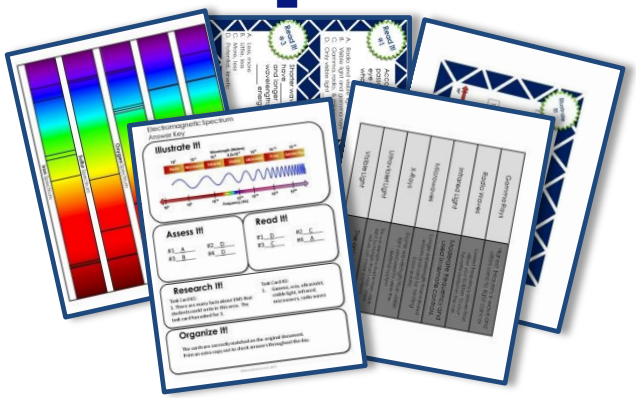
Mad Science Station Labs: Electromagnetic Spectrum



8 Plug & Play Science Stations

Mad Science Station Lab – Electromagnetic Spectrum – Teacher Directions

Explore It! – I will spend much of my time at this station making sure that the students are doing the Electromagnetic Spectrum absorption matching correctly and not wasting time. I would definitely consider laminating the pieces at this station. They will get a lot of touches throughout the day.

Illustrate It! – You will need to set out colored pencil and markers at this station.

Read It! – Print several different copies (I use 6) of the reading passage so that multiple students can read at different paces. You will also need to include copies of the EMS (included).

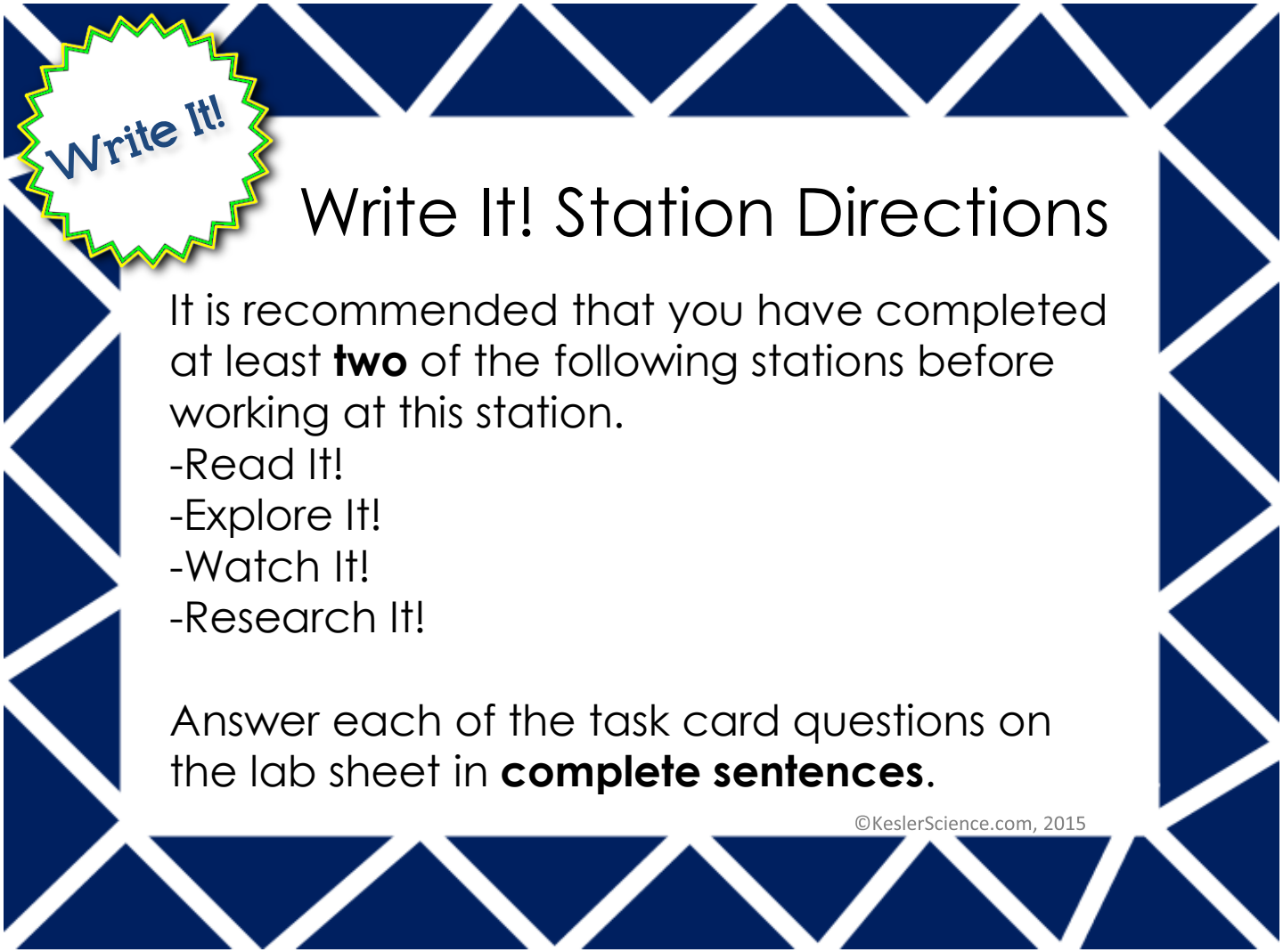
Watch It! – The video is on YouTube and my Google drive. Use YouTube unless your school is blocked. The original link is https://www.youtube.com/watch?v=cfXzwh3KadE Note that both URL's are case-sensitive.

Organize It! – The cards for this activity are attached near the end of this file. Print several sets and then just put them in the basket/baggies for kids to pull from. This is also a good one for later in the week to demonstrate mastery too! Students should be encouraged to do the Research and Explore station before attempting this one.

Write It! – Students should be encouraged to do the Research and Explore station before attempting this one.

Research It! – The goo.gl link on the task card is case-sensitive. The original link is http://www.bbc.co.uk/schools/gcsebitesize/science/21c_pre_2011/radiation/electromagneticradiationact.shtml

Assess It! – Students should be encouraged to do the Research and Explore station before attempting this one. If I grade anything I usually take a close look at the answers from this station.



Write It! Station Directions

It is recommended that you have completed at least **two** of the following stations before working at this station.

-Read It!
-Explore It!
-Watch It!
-Research It!

Answer each of the task card questions on the lab sheet in **complete sentences**.

Write It! #1

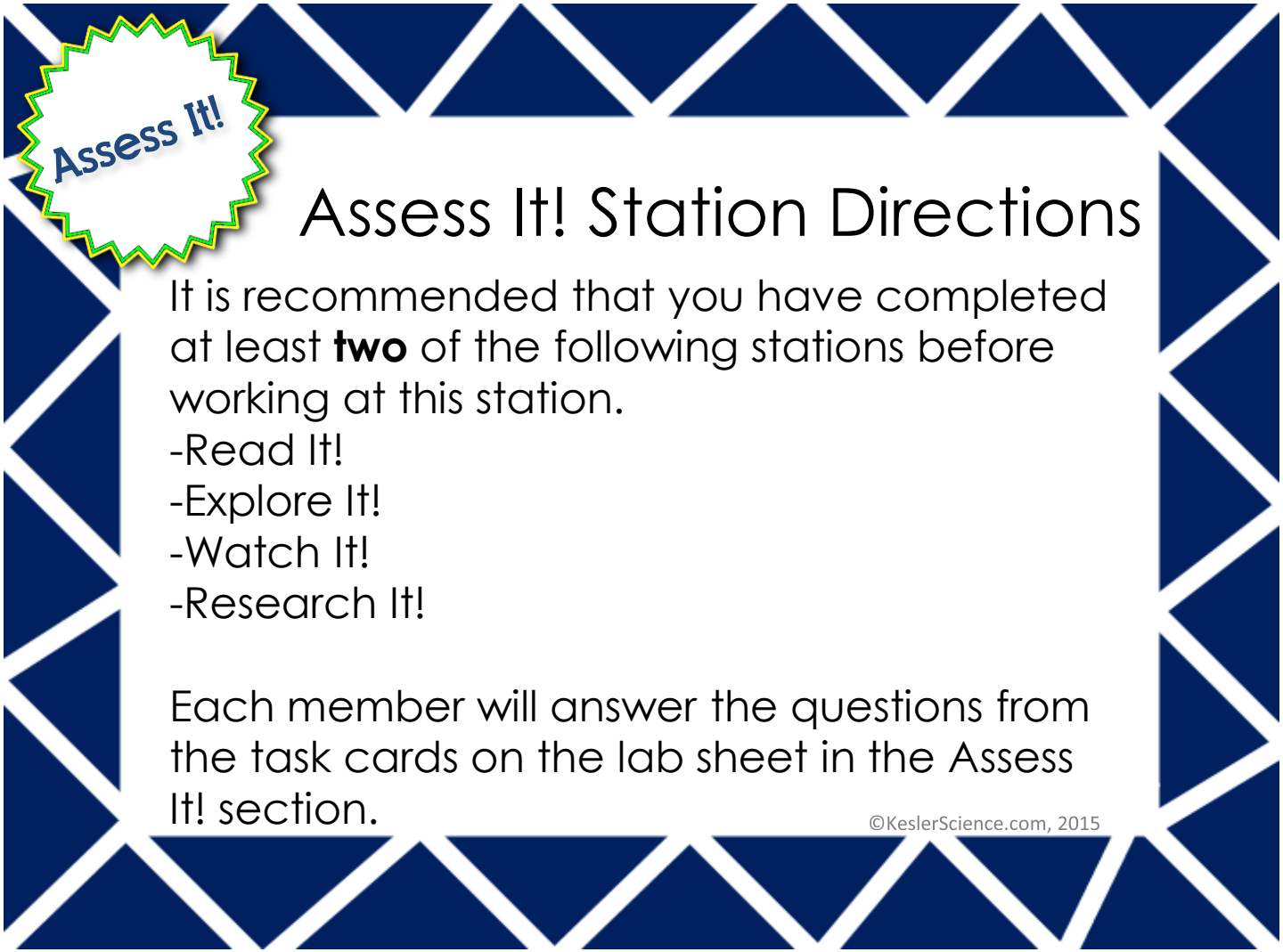
In your own words describe how scientists gain information about the properties of distant stars in the universe.

Write It! #2

Describe what a high and low frequency electromagnetic wave look like.

Write It! #3

Define wavelength as it relates to the electromagnetic spectrum.


Assess It!
Assess It! Station Directions
It is recommended that you have completed at least **two** of the following stations before working at this station.
-Read It!
-Explore It!
-Watch It!
-Research It!
Each member will answer the questions from the task cards on the lab sheet in the Assess It! section.
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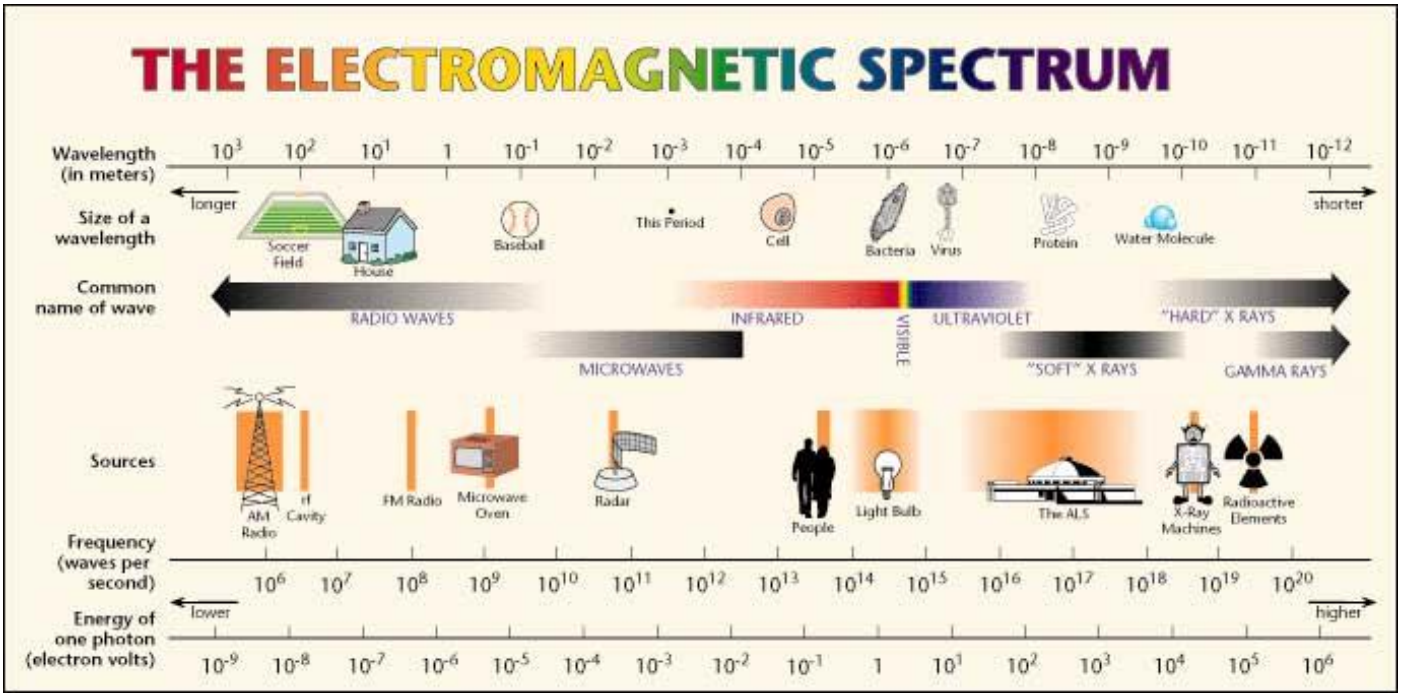
THE ELECTROMAGNETIC SPECTRUM
Wavelength (in meters)
10^3 10^2 10^1 1 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9} 10^{-10} 10^{-11} 10^{-12}
longer
shorter
Size of a wavelength
Soccer Field
House
Baseball
This Period
Cell
Bacteria
Virus
Protein
Water Molecule
Common name of wave
RADIO WAVES
MICROWAVES
INFRARED
VISIBLE
ULTRAVIOLET
"SOFT" X RAYS
"HARD" X RAYS
GAMMA RAYS
Sources
AM Radio
rf Cavity
FM Radio
Microwave Oven
Radar
People
Light Bulb
The ALS
X-Ray Machines
Radioactive Elements
Frequency (waves per second)
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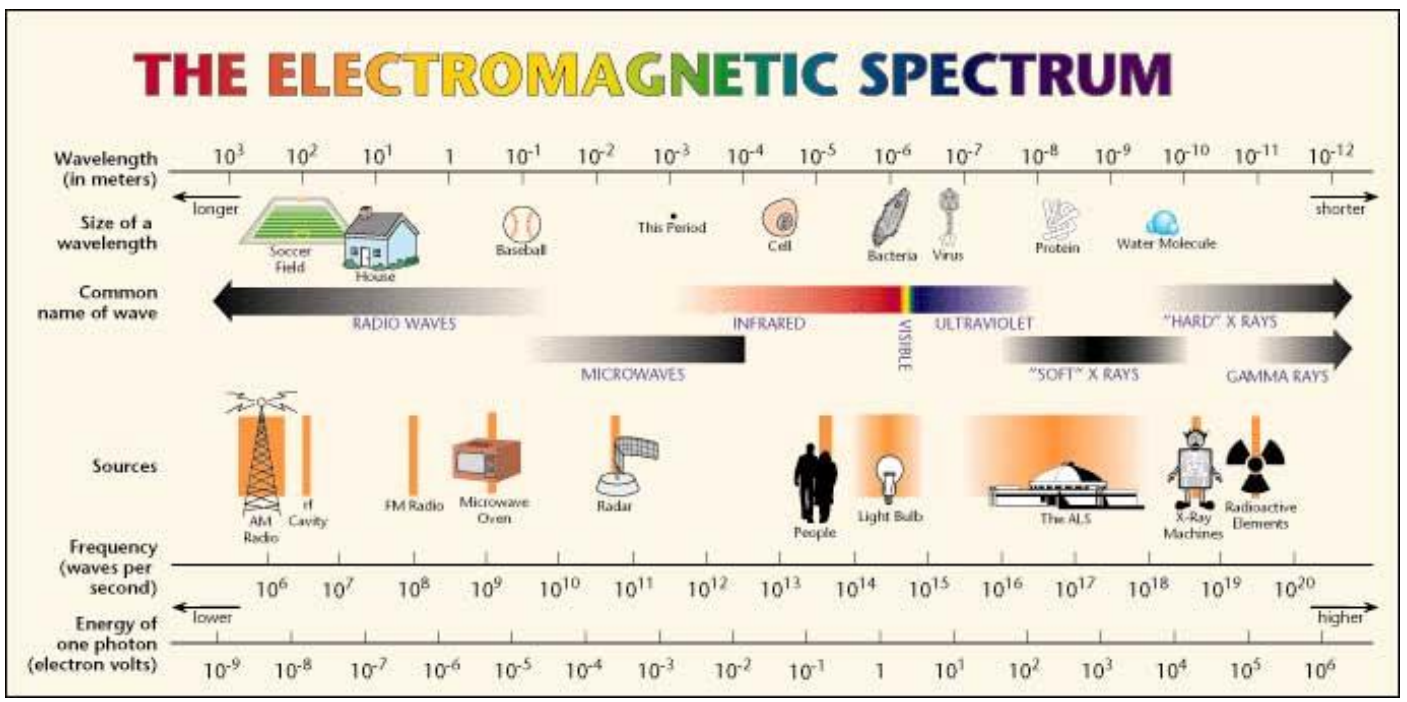
lower
higher
Energy of one photon (electron volts)
10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 1 10^1 10^2 10^3 10^4 10^5 10^6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Assess It! #1

Use the electromagnetic spectrum provided

How does the wavelength of a radio wave compare to the wavelength of a visible light wave?

A. The radio wavelength is longer
B. The visible light wavelength is longer
C. They have the same wavelength
D. Cannot be determined

Assess It! #2

Use the electromagnetic spectrum provided

What is one common product that uses microwaves?

A. AM radio
B. Fluorescent lights
C. X-ray machine
D. Radar

Assess It! #3

Use the electromagnetic spectrum provided

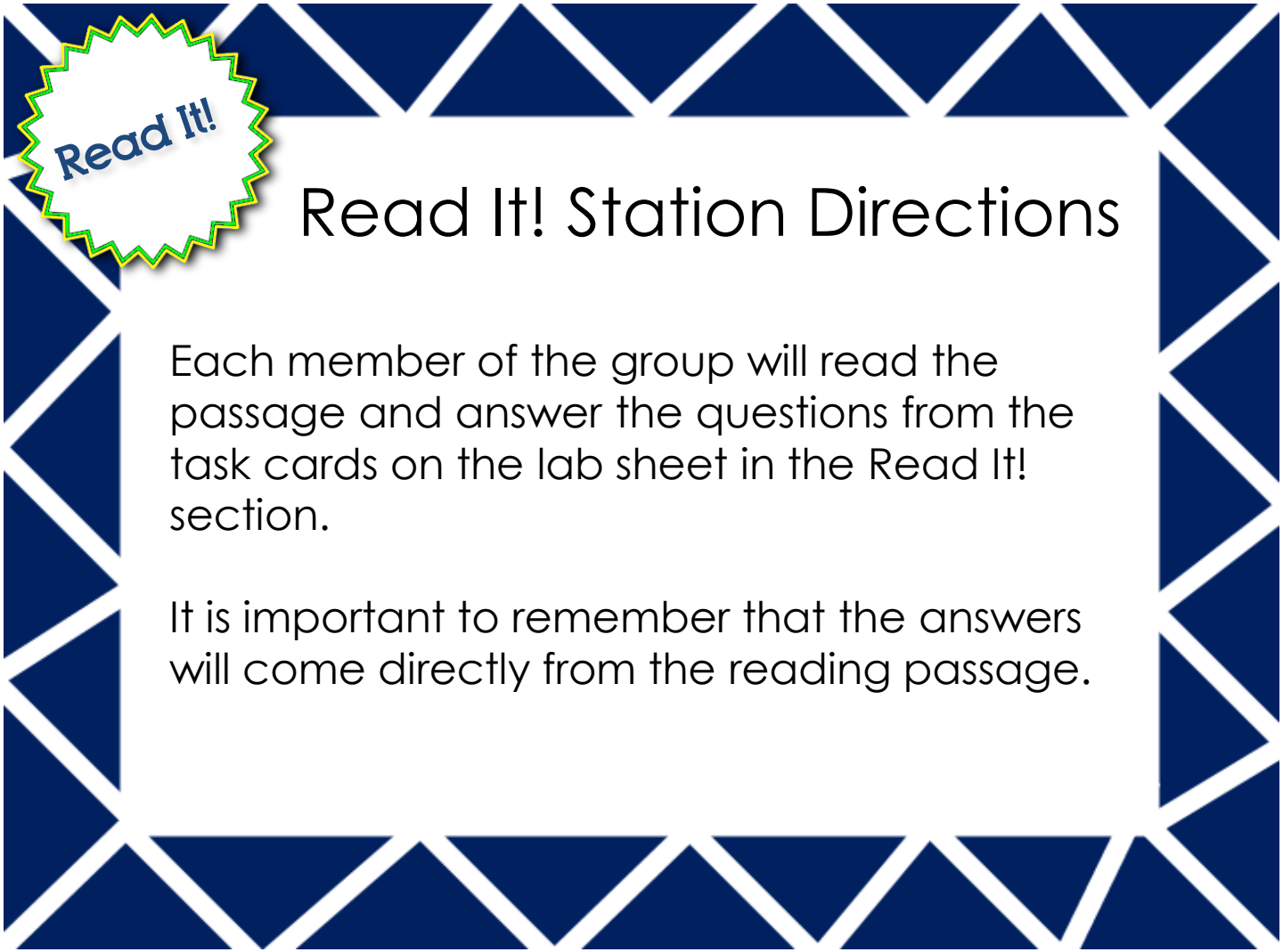
How does the frequency of gamma rays compare to the frequency microwaves?

A. Gamma waves have a lower frequency
B. Gamma waves have a higher frequency
C. They have the same frequency
D. Cannot be determined

Assess It! #4

Why do scientists use the electromagnetic spectrum to study the composition of stars and the universe?

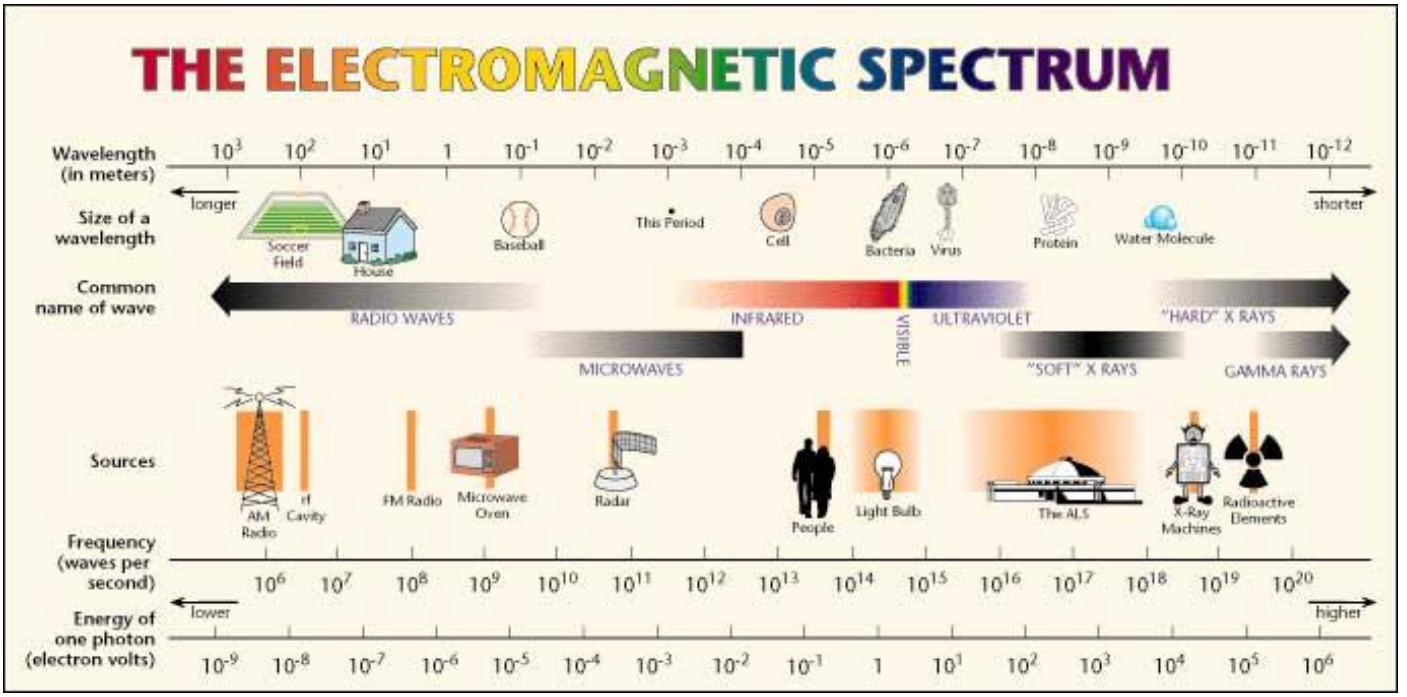
A. We cannot travel to stars
B. The full EM spectrum provides much more information than just visible light from a telescope
C. The EM spectrum allows scientists to compare wavelengths with other known elements on Earth
D. All of the above



Read It! Station Directions

Each member of the group will read the passage and answer the questions from the task cards on the lab sheet in the Read It! section.

It is important to remember that the answers will come directly from the reading passage.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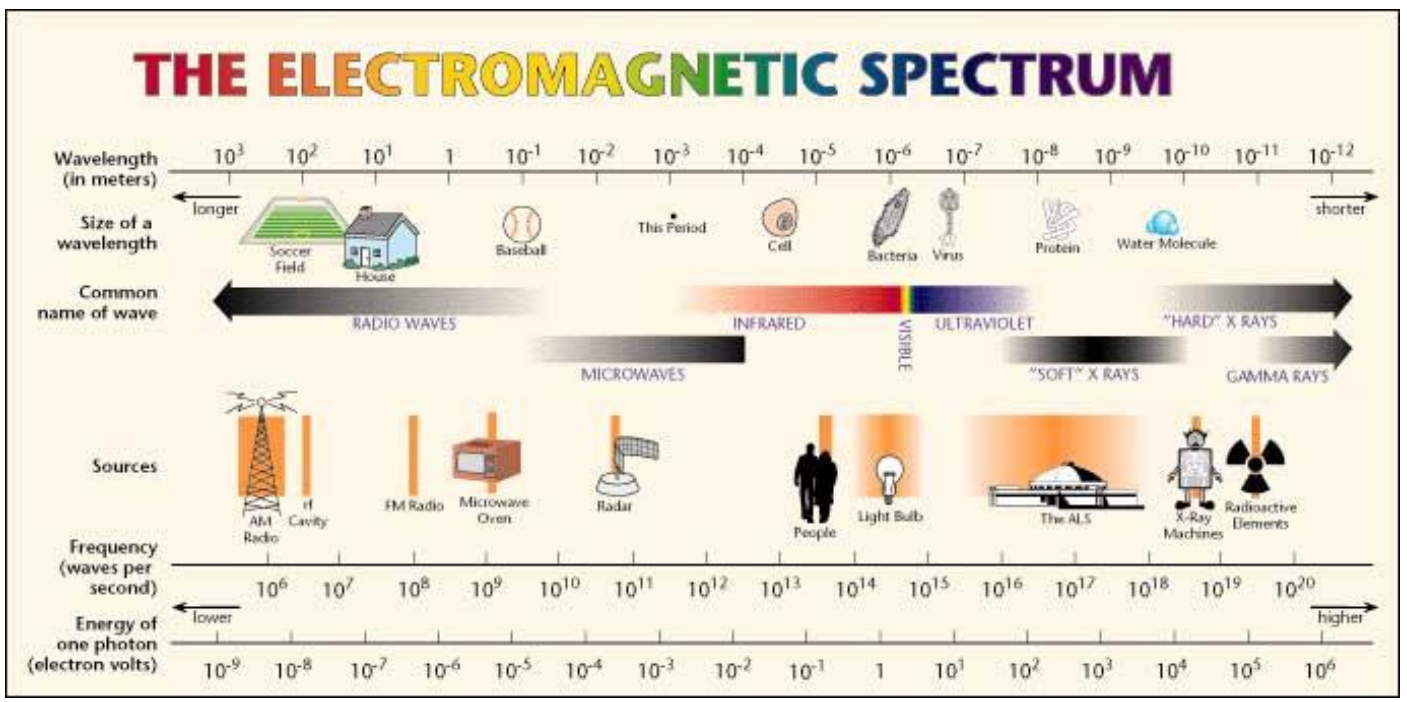
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Read It!

The Electromagnetic Spectrum

When you tune your radio, watch TV, send a text message, or pop popcorn in a microwave oven, you are using electromagnetic energy. You depend on this energy every hour of every day. Without it, the world you know could not exist.

Electromagnetic energy travels in waves and spans a broad spectrum from very long radio waves to very short gamma rays. The human eye can only detect only a small portion of this spectrum called visible light. A radio detects a different portion of the spectrum, and an x-ray machine uses yet another portion. NASA's scientific instruments use the full range of the electromagnetic spectrum to study the Earth, the solar system, and the universe beyond.

Our Sun is a source of energy across the full spectrum, and its electromagnetic radiation bombards our atmosphere constantly. However, the Earth's atmosphere protects us from exposure to a range of higher energy waves that can be harmful to life.

Gamma rays, x-rays, and some ultraviolet waves are "ionizing," meaning these waves have such a high energy that they can knock electrons out of atoms. Exposure to these high-energy waves can alter atoms and molecules and cause damage to cells in organic matter. These changes to cells can sometimes be helpful, as when radiation is used to kill cancer cells, and other times not, as when we get sunburned.

The electromagnetic spectrum describes all the wavelengths of light – both seen and unseen. The shorter the wavelength, the more energetic the light. By using telescopes sensitive to different wavelength ranges of the spectrum, astronomers get a glimpse into a wide variety of objects and phenomena in the universe.

Review the Electromagnetic Spectrum at your table.

Read It! #1

According to the passage the human eye can detect what kinds of waves?

A. Radio and visible light
B. Visible light and gamma rays
C. Gamma, radio, & microwaves
D. Only visible light

Read It! #2

What does the term 'ionizing" mean in the 4th paragraph?

A. Low energy waves that gain electrons in atoms
B. Visible light waves that can be seen
C. High energy waves that can lose electrons in atoms
D. When waves collide with each other

Read It! #3

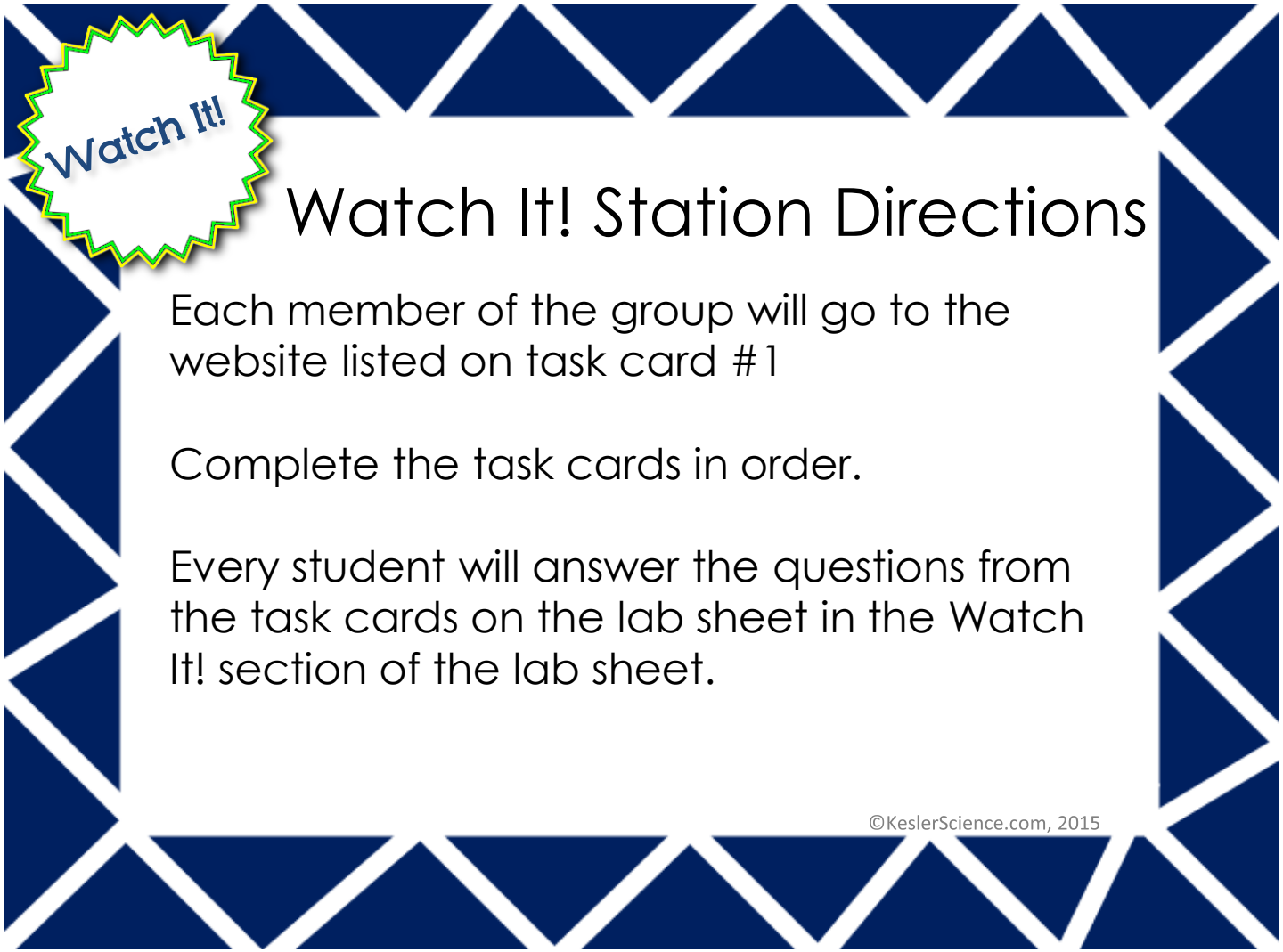
Shorter wavelengths have _____ energy and longer wavelengths have _____ energy.

A. Less, more
B. Little, less
C. More, less
D. Potential, kinetic

Read It! #4

Another title for this passage could be?

A. An Overview of the Electromagnetic Spectrum
B. Visible Light and You
C. The Difference Between High and Low Frequency
D. All about Microwaves


Watch It!
Watch It! Station Directions
Each member of the group will go to the website listed on task card #1
Complete the task cards in order.
Every student will answer the questions from the task cards on the lab sheet in the Watch It! section of the lab sheet.
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Watch It! #1

Flash drive: The Electromagnetic Spectrum

1. Answer questions from cards #2-4 on your lab sheet.

Watch It! #2

Name 4 household items that emit (give off) electromagnetic waves?

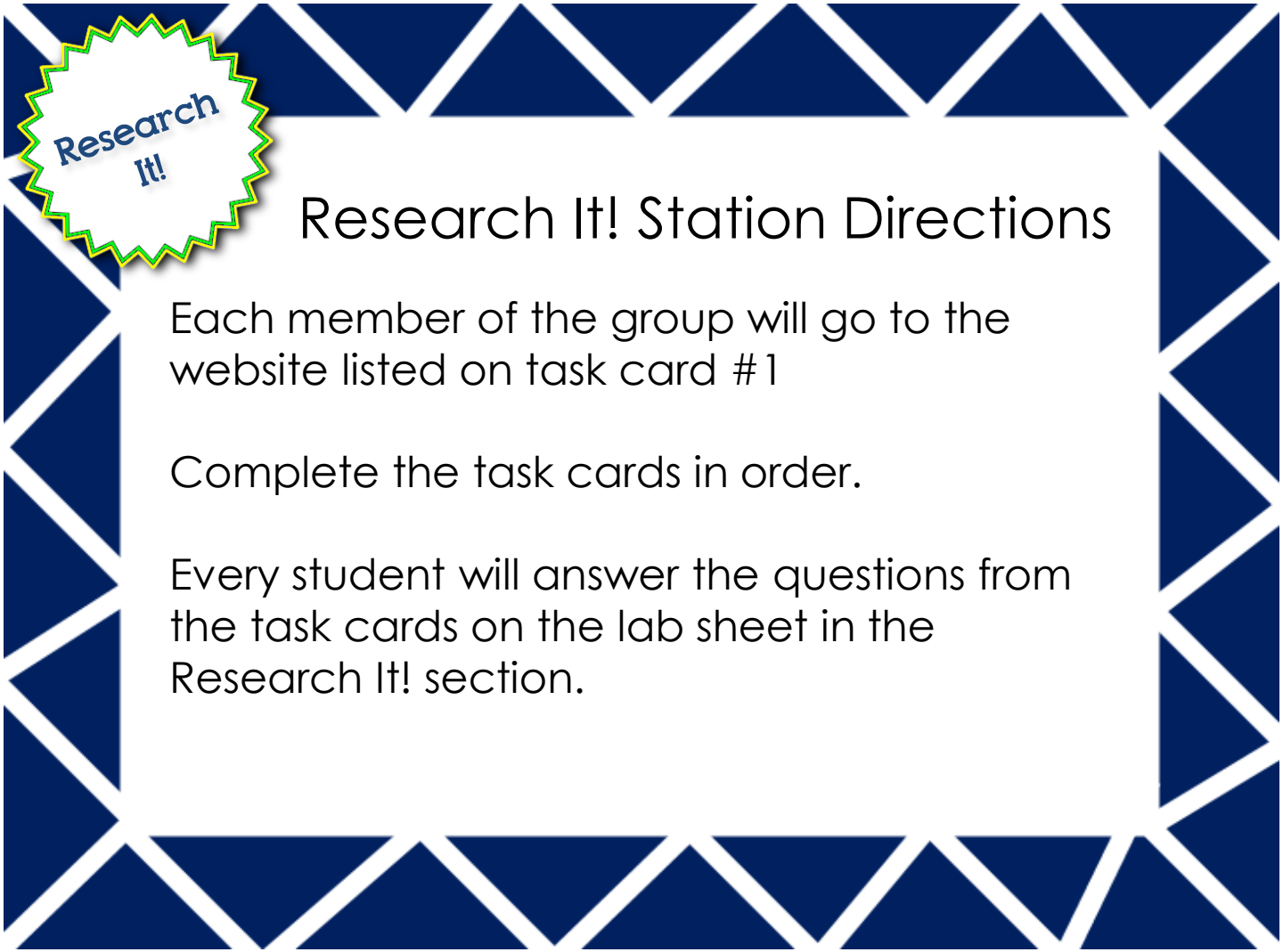
Watch It! #3

Which types of waves have the shortest wavelength?

Which types of waves have the longest wavelength?

Watch It! #4

How does a spectral signature help scientists determine the composition of planets and other stars? (starts around 4:10)



Research It! Station Directions

Each member of the group will go to the website listed on task card #1

Complete the task cards in order.

Every student will answer the questions from the task cards on the lab sheet in the Research It! section.

Research It! #1

Go to http://www.bbc.co.uk/schools/gcsebitesize/science/21c_pre_2011/radiation/electromagneticradiationact.shtml

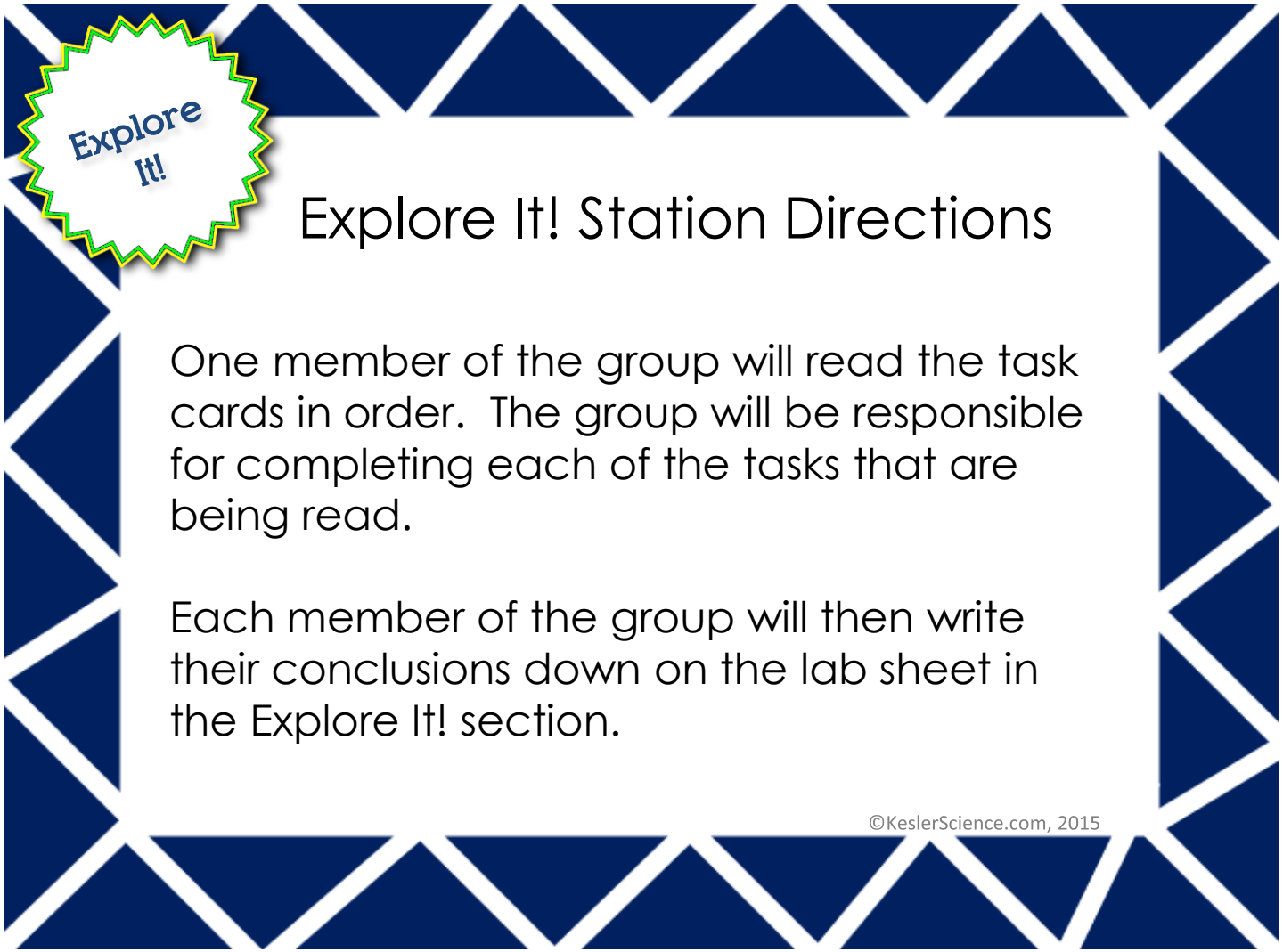
1. Scroll down to the electromagnetic spectrum interactive activity in the middle of the page
2. Click START

Research It! #2

1. Write down 3 things you did not know after completing all 8 slides.

Research It! #3

1. List the wave types in order from shortest to longest wavelength.


Explore It!
Explore It! Station Directions
One member of the group will read the task cards in order. The group will be responsible for completing each of the tasks that are being read.
Each member of the group will then write their conclusions down on the lab sheet in the Explore It! section.
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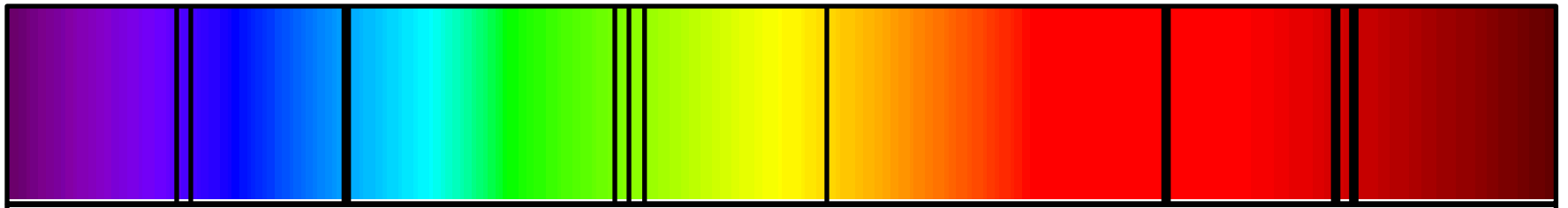
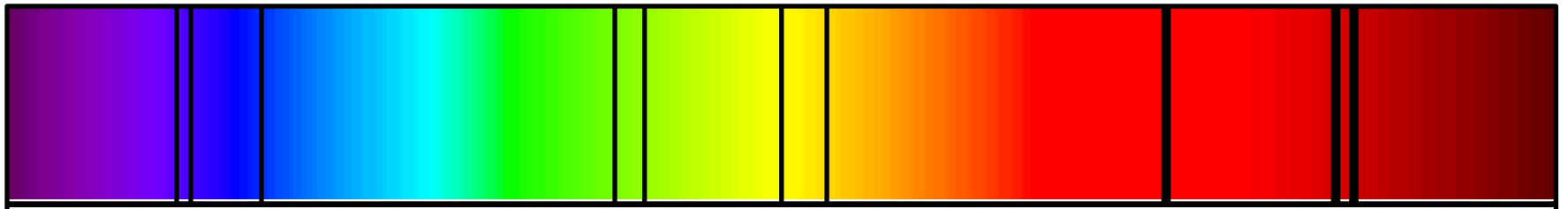
Unknown Star **A**
Full Spectrum



Place spectrums of known elements here.

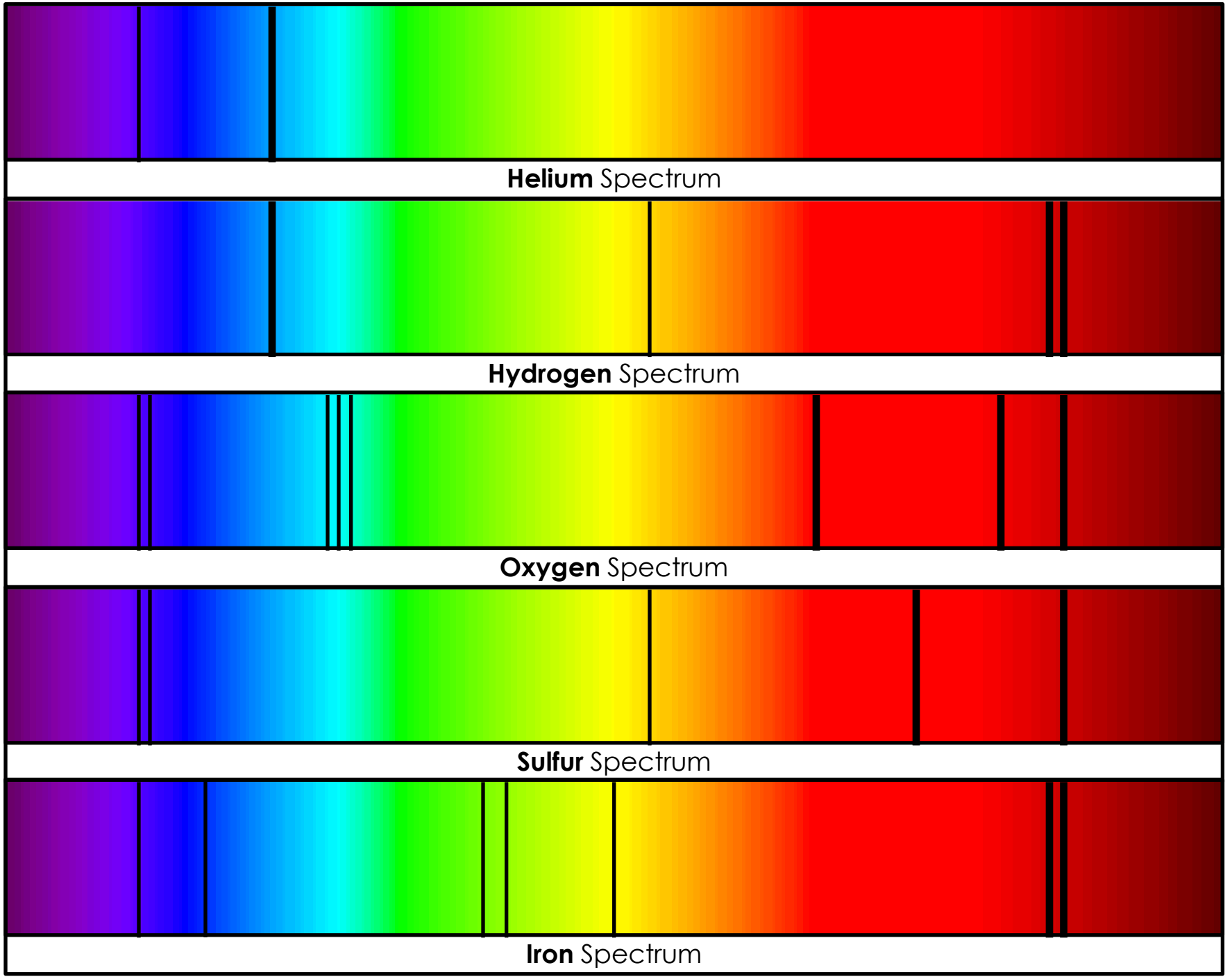
Note: Element and star spectrum are fictitious. Activity is for demonstration purposes only.

Unknown Star **B** Full Spectrum

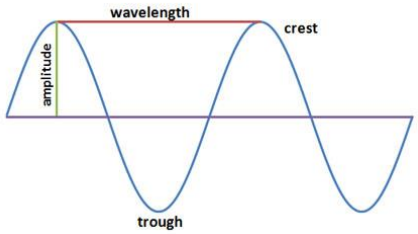


Place spectrums of known elements here.

Note: Element and star Spectrum are fictitious. Activity is for demonstration purposes only.


Helium Spectrum
Hydrogen Spectrum
Oxygen Spectrum
Sulfur Spectrum
Iron Spectrum

Explore It! #1



The parts of an electromagnetic wave can be described using the terms **crest, trough, wavelength,** and **amplitude**.

1. Draw the diagram on your lab sheet.

Explore It! #2

Scientists use different types of waves to identify composition of distant stars and planets.

Each star or planet will emit different kinds of electromagnetic waves which can be matched up to known elements on Earth.
This is how we know what stars are made up of.

Explore It! #3

1. Find the paper that has the full spectrum of **Unknown Star A.**
2. Place one of the known element spectrums in the box below the star spectrum.
3. If **ALL** of the lines from the element spectrum are found in the exact same place in the star spectrum then that element is present in the star.

Explore It! #4

1. Repeat the process for the remaining 4 elements.
2. Fill in your lab sheet.
3. Repeat the process for **Unknown Star B**

Illustrate It! Station Directions

Each member of the group will draw a quick sketch on the lab sheet the shows they understand the concept that is being taught.

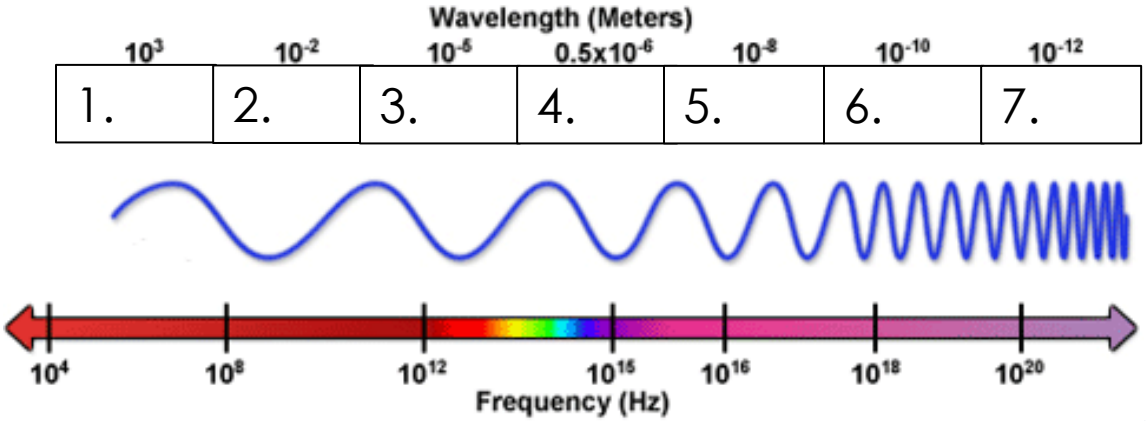
Use the colored pencils and markers that are provided.

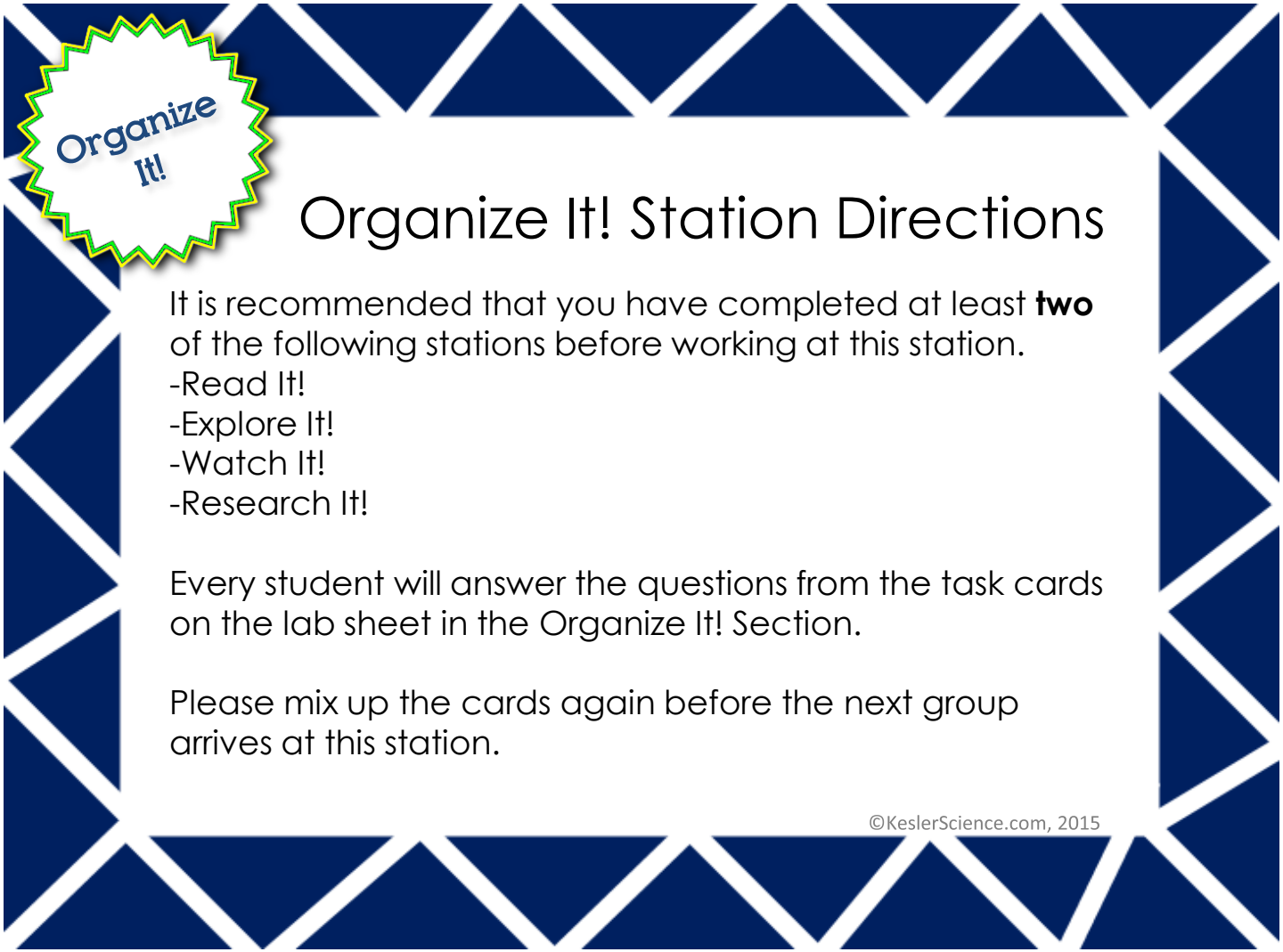
The directions for the sketch are provided on the task card at the table.

Illustrate It!

Illustrate It! Station Directions

1. Quick sketch the diagram and place the name of the waves in the correct spot **(x-ray, gamma ray, visible light, microwave, radio, infrared, ultraviolet)**





Organize It! Station Directions

It is recommended that you have completed at least **two** of the following stations before working at this station.
-Read It!
-Explore It!
-Watch It!
-Research It!

Every student will answer the questions from the task cards on the lab sheet in the Organize It! Section.

Please mix up the cards again before the next group arrives at this station.

Organize It! #1

Match the 7 different wave types with the appropriate description.

Organize It! #2

Write **3** of the matches on your lab sheet.

Have the teacher check your matched sets.

Gamma Rays	Highest frequency wave and often used to fight cancer
Radio Waves	Lowest frequency waves that allow you to listen to your favorite station in the car.
Infrared Light	Moderate frequency and used in remote controls.
Microwaves	Longer wavelength than infrared waves and used for heating food quickly.
X-Rays	Shorter wavelength than visible light and used to view the skeletal system
Ultraviolet Light	This wavelength is shorter than visible light, but longer than x-rays. These waves can cause a sunburn.
Visible Light	The only light waves we can see.

Electromagnetic Spectrum

Name_____

Explore It!

Task Card #1:
Sketch the parts of a wave below.

Task Card #4

List the elements present in each of the unknown stars

Unknown Star A:

Unknown Star B:

Write It!

Task Card #1:

_____

_____

_____

_____

Task Card #2:

_____

_____

_____

_____

Task Card #3:

_____

_____

_____

Electromagnetic Spectrum

Name_____

Illustrate It!

Assess It!

#1_____ #2_____
#3_____ #4_____

Read It!

#1_____ #2_____
#3_____ #4_____

Research It!

Task Card #2:

_____
_____
_____

Task Card #3:

_____
_____
_____
_____

Organize It!

1.
2.
3.

Name_____

Watch It!

Task Card #2:

_____

_____

_____

_____

_____

Task Card #3:

_____

_____

_____

_____

_____

Task Card #4:

_____

_____

_____