Shaping My Knowledge

Warm-up

Before class, first, put together a brief slide show of real-world uses of electromagnetic waves that will be discussed in this session, such as X-ray scanners in airports and hospitals, UV light for sanitizing surfaces and curing gel nail polish, thermal cameras, etc. Then, start the session by showing the slides and having students guess the name of the real-world application of the electromagnetic waves. If you'd like to gamify this, put students into groups and have them write the names as the slide show progresses. Finally, the group with the most correct names wins.

Teaching Tip

For Exercise 1
If appropriate for your group, consider adapting Exercise 1 to a graphic organizer of what I know, what I think I know, and what I'd like to know. Then, have students complete the graphic organizer individually and then compare them with a classmate. Then, invite them to return to their organizers after completing Exercise 3.

Differentiation Strategy

For Exercise 3
Go to the Differentiation Strategies Bank and adapt this exercise using Strategy 6.

Flexi Exercises
(To adjust to students' needs, you can either use or not the activities below)

Exercise 4

Science

How are electromagnetic waves organized?

01 **Choose one of the devices in the list and explain everything you know about how it works to a classmate.**

X-ray scanner

UV light

Thermal camera

02 **Read "Riding the Waves" and write the real-world applications of the EM waves.**

1. Infrared waves: thermal camera, overheating cables, medical problems
2. UV light: detecting counterfeit bills, sanitizing surfaces, sunburn
3. X-rays: airport security, identify broken bones

03 **Answer the following questions.**

1. Which of the three EM waves described has the shortest wavelengths?

   X-rays

2. What is the relationship between wavelength and energy?

   Short wavelengths have higher energy.

3. Which EM wave is the most dangerous? Why?

   X-rays – ionizing radiation is only safe at low doses.

Riding the Waves

Good afternoon, junior scientists, and welcome to the Science Centre. This presentation is about electromagnetic (EM) waves. There are many different EM waves, generally categorized by **wavelength**, energy, and **frequency**, more on that later. The three exhibits we'll look at focus on light and heat.

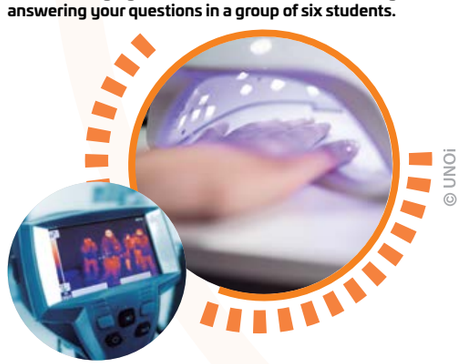
First, the thermal camera detects **infrared** waves (all objects **emit** them) and displays heat signatures of the infrared radiation emitted. As a result, these cameras or detectors help technicians identify overheating cables or circuits and detect medical problems. You may have seen this in movies or TV series; it's like night vision but only shows heat. Longer than visible light, infrared waves are shorter than microwaves used to make popcorn.

Next, moving on to the UV light display. **Ultraviolet** or UV light is what the Sun emits. It has a shorter wavelength than visible light, more energy, and a higher frequency. While humans can't see it, some insects, such as bumblebees, can. Aren't bees awesome? Other than sunburns, some real-life applications of UV light include detecting counterfeit bills and gel manicures. UV light readers can see things we can't.

Finally, there is the **X-ray** scanner, which will be familiar if you've ever been through an airport or had a broken bone. Of the three, X-rays have the shortest wavelengths and the highest frequency and energy. X-rays can pass through or penetrate objects—such as your backpack—to see what's inside through ionizing radiation, which is only safe at low doses.

I hope you enjoyed this introduction to the classification of EM waves; remember, the shorter the wave, the higher the energy and frequency.

04 **Work with a classmate. Write three more questions about classifying EM waves. Then, take turns asking and answering your questions in a group of six students.**



Shaping My Knowledge

Language Structures and Functions Tip

For Exercise 6
First, model the task with an example sentence providing or eliciting the use of each adverbial conjunction option; for example, *I had slept in and missed breakfast; as a result, I was very hungry.* Then, consider reviewing each type of linker's different uses and examples; for example, *as a result of this–cause and effect/result; on the other hand–contrast; nonetheless–concession; meanwhile–time.* Have students complete the exercise individually and review their answers with a classmate. Elicit sentences from volunteers, checking the use and form of the sentences as a group.

Teaching Tip

For Exercise 7
First, extend the exercise by having students record their questions and answers for a TikTok-style informative video. Then, collect the videos for students to view. Finally, close the exercise with a whole-class report-back session.

Differentiation Strategy

For Exercise 6
Go to the Differentiation Strategies Bank and adapt this exercise using Strategy 7.

Wrap-up

Extend Exercise 8 into a Tech Fair where groups present their new real-world application for EM waves. Before the class, decide how much time groups will have to present their ideas and what format your group would benefit most from. Then, consider whether your groups should create visual presentations with a prototype of their EM wave using device. Next, consider organizing the fair as a gallery walk with half the groups presenting while others listen, or a typical presentation style with each group presenting individually. Finally, create a listening task for students to complete, including functions such as identifying the most original device, etc.

Flexi Exercises
(To adjust to students' needs, you can either use or not the activities below)

Exercise 5

05 Match to create logical sentences. Then, underline the linking adverbials.

1. X-rays have high frequency and energy; nevertheless,	a. they carry the highest energy in the EM spectrum.
2. Radio waves travel at the same speed as other EM waves, yet	b. they are used for communication and heating.
3. Gamma rays have extremely short wavelengths, as a result	c. they are helpful in thermal imaging.
4. Infrared waves are just below visible light in frequency; therefore	d. their much longer wavelengths make them ideal for broadcasting.
5. Microwaves have lower frequencies than visible light, and in contrast	e. they can penetrate most materials, making them useful in medicine.

06 For each sentence, choose the ONE linking adverbial that does not correctly complete the sentence.

Electromagnetic waves can be classified by their wavelength, frequency, and energy. Radio waves have the longest wavelengths; **therefore / besides / so**, they also have the lowest frequency and energy. Visible light, **on the other hand / as a result / however**, falls in the middle of the spectrum and has more energy than infrared radiation. X-rays and gamma rays, **furthermore / in contrast / however**, have extremely short wavelengths and very high frequencies. **Consequently / Therefore / In addition**, these waves carry the most energy and can pass through many materials.

07 Write a question to ask about EM waves. Then, exchange your question with another classmate. Use the space below to answer your classmate's question using the linking adverbials from Exercises 5 and 6.

Answers will vary.

08 Work with a classmate to create another real-world application for one of the EM waves on the spectrum. Answer the questions. Then, present your idea to the rest of the class.

- What is the real-world application?
- What type of EM wave does it use?
- Why this one?
- What are the benefits of the application?