

Enrichment**LESSON 3**

Doppler Radar

Meteorologists have many tools available to help them prepare weather forecasts. Accurate forecasts are important for giving people time to prepare for severe weather. With enough time, people can evacuate, find shelter, and take other measures to protect themselves. One of the newest tools for tracking and forecasting severe weather is Doppler radar.

The Doppler Effect

The Doppler effect is an apparent shift in the observed frequency of a wave, due to the relative motion between the source and the observer. If you are standing still by the side of a road and a car is moving toward you with its horn blasting constantly, you will hear a shift in the sound as the car passes you. Sound waves stack up in front of the moving car, making the pitch higher. The pitch suddenly shifts downward when the car passes and the sound waves are stretching out behind the car moving away from you. By measuring the Doppler shift, the speed of an object can be determined with great accuracy. The Doppler effect can be observed with sound waves and electromagnetic waves, including colors in the visible spectrum.

Radar

Radar stands for radio detection and ranging. Radar uses electronic instruments

that transmit radio waves to determine the distance and location of other objects. Radar works by sending a pulse of radio waves toward a target or in a sweeping motion and then waiting to receive an echo. When the radar signal hits an object, the waves bounce off in all directions. Some are directed back toward the transmitter. The delay between the transmitted pulse and the received echo is used to determine the distance to the target.

Doppler Radar

Doppler radar uses the Doppler effect to measure a target's velocity relative to the radar—the radar transmitter is the observer. This effect raises or lowers the frequency of the target echoes, depending on whether the target is moving toward or away from the radar. The difference between the radar's transmitted frequency and the reflected echoes of the target is a measure of the relative speed of the radar and target.

Doppler radar can effectively image the precipitation in a thunderstorm from the reflection of the water droplets in the system. It can also determine its motion—how fast the rain or hail is moving toward or away from the transmitter. Since the 1980s, computer programs have been developed to enable Doppler radar to identify hail, heavy rain, severe downdrafts, and tornadoes forming on the ground.

Applying Critical-Thinking Skills

Directions: *Respond to each statement.*

1. **Infer** how a meteorologist might tell the difference between the Doppler echo of a weather system and of a flock of migrating geese.
2. Police use Doppler radar for traffic patrols. **Explain** the advantage of using Doppler radar over regular radar in traffic law enforcement.