MY PLANET DIARY

The Power of Waves

Where does the energy that powers your school come from? It may be from oil, gas, or coal. You also may have heard of using the sun or wind as energy sources. But did you know that ocean waves could be used as an energy source, too? Mechanical systems placed in the ocean or along the shore transform the energy from waves into electricity. Unlike oil, gas, or coal, the energy from ocean waves will not run out. Although wave energy technology is still very new, many scientists are optimistic about its possible use around the world.

FUN FACTS

Communicate Discuss this question with a partner. Write your answer below.

How might wave energy impact the environment? Consider both intended and unintended consequences.

wave energy does not use up natural resources like coal or oil

Mechanical systems might disrupt sea life

PLANET DIARY Go to **Planet Diary** to learn more about waves.

What Forms Mechanical Waves?

You have probably seen and felt water waves while swimming. But did you know that many kinds of waves affect you daily? Sound and light are very different from water waves, but they are waves, too.

Characteristics of Waves

What is a wave? A wave is a disturbance involving the transfer of energy from place to place. In science, energy is defined as the ability to do work. For example, the energy of a water wave can lift an object on the water's surface as the wave passes under it. But after the wave passes, the water is calm again.

Most waves need something to travel through. For example, sound waves can travel through air, water, and even solid materials. Water waves travel along the surface of the water. A wave can even travel along an object, such as a rope. The material through which a wave travels is called a medium. Gases (such as air), liquids (such as water), and solids (such as ropes) can all act as mediums. Waves that require a medium to travel are called mechanical waves.

Waves and Energy

Energy is needed to make a wave.

Mechanical waves form when a source of energy causes a medium to vibrate. A vibration is a repeated back-and-forth or up-and-down motion. Moving objects have energy, which they can transfer to a medium to produce waves. For example, as you see in **Figure 1,** a motorboat's propeller can transfer energy to calm water. As a result, the particles that make up the water start to vibrate. The vibrations move through the water, resulting in a wave.

CHALLENGE The news media, such as newspapers and television stations, carry current events worldwide. Explain how the way news travels is similar to the way a wave travels.

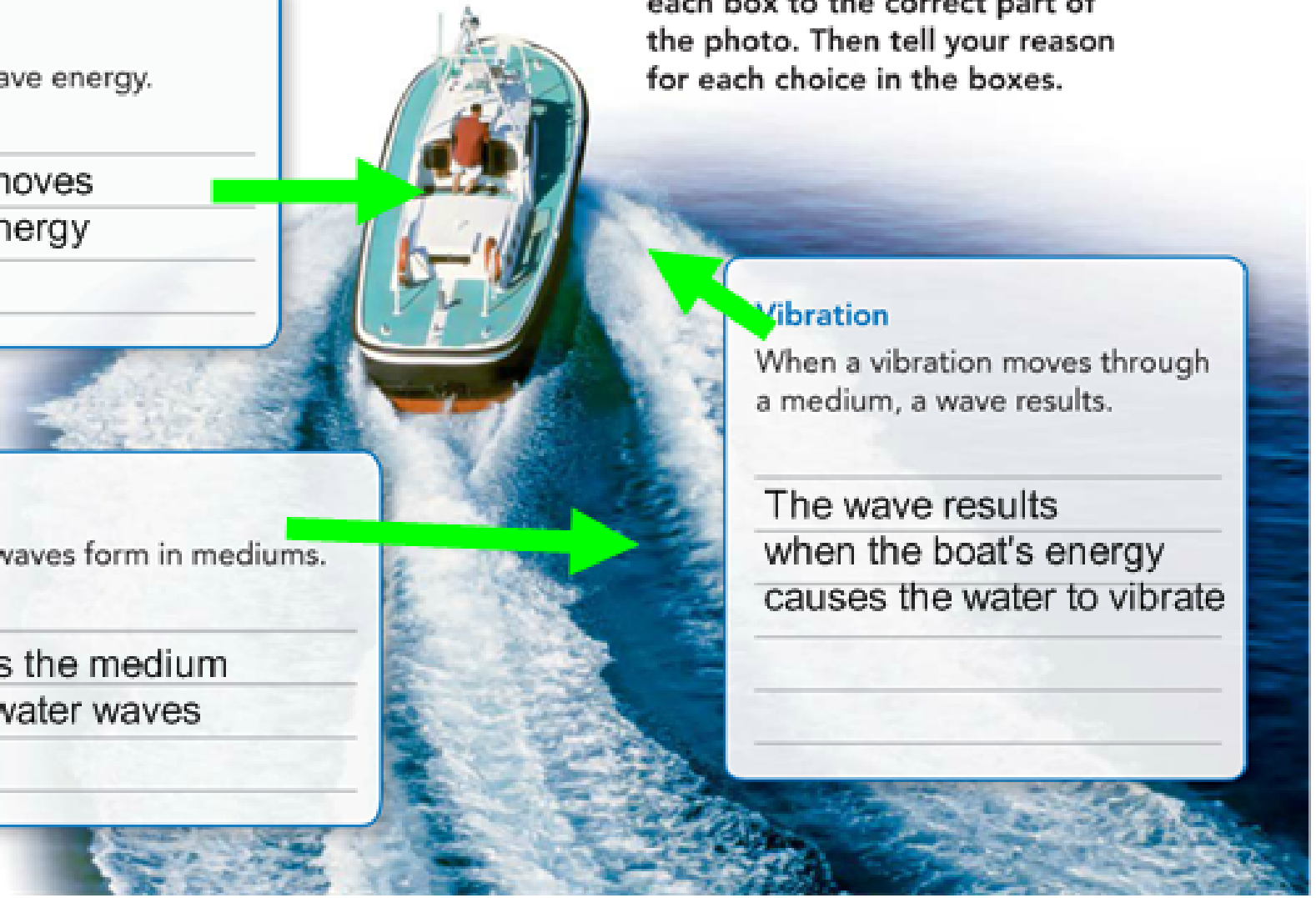
News travels through media like a wave travels through a medium

FIGURE 1

Forming a Mechanical Wave

A source of energy in a medium can cause a mechanical wave to form.

Explain Draw an arrow from each box to the correct part of the photo. Then tell your reason for each choice in the boxes.



Energy Source

Moving objects have energy.

The boat moves so it has energy

Medium

Mechanical waves form in mediums.

Water is the medium for the water waves

Vibration

When a vibration moves through a medium, a wave results.

The wave results when the boat's energy causes the water to vibrate

I got it

An energy source causes a medium to vibrate.

What Are the Types of Mechanical Waves?

Waves move through mediums in different ways. **The three types of mechanical waves are transverse waves, longitudinal waves, and surface waves.** These waves are classified by how they move through mediums.

Transverse Waves

When you make a wave on a rope, the wave moves from one end of the rope to the other. However, the rope itself moves up and down or from side to side, at right angles to the direction in which the wave travels. A wave that vibrates the medium at right angles, or perpendicular, to the direction in which the wave travels is called a transverse wave.

Making a transverse wave on a rope forms high and low points along the rope. A high point on a transverse wave is called a crest, and a low point is called a trough (trawf). In **Figure 2,** you can see that the red ribbon on the rope is first at a crest and then at a trough. As the wave moves through the rope, the ribbon moves up and down between crests and troughs. The dashed line shows the rope's position before it was moved. It is called the rest position.

Vocabulary **Identify Multiple Meanings** The word *trough* has more than one meaning. Write two sentences that use the word, one showing its everyday meaning and one showing its scientific meaning.

Animals eat at trough.

A trough is the low point of a transverse wave.

FIGURE 2

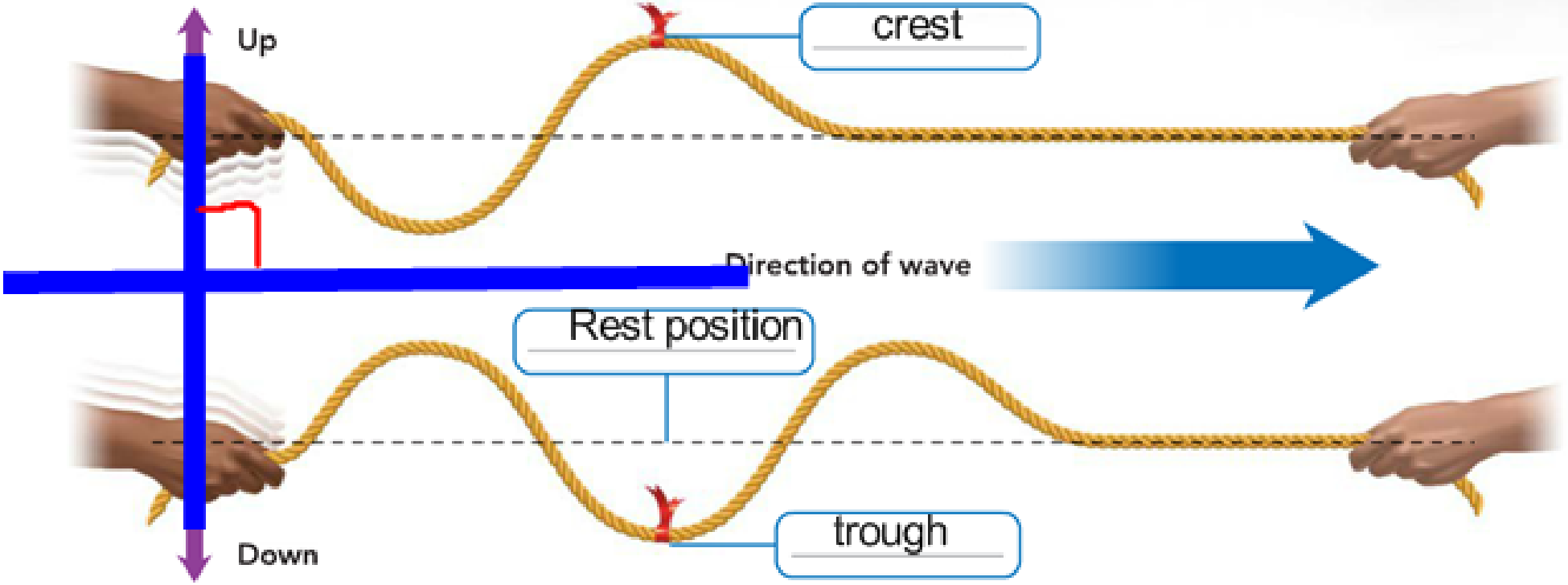
Motion in a Transverse Wave

When you shake out a bedsheet or move a rope up and down, you create a transverse wave.

Complete the tasks.

1. **Identify** Label the crest, trough, and rest position.
2. **Relate Text and Visuals** Draw a vertical line through the purple arrows and a horizontal line through the blue arrow until it touches the vertical line. What angle did you draw?

Right Angle



Longitudinal Waves

If you push and pull one end of a spring toy, you can produce a longitudinal wave like the one shown in **Figure 3.** Notice that the coils in the spring move back and forth in the same direction, or parallel, to the wave's motion. A longitudinal wave (lawn juh TOO duh nul) vibrates the medium in the same direction in which the wave travels. Also, notice how the spacing between the coils varies. Some coils are close together, while others are farther apart. An area where the coils are close together is called a compression (kum PRESH un). An area where the coils are spread out is called a rarefaction (rair uh FAK shun).

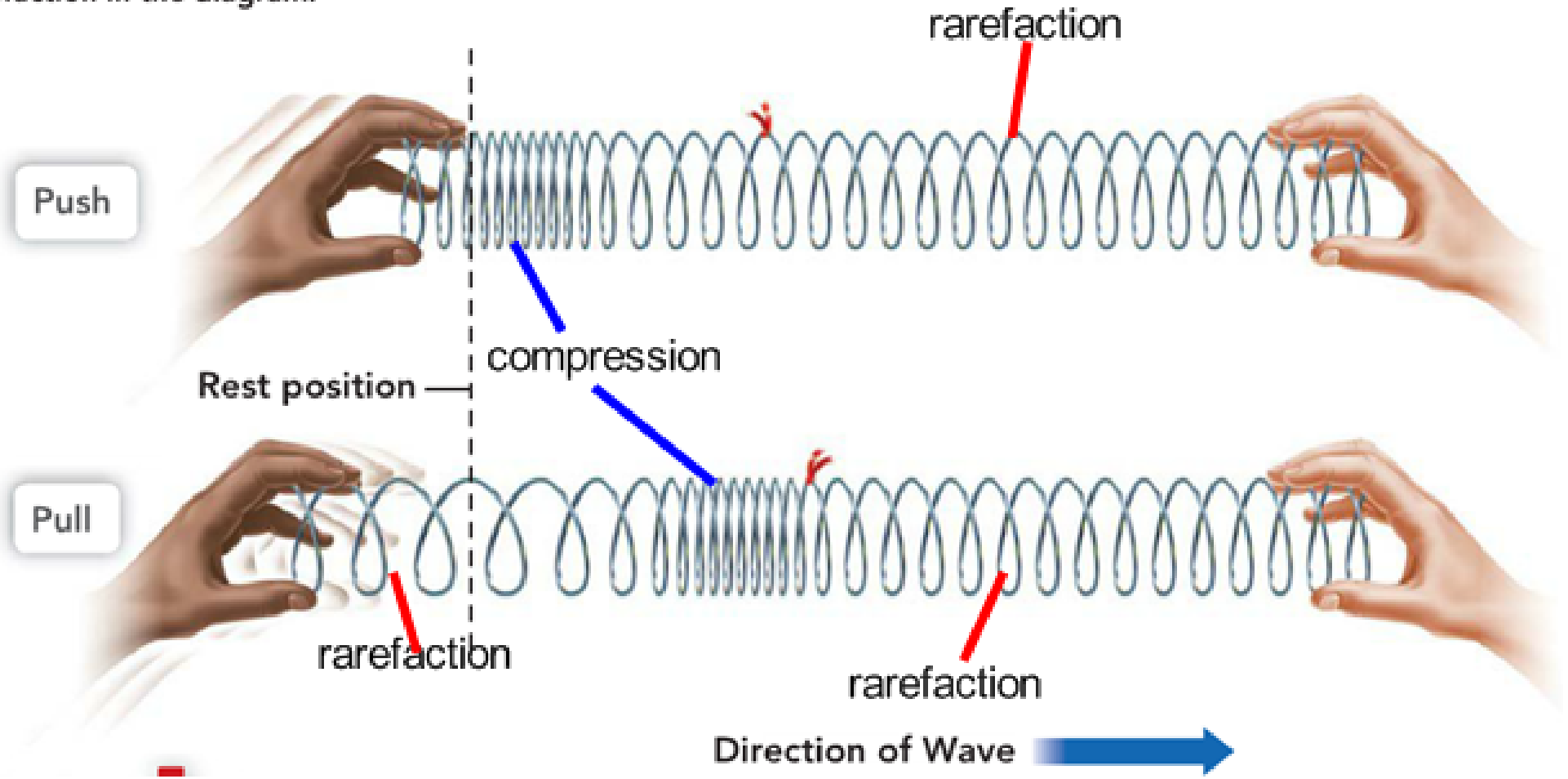
As compressions and rarefactions travel along the spring toy, each coil moves forward and then back. The energy travels from one end of the spring to the other, in the form of a wave. After the wave passes, each coil returns to its starting position.

FIGURE 3

Motion in a Longitudinal Wave

Fixed points on a transverse wave vibrate up and down. Fixed points on a longitudinal wave, such as the one marked by the red ribbon, vibrate back and forth.

Interpret Diagrams Label the areas of compression and rarefaction in the diagram.

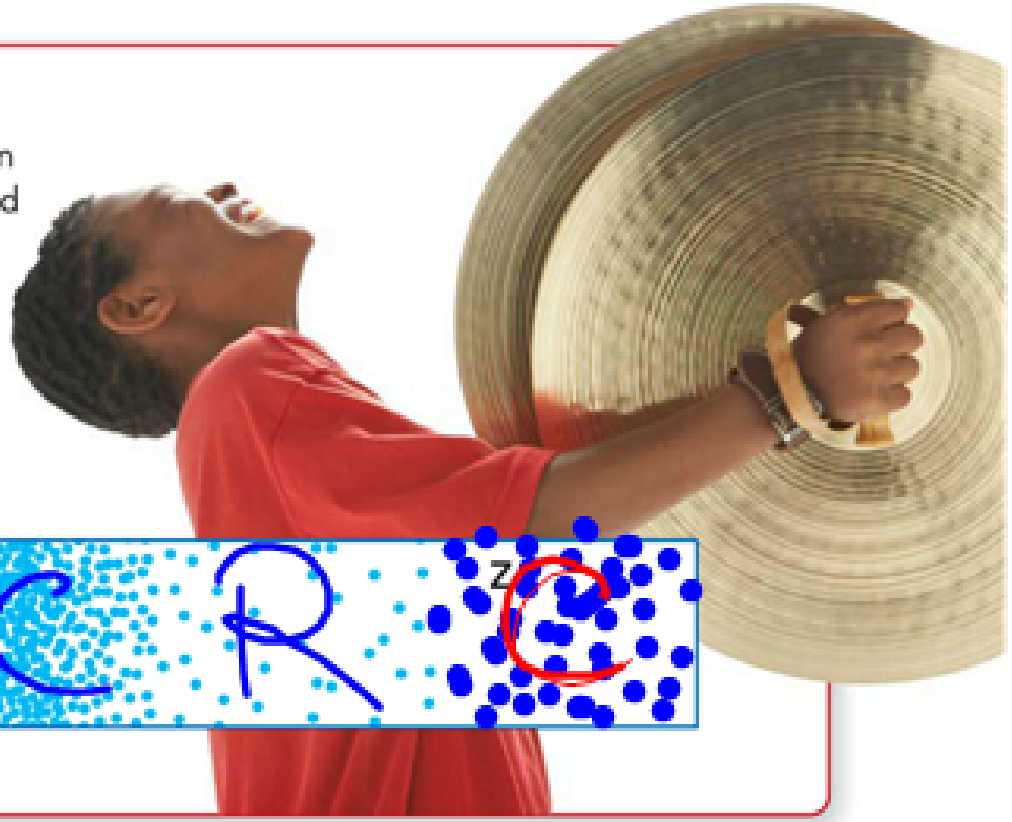


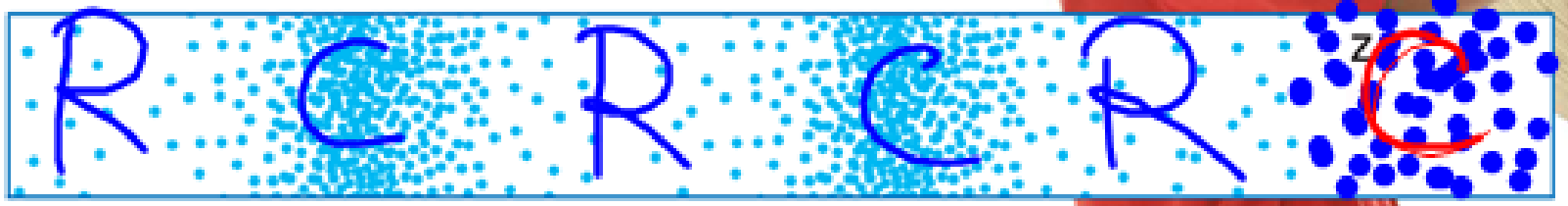
apply it!

Sound waves are longitudinal waves. The picture shows an area of air as the compressions and rarefactions of a sound wave pass through it. The dots represent air particles.

1 Classify Write an *R* in the rarefaction areas and a *C* in the compression areas.

2 Predict Draw what the particles should look like in area Z.





Direction of Wave

Surface Waves

Surface waves are combinations of transverse and longitudinal waves. This type of wave travels along a surface that separates two mediums. Ocean waves are the most familiar surface wave. An ocean wave travels at the surface between water and air. When a wave passes through water, the water (and anything on it) vibrates up and down, like a transverse wave on a rope. The water also moves back and forth slightly in the direction that the wave is traveling, like the coils of a spring. But unlike the coils of a spring, water does not compress. The up-and-down and back-and-forth movements combine to make each particle of water move in a circle, as you see in **Figure 4.**

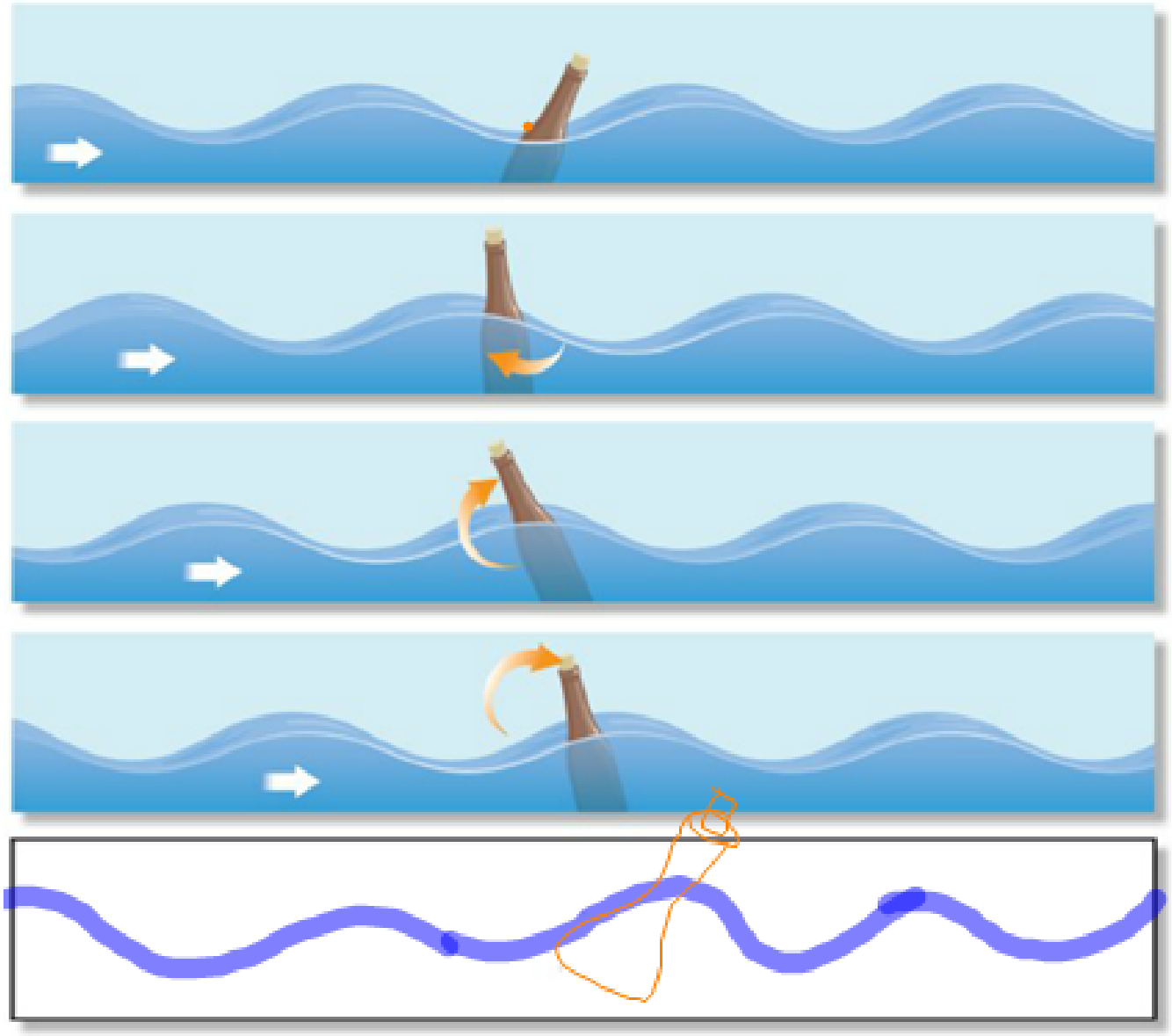


FIGURE 4

ART IN MOTION **Waves Transfer Energy**

A wave moves the bottle in a circular motion. After the wave passes, the bottle returns to where it started.

Predict **In the empty box, draw what the next picture should look like.**

Lab zone Three Types of Waves.

Assess Your Understanding

1a. Review Compared to the direction it travels, at what angle does a transverse wave vibrate a medium?

The medium moves at a right angle to the wave

b. Compare and Contrast How are transverse and longitudinal waves alike and different?

Both waves vibrate but in different directions.

got it?

○ **I get it!** Now I know that the three types of mechanical waves are

transverse
longitudinal
surface

○ **I need extra help with** _____

Go to MY SCIENCE COACH *online for help with this subject.*