make a copy of the virus pattern (page 37).
2. Cut along the outer edge of the pattern.
3. Fold and crease the bold lines.
4. Tape the edges together, leaving one side open.
5. Cut 10 meters of yarn to represent the DNA and place it inside your virus.
6. Tape the virus model closed.

Explain

Review the components of the virus. Describe the different shapes of viruses and the process viruses use to infect a host cell, replicate, and infect new viruses. Discuss theories about why viruses are symmetrical and have repeated faces composed of regular subunits.

Extend
Invite your students to find the most unusual virus they can locate on the internet. What is the shape of the virus? What is the host cell for this new virus?

Encourage your students to add to their virus model to more accurately represent specific viruses. What would it take to make the model look like HIV or herpes simplex?

Ask students to decide if a virus is living or nonliving. What defines life in this context? If a human engineered nanomachine could self-assemble and self-replicate, would it be considered living or not?

Research how viruses recognize and attach to specific types of host cells. How does a virus know when to penetrate a cell?

Evaluate
Show students a series of different virus images and ask them to identify whether or not it is an icosahedral or helical capsid virus type.

Check for understanding:

1. What is the shape of the virus model that you made?
   Answer: icosahedral

2. How many faces are there on the virus model?
   Answer: 20

3. What is the protein shell called?
   Answer: capsid

4. Why do most viruses take the form of one or two basic shapes? Why would two very unrelated viruses have the same shape?
   Answer: Given the small size of the virus and the limited amounts of DNA or RNA, scientists speculate that using repeated faces and a regular symmetry allows the virus to replicate with the fewest number of unique parts.

5. How is a virus like a machine? If you could alter a virus to benefit humans, what would you engineer the virus to do?
   Answer: This question allows students to think creatively about how viruses might deliver drugs, clean out plaque from arteries, gobble up fat cells, or provide extra calcium for bone repair or growth.

Build a Telescope
from Sensing the Radio Sky by the Pisgah Astronomical Research Institute

Materials:

Large diameter (approximately 7 - 10 centimeters) bi-convex lens
Small diameter (approximately 2 - 5 centimeters) bi-convex lens
Modeling clay
Meter stick
Blank white index card (4’ x 6’)
Table facing a window (window should be approximately same height as table top)
Procedure:

1. Place an approximately 1.5-inch ball of clay at the end of the table near the window, facing the window (parallel to it). Press it firmly onto the table. Press the edge of the large-diameter bi-convex lens into the clay so that the lens stands securely in the clay. This is the objective lens.

2. Hold the white index card behind the lens so that light from the window goes through the lens onto the card. Turn out the lights in the room. Move the card toward or away from the lens until an image from outdoors is focused on the card. Mark this position.

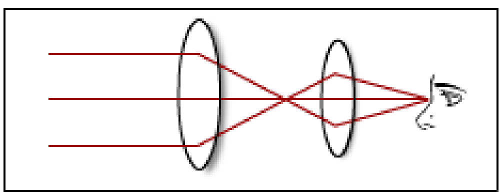
3. Use the meter stick to measure the distance from the center of the lens to the mark at the position of the card. Record this distance (i = image distance, f = focal length).
   $i_{objective}$ lens = ____________ = $f_{objective\ lens}$

4. Remove the large diameter bi-convex lens from the clay and replace it with the small-diameter bi-convex lens. Again, the lens should stand up in the clay without being held and without wobbling. This is the eyepiece lens.

5. Hold the white index card behind the lens so that light from the window goes through the lens onto the card. If they are not still out, turn out the lights in the room. Move the card toward or away from the lens until an image from outdoors is focused on the card. Mark this position.

6. Use the meter stick to measure the distance from the center of the lens to the mark at the position of the card. Record this distance.
   $i_{eyepiece}$ lens = ___________ = $f_{eyepiece}$ lens

7. Replace the small diameter bi-convex eyepiece lens with the large-diameter bi-convex objective lens. Mark the focal point of the large-diameter lens. Stand up the small-diameter lens with another ball of clay. The small lens should be behind the focal point of the large lens, in a position where its focal point is at the same mark as the large lens's focal point. The small lens should be placed so that it is in line with the large lens and parallel to it.

   Lens with focal length

8. To use the telescope, look through the eyepiece lens, through the objective lens, towards an object outside the window. If necessary, you can focus the telescope by moving the eyepiece lens a slight distance either closer or further away from the objective lens.

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