

# Key Physics Concepts and Skills

## Activity Summaries

## Physics Principles

### Activity 1: Lenses and Ray Optics

Observing images formed with convex lenses introduce students to how telescopes work. They also observe that real images are not formed nor magnified by concave lenses. Comparing measurements helps students understand the importance of focal length in the making of a telescope.

- Convex lenses
- Concave lenses
- Real and virtual images

### Activity 2: The Telescope

Students make refracting telescopes, using convex lenses. Their observations lead to discussion about why a telescope requires two lenses with specific positioning and different focal lengths.

- Telescope construction
- Convex lenses
- Concave lenses
- Real and virtual images

### Activity 3: Digital Imaging

This activity introduces students to the use of pixels in electronic images and the relationship between the number of pixels and detail in the image. This leads to understanding of the differences between analog and digital images.

- Pixels
- Digital and analog images

### Activity 4: The Electromagnetic Spectrum

In this activity, students first estimate Earth – Moon distance from a NASA video clip that highlights time delay in communication between Apollo astronauts and Houston. Reading about the speed of light introduces students to wavelengths in the electromagnetic spectrum.

- Electromagnetic waves
- Speed of light
- Wavelength and frequency of light

### Activity 5: Interference and Spectra

Viewing a light through a diffraction grating enables students to observe separation of white light into its colors. They read about how scientists use this process and characteristic spectra of gases to identify the presence of gases on stars. Students consider how the light spectrum could be used to communicate with advanced beings.

- Diffraction
- Light interference
- Light spectra

### Activity 6: Send Them a Recording

Students measure the number of grooves per centimeter to observe differences in long-playing records and CDs. From this they are able to infer the differences in how information is stored on analog and digital recordings. Students then apply this information to their plans for communication with extraterrestrial beings.

- Speed of electromagnetic waves
- Digital vs. analog
- Diffraction and Interference

### Activity 7: The Size of Space

After reading about how parallax is used to measure distance to nearby stars, students apply this concept to find distances between objects. Learning the extreme distances between stars engages students in discussion and consideration of the challenges inherent in attempts to travel to, or communicate with, life on distant stars.

- Parallax
- Speed of sound
- Measuring distances in space

### Activity 8: The Doppler Effect

In this activity, students are introduced to the Doppler Effect in an experiment in which they toss an oscillator embedded in a Nerf ball. The change in pitch as the Nerf ball moves is related to how the Doppler Effect is used to measure distance to distant stars. This is then related to the development of the Big Bang Theory.

- Doppler Effect
- Big Bang Theory
- Measuring distances in space

### Activity 9: Communication Through Space

In this final activity, students are confronted with the extreme amount of time required for light waves to reach stars. After considering the impact of this time delay on communication with life on stars, students return to the Chapter Challenge and discuss what type of information is most important to send and receive.

- Speed of sound
- Speed of electromagnetic waves
- Measuring distances in space