



Objectives

- Students will learn about the electromagnetic spectrum
- Students will apply their understanding of work, energy, and power in answering questions about the story
- Students will learn about wavelength and frequency
- Students will learn about the STEM career – Photojournalism

Vocabulary

- | | |
|----------------------------|-----------------|
| • Electromagnetic Spectrum | • Waves |
| • Wavelength | • Frequency |
| • Speed of Light | • Radiation |
| • Crest | • Trough |
| • Photojournalism | • Gamma Rays |
| • X-Rays | • Microwaves |
| • Ultraviolet | • Visible Light |
| • Infrared | • Microwaves |
| • Radio waves | • ROY-G-BIV |
| • Refraction | • Aperture |
| • RFID | |

About the Lesson




- The lesson tells the story of a photojournalist reporting a story about a popular ghost hunting television show
- Throughout the story, students will learn about the types of electromagnetic radiation and their applications
- Teaching time: one to two 45-minute class period(s)



TI-Nspire™ Navigator™

- Send out the *Haunted_or_Hoax.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies:  TI-Nspire™ CX Handhelds,  TI-Nspire™ Apps for iPad®,  TI-Nspire™ Software



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>.

Lesson Files:

Student Activity

- Haunted_or_Hoax_student.pdf
- TI-Nspire document
- Haunted_or_Hoax.tns

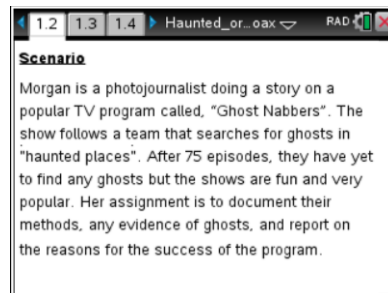
Background

STEM CAREER - This activity tells a story about a photojournalist on assignment behind the scenes of a fictitious popular TV program called *Ghost Nabbers*. Throughout the activity, the photojournalist takes pictures of key pieces to the story and asks probing questions of the Nabbers.

OVERVIEW – Students will be introduced to key concepts surrounding the electromagnetic spectrum in the context of a fun story about a television show trying to find evidence of a fictitious ghost called, “Biker Bob”. As they progress through the story, the photojournalist asks questions about the interactions of light and matter and how that applies to ghosts, which apparently have no mass. Eventually it is revealed that the television crew faked the ghost sighting. The photojournalist is able to uncover the scheme with a strong knowledge of the electromagnetic spectrum. Several elements about the EM Spectrum, such as visible light, ultra violet, infrared, and radio are used by the Ghost Nabbers to provide context for students.

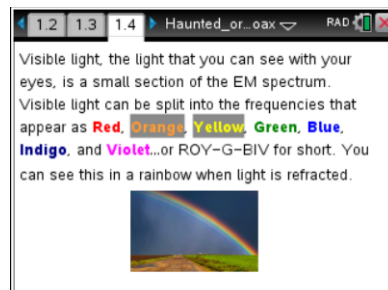
Move to pages 1.2–1.3.

1. Pages 1.2 to 1.3 provide an introduction to the activity by laying out the storyline for students. Page 1.3 introduces the concept of the electromagnetic spectrum.



Move to pages 1.4—1.6.

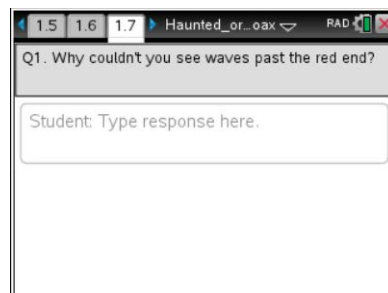
2. Pages 1.4 to 1.6 provide more information about the visible light portion of the EM Spectrum.



Move to page 1.7.

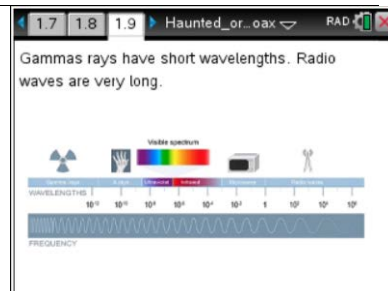
Q1. Why couldn't you see waves after red?

Suggested Answer: Light is no longer visible to the human eye after the red part of visible light. Infrared would only be sensed as heat on the skin.



Move to pages 1.8 – 1.9.

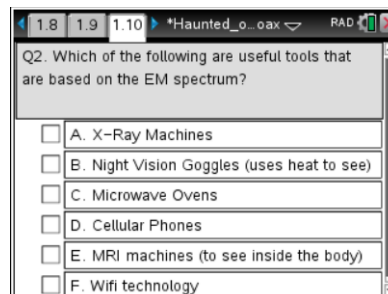
- Pages 1.8 and 1.9 introduce the definition of wavelength and provide an image of all of the relative portions of the EM spectrum for comparison.



Move to page 1.10.

Q2. Which of the following are useful tools that are based on the EM Spectrum?

Answer: All are correct (A through F)



Move to pages 1.11 – 1.12.

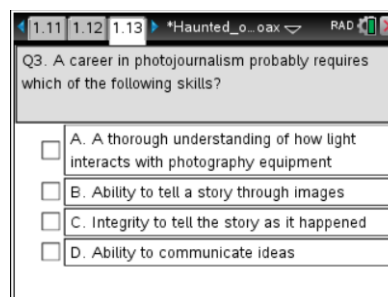
- Pages 1.11 and 1.12 provide a simulation of a (virtual) camera, since a camera is such an essential tool for photojournalists. This simulation enables an understanding of the camera aperture and how the amount of light that is permitted into the camera is related to the aperture diameter.



Move to page 1.13.

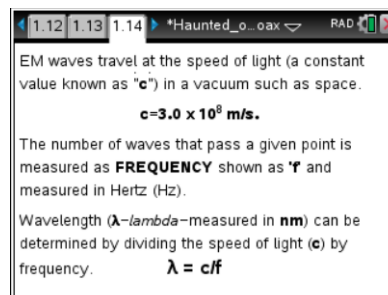
Q3. A career in photojournalism probably requires which of the following skills (Select all that apply)?

Answer: All are correct (A through D)



Move to pages 1.14 – 1.15.

- Pages 1.14 and 1.15 explain the speed of light as a constant, the concept of frequency, and the equation for the relationship among wavelength, frequency, and the speed of light.

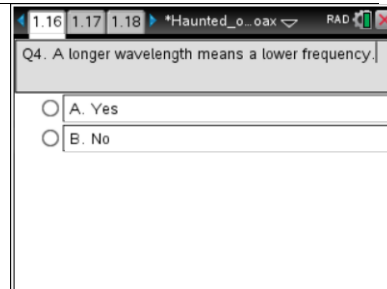




Move to pages 1.16 -- 1.17.

Q4. A longer wavelength means a lower frequency.

Answer: A. Yes



1.16 1.17 1.18 *Haunted_o_oax RAD

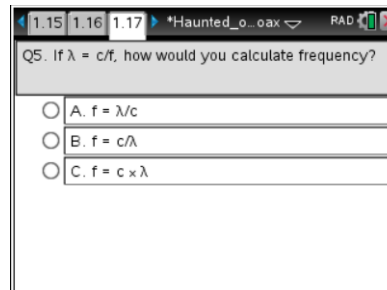
Q4. A longer wavelength means a lower frequency.

A. Yes

B. No

Q5. If $\lambda = c/f$, how would you calculate frequency?

Answer: B. $f = c/\lambda$



1.15 1.16 1.17 *Haunted_o_oax RAD

Q5. If $\lambda = c/f$, how would you calculate frequency?

A. $f = \lambda/c$

B. $f = c/\lambda$

C. $f = c \times \lambda$

Move to pages 1.18 – 1.20.

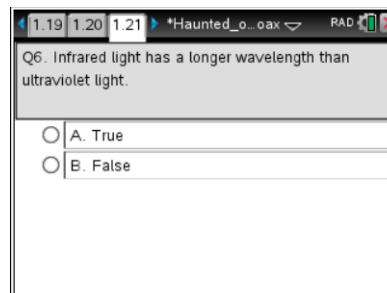
6. Pages 1.18 through 1.20 reveal that the team and photojournalist will be exploring Deadman's Curve the alleged haunt of the infamous "Biker Bob". The team explains the use of a new device they've created called the Specter Spotter that senses wavelengths in UV, visible, and IR radiation and converts the detection of waves into images. The photojournalist begins asking inconvenient questions of the Nabbers that reveal some possible holes in their ghost hunting technology.



Move to page 1.21.

Q6. Infrared light has a longer wavelength than ultraviolet light.

Answer: A. True



1.19 1.20 1.21 *Haunted_o_oax RAD

Q6. Infrared light has a longer wavelength than ultraviolet light.

A. True

B. False

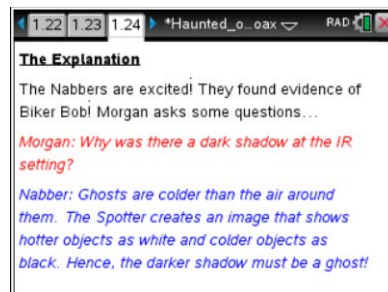
Move to pages 1.22 – 1.23.

- Pages 1.22 and 1.23 reveal “evidence” for the ghost of Biker Bob.



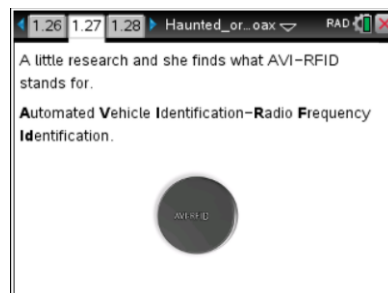
Move to pages 1.24 – 1.25.

- Pages 1.24 and 1.25 documents an interview the Nabbers are giving the photojournalist. The answers from the Nabbers seem to be reasonable until the journalist starts to ask tougher questions revealing a lack of understanding the Nabbers have regarding the interactions between matter and light.



Move to pages 1.26 – 1.28 and 1.30.

- Pages 1.26 to 1.28 and 1.30 explain the clues found by the photojournalist at the Biker Bob site. RFID technology used with a radio inside the Specter Spotter seems to trigger the images in the Specter Spotter. The Nabbers apparently set up the technology to fool the photojournalist and their fans into believing they found actual evidence of a ghost. The RFID technology uses radio waves, another part of the EM spectrum.



Move to page 1.29.

- AVI-RFID uses a frequency of 928 MegaHz. Calculate λ in nm. Use the calculator below.

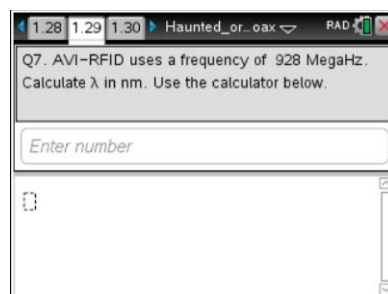
Answer:

$$F = 928 \text{ MHz or } 9.28 \times 10^8$$

$$C = 3.0 \times 10^8 \text{ m/s}$$

$$\text{So, } \lambda = 3.0 \times 10^8 \text{ m/s} \div 9.28 \times 10^8 \text{ Hz}$$

$$\lambda = 3.23 \times 10^8 \text{ nm}$$



Haunted or Hoax

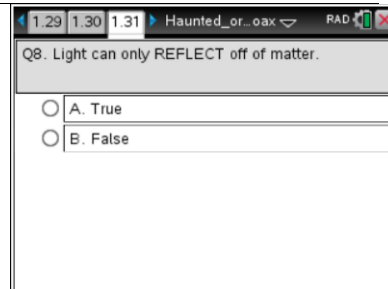
TEACHER NOTES



Move to pages 1.31 -- 1.32.

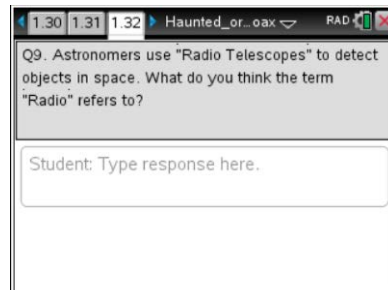
Q8. Light can only REFLECT off of matter.

Answer: A. True



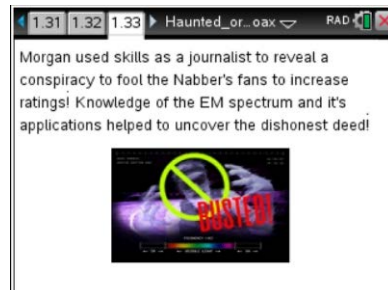
Q9. Astronomers use "Radio Telescopes" to see objects in space. What do you think the term "Radio" refers to?

Suggested Answer: Astronomers use telescopes to see visible light reflected or emitted from objects in space. But they also use radio waves that are emitted from galaxies and stars. These signals can be turned into images that help astronomers better "see" and understand the universe.



Move to pages 1.33

10. Page 1.33 is the end of the activity



TI-Nspire Navigator Opportunities

Make a student the Live Presenter to demonstrate their simulation screens.

Assessment

- Students will answer questions throughout the lesson to ensure they understand the concepts of the electromagnetic spectrum and its applications in everyday life.