

Waterscope

Teacher Section

Overview Tide pools are best observed undisturbed. But, they're too shallow to snorkel... So how can we explore them without removing their inhabitants? With an Aquascope! Aquascopes are very cheap and easy to make. With only a coffee can, some plastic food wrap, and a couple of other items you can make a window into the world of tide-pools! In principle, aquascopes allow us to take a glass-bottom-boat tour of the rich ecosystems of tide pools. The plastic acts as the glass, while the coffee can allows us to break the distorting surface of the water.

Suggested Time 30-45 minutes

Objectives Students will understand the simple optics of a waterscope (also called an aquascope), and use it to observe organisms in water.

Materials (per lab group)

- milk or juice jug
- plastic wrap
- scissors
- rubber band

Lab Preparation

1. Print out copies of the student worksheets.
2. Read over the Background Lesson Reading before teaching this class.
3. Watch the video for this experiment to prepare for teaching this class.

Background Lesson Reading

You can't see clearly underwater with just your eyes for a couple of reasons. One is the thickness of the lens on your eye, but the main one is the index of refraction of water is different than that of air. Light rays bend when they travel from one medium to another of different density. The amount that the light bends depends on refractive index of each substance along with the shape. The eye focuses images on the retina, and our eyes are built for viewing in air. Water has approximately the same refractive index as the cornea which effectively eliminates the cornea's focusing properties. This is why you see a blurred image underwater. The eyes are focusing the image far behind the retina instead of on the retina. The waterscope puts a layer of air between your eyes and the water (the same way goggles do) so you can view underwater without blurred vision.

Lesson

1. Ask students if it would be better to go look at a fish underwater in a lake or the ocean (with the naked eye), or if it would be better to look at the fish in an aquarium.
2. If they say "aquarium" ask why. Say: *That's right! An aquarium will allow us to see the animals clearly, while underwater is muddy and blurry at best.*
3. Say: *We can't see well underwater because our eyes are adapted for viewing in air. When underwater, the water has the same refractive index as the cornea, which eliminates the cornea's focusing ability under water. So, everything looks blurry.*

4. Explain: *Today we are going to build a layer to put between our eyes and the water, which will help focus everything underwater, just like the glass of an aquarium does.. Our layer is a plastic wrap!! The plastic will function like goggles!*

Experiment

1. Review the instructions on their worksheets and then break the students into their lab groups.
2. Hand each group their materials and give them time to perform their experiment and write down their observations.
3. Clean out your jug first. Then cut the bottom and top off without cutting off the handle.
4. Cover the opening at the bottom with your plastic wrap, securing it in place with the rubber band. Use tape if you need extra support to hold the plastic wrap in place. The window needs to be water-tight.
5. Place the waterscope in the water, bottom-side down. You'll be able to see all kinds of interesting creatures through your scope!
6. Try to keep your scope still so the animals won't be afraid to come close to you so you can have a good peek at their world. The aquascope works the same way snorkel goggles work—except you don't have to get wet!
7. The key to the aquascope is the taught plastic wrap. If it's loose, or if there are holes, it won't work as well. Make sure that the plastic wrap is securely fastened to the can, and is stretched tight. If you find your waterscope leaks, use a stronger rubber band to secure your plastic wrap in place. You can alternatively use strong waterproof tape or hot glue to secure it in place, but use the rubber band first so you can stretch the film tightly over the open end.

Exercises

1. What is the term for light rays bending? (refraction)
2. Why is underwater vision blurred? (Because water has the same refractive index as the cornea, which effectively eliminates the cornea's focusing property.)
3. How can we focus vision underwater? (Put a layer of something with a different refractive index between your eye and the water. Plastic or air are good examples of this.)

Closure Before moving on, ask your students if they have any recommendations or unanswered questions that they can work out on their own. Brainstorming extension ideas is a great way to add more science studies to your class time.

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Student Worksheet

Name _____

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What to Learn Using the simple optics of a waterscope (also called an aquascope), you'll be able to observe organisms in water.

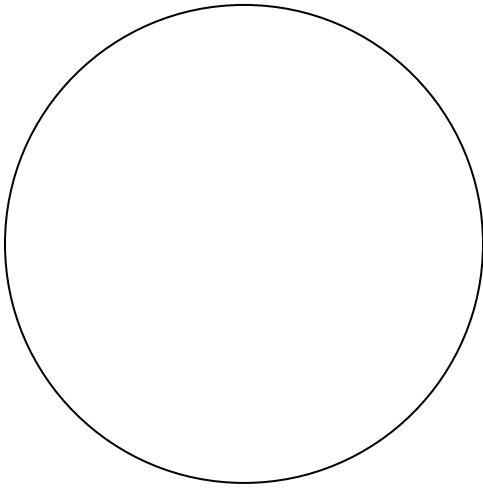
Materials

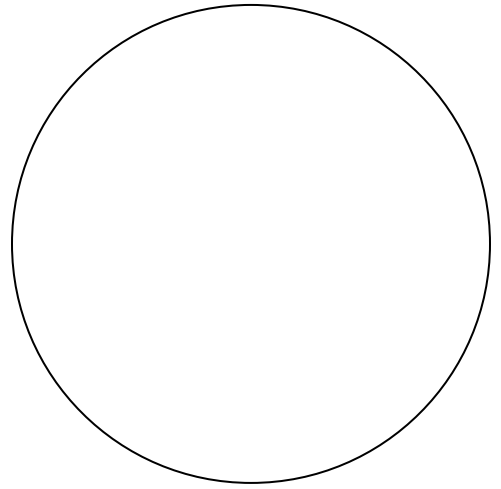
- milk or juice jug
- plastic wrap
- scissors
- rubber band

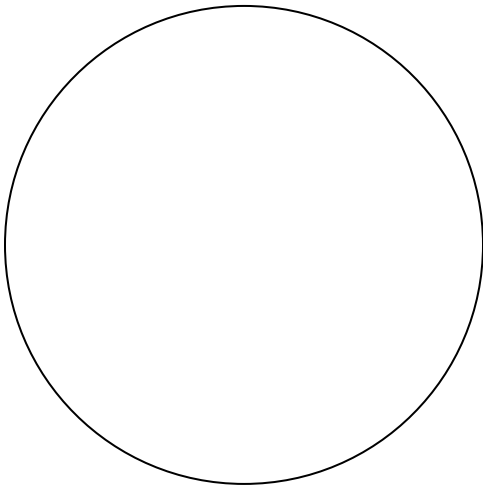
Experiment

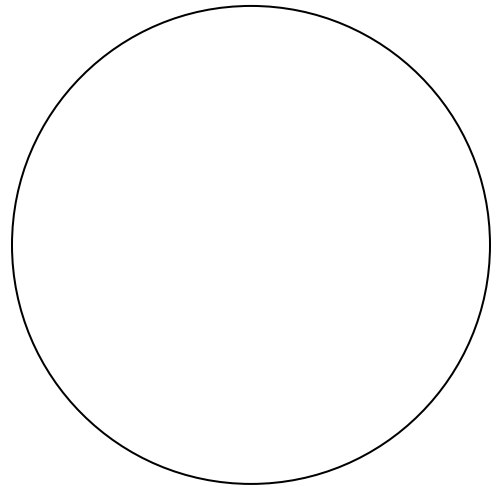
1. Clean out your jug first. Then cut the bottom and top off without cutting off the handle.
2. Cover the opening at the bottom with your plastic wrap, securing it in place with the rubber band. Use tape if you need extra support to hold the plastic wrap in place. The window needs to be water-tight.
3. Place the waterscope in the water, bottom-side down. You'll be able to see all kinds of interesting creatures through your scope!
4. Try to keep your scope still so the animals won't be afraid to come close to you so you can have a good peek at their world. The aquascope works the same way snorkel goggles work—except you don't have to get wet!
5. The key to the aquascope is the taught plastic wrap. If it's loose, or if there are holes, it won't work as well. Make sure that the plastic wrap is securely fastened to the can, and is stretched tight. If you find your waterscope leaks, use a stronger rubber band to secure your plastic wrap in place. You can alternatively use strong waterproof tape or hot glue to secure it in place, but use the rubber band first so you can stretch the film tightly over the open end.
6. Draw what you see through your waterscope in the circles below and label each drawing:

Waterscope Diagrams









Reading

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cornea's focusing properties. This is why you see a blurred image underwater. The eyes are focusing the image far behind the retina instead of on the retina. The waterscope puts a layer of air between your eyes and the water (the same way goggles do) so you can view underwater without blurred vision.

Exercises

1. What is the term for light rays bending?
2. Why is underwater vision blurred?
3. How can we focus vision underwater?

Answers to Exercises: Waterscope

1. What is the term for light rays bending? (refraction)
2. Why is underwater vision blurred? (Because water has the same refractive index as the cornea, which effectively eliminates the cornea's focusing property.)
3. How can we focus vision underwater? (Put a layer of something with a different refractive index between your eye and the water. Plastic or air are good examples of this.)