Telescopes

Background Information

When we look at the stars with our naked eyes, we see only a tiny part of their light. Stars, planets, galaxies, clouds of dust and gas, and other matter in space are sending out energy all the time. This energy, called electromagnetic energy, travels in pulses or waves. Like waves traveling through the ocean, they can be very long and lazy, very short and peppy, or anything in between.

Visible light is what we call the particular range of wavelengths that our eyes can see. But this light tells only a small part of the story of the stars.
Electromagnetic spectrum chart

To learn the rest of the story, we have had to invent new kinds of electromagnetic energy detectors and put these detectors on new kinds of telescopes. Optical telescopes are the oldest kind, but now we have invented new kinds. Each kind of telescope adds to our knowledge and understanding of the Universe.

Hubble Space Telescope/Optical telescopes gather visible light, just like our eyes, but greatly magnified. Using special cameras that work the same way our digital cameras work, astronomers can photograph planets, stars, and galaxies. For hundreds of years we have built optical telescopes on Earth, but they work even better in space. This is because light twinkles--it wiggles or jiggles as it travels through Earth's atmosphere, so putting an optical telescope in space makes a big difference and we get much clearer photographs. The Hubble Space Telescope has given us some amazing views of the Universe that we could not see from Earth.

Deep Space Network antenna.Radio telescopes are large dish antennas designed to collect long, lazy radio waves. Radio waves also shine right through Earth's atmosphere, so putting these telescopes on the ground works fine.

Although radio waves are long, they still move fast, at the same speed as light. Radio waves can be used for lots of different things. Our TV, radio, and cell phone signals are carried by radio waves of specially selected wavelengths. Other wavelengths can be used to look out at our Universe to learn about planets or galaxies. Yet others are used by NASA's Deep Space Network of antennas to detect the faint radio signals from spacecraft traveling to faraway destinations, like Mars. We use these radio waves to send messages to our spacecraft and receive information from their special instruments.

Spitzer Space Telescope/Infrared telescopes work best in space. Why? Objects that are even a little bit warm put out infrared energy. So it makes sense to put an infrared telescope into space where it won't just detect all the warm things on Earth. Even in

space, we must make the telescope very cold using refrigerator-type technology so that it won't just detect itself! Then the telescope can look around and see the infrared light coming from the rest of the Universe. The new Spitzer Space Telescope is just such an instrument.

GALEX Space Telescope/Ultraviolet telescopes must be space telescopes because very little ultraviolet energy gets through Earth's atmosphere. A new telescope, called GALEX (for Galaxy Evolution Explorer) is taking a survey of nearly the entire sky in ultraviolet light. Hot, young stars put out a lot of ultraviolet light, so GALEX will be able to find the places where stars are being born.

Chandra X-ray ObservatoryX-ray telescopes also must be placed in space, because x-rays can't penetrate Earth's atmosphere. It's a good thing, too, because x-rays are so energetic they would soon kill almost every living thing on Earth. X-rays are made by the hottest events and objects in the Universe. The Chandra X-ray telescope has helped us learn more about black holes, pulsars, quasars, and other exciting cosmic objects.

Swift Gamma Ray Burst ObservatoryGamma ray telescopes can operate only in space. Gamma rays cannot pass through Earth's atmosphere, thank goodness! Otherwise, Earth would most likely be a very fried and lifeless place. Gamma rays are the smallest wave and most energetic form of electromagnetic energy (that is, light) that we have been able to detect. Huge bursts of gamma rays have been detected from all parts of the sky, but astronomers do not yet know what events trigger them. The Swift Gamma Ray Burst Explorer space observatory to be launched in 2004 will study them.

Objectives
Will be introduced to the invisible spectrum
Gain knowledge of the value of different types of light
Create images symbolizing the spectrum of light

Instruction Time
45 Minutes

Materials

- Astronomer Journal page 22
- Internet Access
- Telescope building kits - can be purchased at https://www1.fishersci.com/Coupon?cid=1341&gid=2376340

Telescopes

Procedure

1. (Optional) Have students build telescopes with telescope kits, according to instructions provided with the kits.
2. (Optional) Students should practice focusing and viewing objects with their telescopes.
3. After students have gained experience using their telescopes, go to the computer lab.
4. Students should go to the website https://www1.fishersci.com/Coupon?cid=1341&gid=2376340
5. Use the information at the SpacePlace website to answer the first two questions on page 22 of the Astronomer Journal.
6. After answering the first two questions, have students click on the "*Cosmic Colors"* link at the top right of the page.
7. Let students explore the Cosmic Color viewer for a few minutes.
8. After a few minutes of exploration, have all students click on the Moon.
9. Have students view the Moon in visible light. Then, have them view the Moon in infrared light.
10. Ask students to make observations about what they see.
11. Tell students that sometimes infrared can tell how hot something is. Ask them why they think part of the Moon looks really hot while the rest of it doesn't look hot in the infrared picture. [Answer: The Sun is on one side of the Moon and is heating up that side of the Moon.]
12. Continue group exploration, trying to make observations about the Moon and other objects in various kinds of light.
13. Create an art project that demonstrates different images captured using different aspects of the spectrum

Expected Results & Explanations

Upon completion of this activity, students should be able to have an idea of the things that exist beyond our solar system. While we are not able to see them with the naked eye, land base telescopes as well as many satellites send us the images that make it possible for us to have a better understanding of what is actually out there.