

# Signals on the Move

Trace how waves carry energy and information through useful devices.

**HS-PS4-5** "Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy..."

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## 1 READ AND MARK \_\_\_\_\_ Read it twice

**YOUR JOB** Underline each wave or signal named in the passage. Then number the steps in each device's pathway from a wave source to a useful output, including each interaction or energy conversion, to show how the device transmits or captures energy or information.

### Waves at Work

- ① Solar panels on a school roof use light waves to capture energy. Sunlight carries energy across space as electromagnetic waves. When light reaches a solar cell, some of it is absorbed by the cell material. That interaction transfers energy from the light to charges in the material, creating an electric current. Wires carry this electrical energy to an inverter, which changes it into a form that can power building equipment or enter the electric grid. The panel does not store sunlight as a picture or message. It captures wave energy and converts it into electrical energy.
- ② An ultrasound scanner sends brief pulses of high-frequency sound into the body. Sound is a mechanical wave, so it needs matter to travel through. At boundaries between tissues, such as muscle and fluid, part of each pulse reflects back while part continues forward. A transducer detects the returning echoes and converts their wave energy into electrical signals. Because echoes from deeper structures take longer to return, the scanner can use return time and echo strength to build an image. The device sends sound energy into tissue, then captures information carried by the reflected waves. No radiation like X-rays is used in ordinary diagnostic ultrasound.
- ③ When you send a text message, your phone converts the message into coded electrical signals. Its antenna uses those signals to produce radio waves, electromagnetic waves that can travel through air. The phone sends the radio signal to a nearby cell tower, not usually straight to your friend's phone. Equipment at the tower and in the communication network relays the message toward a tower near your friend's phone. That tower sends radio waves to the receiving phone. The receiving antenna captures the waves and converts the coded signal into electrical signals, allowing the phone to display the text. Obstacles, distance, and interference can weaken or disrupt radio signals.

**2 ANSWER WITH EVIDENCE** \_\_\_\_\_ Use the passage

**1** Trace the energy pathway in a solar panel, beginning with sunlight and ending with a useful electrical output.

**2** How do reflected sound waves help an ultrasound scanner create an image?

**3** Explain how a text message travels from one phone to another in the passage. Include the role of the cell towers and network.

**4** Compare what the solar panel captures with what the ultrasound scanner captures from waves.

**3 YOUR TURN** \_\_\_\_\_ Your own words

Choose a device not described in the passage that uses waves. In 3 to 4 sentences, name the wave, explain how the device sends or captures it, and describe an interaction or conversion that produces a useful result.

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**PART 1 • READ AND MARK**

Underline each wave or signal named in the passage. Then number the steps in each device's pathway from a wave source to a useful output, including each interaction or energy conversion, to show how the device transmits or captures energy or information. Accept any marking that follows this job and points at the right text.

**PART 2 • ANSWERS**

| # | QUESTION                                                                                                                      | ANSWER                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Trace the energy pathway in a solar panel, beginning with sunlight and ending with a useful electrical output.                | <b>Sunlight is absorbed by the solar-cell material, transferring energy to charges and creating an electric current. Wires carry the electrical energy to an inverter, which changes it into a form that can power equipment or enter the grid.</b>          |
| 2 | How do reflected sound waves help an ultrasound scanner create an image?                                                      | <b>Tissue boundaries reflect part of each sound pulse. The transducer detects the echoes, and the scanner uses their return time and strength to build an image.</b>                                                                                         |
| 3 | Explain how a text message travels from one phone to another in the passage. Include the role of the cell towers and network. | <b>The sending phone changes the message into coded electrical signals and radio waves that travel to a nearby cell tower. Tower and network equipment relay the message toward a tower near the receiving phone, which sends radio waves to that phone.</b> |
| 4 | Compare what the solar panel captures with what the ultrasound scanner captures from waves.                                   | <b>The solar panel captures light-wave energy and converts it into electrical energy. The ultrasound scanner detects reflected sound waves to capture information used to make an image.</b>                                                                 |

**PART 3 • YOUR TURN (SAMPLE ANSWER)**

A television remote converts electrical energy from its battery into coded pulses of infrared light. The television's sensor absorbs the pulses and converts them into electrical signals that represent a command, such as changing the volume. The television then uses electrical energy to carry out the command.

Accept scientifically accurate qualitative pathways that identify a wave, a transmission or capture step, and an interaction or conversion. For cellular communication, require that the message travels through a cell tower and communication network before reaching a tower near the receiving phone.