Signals in the Gym

Trace a weather report from transmitter to receiver.

PS.2.e "Obtain and communicate information from published materials to explain how transmitting and receiving devices use the principles of wave behavior and wave interactions to transmit and capture information and energy."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where the station puts information onto a wave, circle where the radio recovers that information, and number the wave interaction and its effect on reception as 1 and 2.

How a Weather Report Reaches the Gym

1. During a storm, an FM station sends a weather report to a battery-powered radio inside a school gym. A microphone changes the announcer's sound waves into a changing electrical signal. At the station, a circuit varies the frequency of a high-frequency carrier wave in step with that signal. This process, called frequency modulation, puts the report's pattern onto the carrier. A powered transmitting antenna sends out electromagnetic waves. The waves carry energy supplied by the station, but their changing frequency also carries information. The announcer's voice itself does not travel through the air from the station to the gym.

2. On the way to the gym, some radio waves travel directly while others reflect off the building's metal roof. The reflected waves can overlap the direct waves. Where their electric fields partly cancel, the received signal is weaker; a radio moved a short distance may receive a stronger signal. Waves can also pass through some building materials, although those materials may absorb some of their energy. These interactions explain why reception can change from place to place even when the transmitter's report stays the same. The building does not create a second weather report.

3. At the gym, the radio's receiving antenna intercepts a small part of the wave's energy. The wave's changing electric field makes electrons in the antenna move, producing a tiny alternating electrical signal. A tuning circuit selects the station's carrier from signals sent by other stations. The receiver then detects the carrier's frequency changes and rebuilds an electrical version of the report's sound. Its speaker turns that signal into sound waves that students can hear. The radio's battery supplies most of the energy that drives its circuits and speaker; the incoming wave supplies the encoded information.

2 ANSWER WITH EVIDENCE

Use the passage

1. Explain how the station changes the announcer's speech into information carried by radio waves.

2. Why might moving the radio a short distance improve reception even though the station has not changed its report?

3. Trace what happens from the moment a radio wave reaches the receiving antenna until students hear the report.

4. A student says the incoming radio wave provides all the energy needed to play the report. Is that correct? Explain what the wave and battery each provide.

3 YOUR TURN

Your own words

A battery radio sounds unclear beside a metal locker in the gym. Propose a two-location test to improve reception, then predict a result. In one paragraph, explain how wave interactions could affect the test, how the report is transmitted and recovered, and what powers the speaker.

ANSWER KEY

Signals in the Gym

HIGH SCHOOL · PS.2.e

PART 1 · READ AND MARK

Underline where the station puts information onto a wave, circle where the radio recovers that information, and number the wave interaction and its effect on reception as 1 and 2. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Explain how the station changes the announcer's speech into information carried by radio waves.	**A microphone changes the speech into an electrical signal. A circuit varies the carrier wave's frequency in step with that signal, and the antenna transmits the wave.**
2	Why might moving the radio a short distance improve reception even though the station has not changed its report?	**Reflected waves overlap direct waves. At some locations their electric fields partly cancel, weakening reception; at another location, the signal may be stronger.**
3	Trace what happens from the moment a radio wave reaches the receiving antenna until students hear the report.	**The wave induces a tiny electrical signal in the antenna. The radio selects the station's carrier, detects its frequency changes, rebuilds the sound signal, and drives the speaker.**
4	A student says the incoming radio wave provides all the energy needed to play the report. Is that correct? Explain what the wave and battery each provide.	**No. The incoming wave provides a small amount of captured energy and carries the encoded report. The battery supplies most of the energy that drives the radio's circuits and speaker.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would listen beside the locker, then move the radio several steps away and compare how clearly I hear the report. I predict the second location might sound clearer because waves reflected by the metal can overlap direct waves and partly cancel at the first location. The station puts the announcer's sound pattern on a carrier by changing its frequency. At either location, the receiving antenna captures some wave energy, and the radio detects the frequency changes to rebuild the sound signal. The battery supplies most of the energy that runs the speaker.

Accept different pairs of locations and either predicted outcome if the explanation correctly links reflection and overlap to possible changes in signal strength. The response should distinguish information carried by the wave from the battery energy used to play the sound.