



Bounce Back

Advancing Radar in the Laboratory



Lexington, MA (MIT Lincoln Laboratory)—Engineers are designing, building, and testing RADAR antennas to track the position and velocity of objects. Testing is conducted both in a large anechoic chamber and on small airplanes. The engineers are building some of the most advanced RADARs in the world.

"Radar pulses are electromagnetic waves that travel at the speed of light." John Sandora, electrical engineer

Framework

Middle School

Standards

- NSES - B.iii.1 ➤ Energy is transferred in many ways.
- STL - 9.H ➤ Testing and evaluating are used.
- STL - 17.H ➤ Communication systems transfer information from machine to machine.
- STL - 17.1 ➤ Communication systems transmit and receive.

Content Illustrated

- RADAR uses electromagnetic energy to track objects.



Content



Physical Science

- ▶ Electromagnetic waves travel at the speed of light, 300 million meters per second.
- ▶ The Doppler effect describes a phenomenon caused by the compression and expansion of sound waves as an object travels toward then away from you. This is why you hear the sound of an object changing pitch as it travels past you.
- ▶ The Doppler effect is exemplified in the sound of a race car. The sound is at a higher pitch when the car travels toward you and at a lower pitch when it travels away from you.



Technology

- ▶ Radar transmitters send pulses of electromagnetic energy in the form of radio waves. When those pulses bounce off a target such as an airplane, a radar receiver can “listen for” or pick up the echo of those electromagnetic waves.
- ▶ Common uses for antennas include wi-fi, car radios, and GPS devices. The military uses antennas for communication and radar.
- ▶ RADAR stands for radio detection and ranging. It is used to determine the location and velocity of objects such as airplanes, ships, and people. It is used for navigation, making maps, weather analysis, air traffic control, surveillance, and to detect speeding cars.
- ▶ Radar uses the Doppler effect to figure out how fast objects are moving.

Engineering

- ▶ Engineers design, build, and test radar antennas. For testing, the long distance usually traveled by radio waves is simulated in an anechoic chamber. Waves from an antenna are transmitted and reflected off a parabolic surface inside the chamber.
- ▶ Metal shields the chamber from all outside electromagnetic radiation. Sound absorbers, made of spongy carbon foam, get rid of ambient noise and prevent radio waves from bouncing around from surfaces other than the parabolic reflector.
- ▶ Radar systems are also tested in the field using aircraft containing hardware, software, and equipment.

Guiding Questions

To think about as you watch:

- ▶ How can radio waves be used for tracking and navigation?

Suggested Activities

- ▶ Have students investigate the similarities and differences between RADAR and SONAR. Try some simple SONAR activities outside or in the gym.

▶ *Bounce Back* can be found online at www.ndep.us/Bounce-Back. Visit www.ndep.us/LabTV for a list of process skills modeled in webisodes.

Keywords

chemical laser
absorber, ambient,
anechoic chamber,
antenna, Doppler
effect, echo, electro-
magnetic waves,
gain, instrumentation
radar, parabola, radar,
receiver, speed of
light, transmitter,
velocity, wave