

NASA – Mission: Science

Introduction to the Electromagnetic Spectrum Web Quest

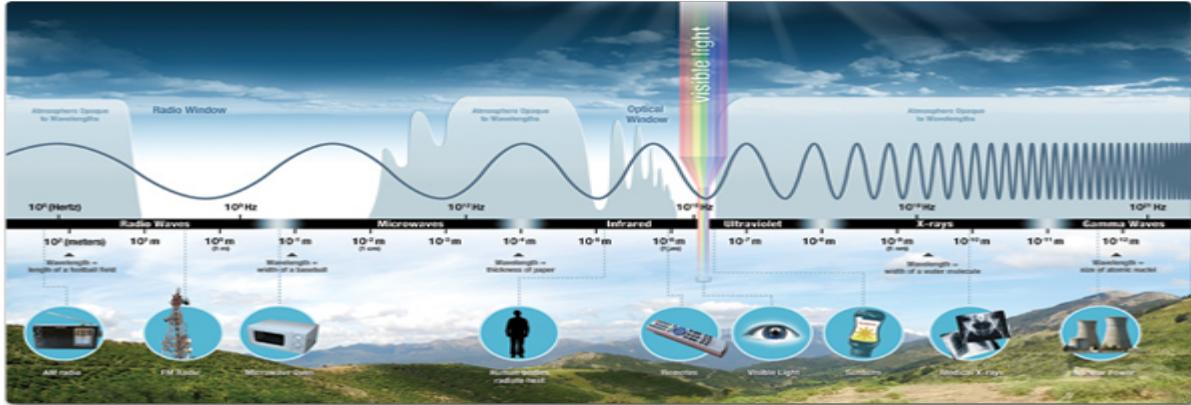
Directions: Load the following website which will discuss the electromagnetic spectrum in detail.

http://missionscience.nasa.gov/ems/01_intro.html

Explore the website and answer the questions which follow. The questions are divided into categories which you will easily find throughout the site. (Use tabs on the right hand column.)

Intro To The EMS

1. Whenever you tune your radio, watch television, send text messages, or make popcorn in a microwave oven, what are you using?
2. How does electromagnetic energy travel?
3. The very long ones are called _____ waves, and the very short ones are called _____ waves.



4. What are the three types of electromagnetic waves which are “ionizing” waves, meaning that they have high enough energy that they can knock electrons off of atoms?
5. Our atmosphere protects us from most of the ionizing waves that the sun emits. What are the three most important gases in our atmosphere which protect us?

6. What do we call the regions of the EM spectrum which are able to pass (transmit) through our atmosphere?

Anatomy of an Electromagnetic Wave

7. Electromagnetic waves are created when what moves?

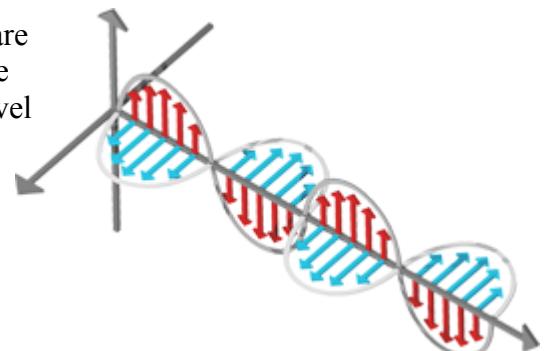
8. Mechanical waves are different than electromagnetic waves in that mechanical waves are a vibration or disturbance in _____.

9. Light is made up of discrete particles called _____.

10. Light acts like a particle, and acts like a wave. Light waves are made up of two parts, a _____ wave and a _____ wave, which travel at right angles to each other.

11. The frequency of a wave is described as the number of _____ that pass a given point within one _____.

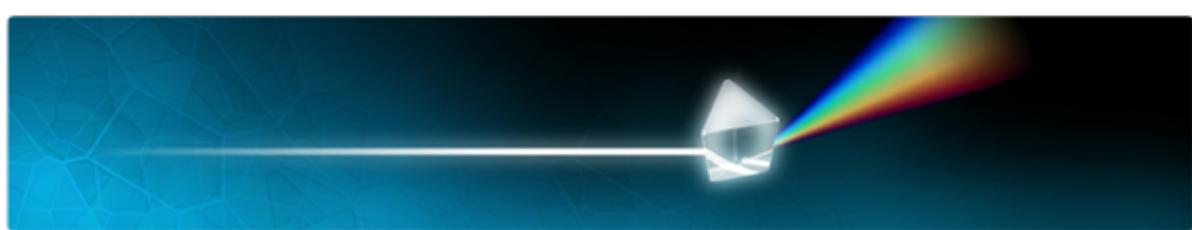
12. The distance between two consecutive wave crests is called the _____.



Wave Behaviors

13. When light waves encounter objects, they are either

- * _____,
- * _____,
- * _____,
- * _____,
- * _____,
- * _____, or
- * _____, depending on the composition of the object and the wavelength of the light.



14. Match the following wave behaviors to their descriptions:

Reflection Absorption Diffraction

Scattering Refraction

- a. When light waves change direction when passing from one medium to another.
- b. The bending and spreading of waves around an obstacle, edge, or boundary.
- c. When an incoming light wave bounces off of an object.
- d. When photons of light hit atoms and cause them to increase their vibrations (causing them to heat up).
- e. When light bounces off of an object in a variety of directions.

Visualization: From Energy To Image

15. False color, also known as _____ is what helps scientists visualize data from EM waves that are beyond the visible spectrum range.

16. Composite images can be put together using multiple images from different sensors. The galaxy Messier 101 is shown. What are the three different sensors used to form the composite, and what section of the EM spectrum did each record?

| Sensor | Type of EM waves recorded |
|--------|---------------------------|
| | |
| | |
| | |

Radio Waves

17. Radio waves have the _____ wavelengths of the spectrum.

18. Multiple space objects, including the sun, earth, Jupiter, and even galaxies emit radio waves. Radio telescopes resemble large dishes. Radio astronomy has what advantage compared to attempting to study the other areas of the spectrum?



Microwaves

19. Microwave ovens use microwaves which are about _____ in length. They force water and fat molecules to rotate. The more they rotate, the hotter they have become. This heat energy cooks the food.

20. Microwave bands which can penetrate haze, light rain, snow, etc. are very useful for _____ and studying the earth from space.

21. The microwave background radiation, an image of which is shown from the WMAP project, gives wide support for what theory?

Infrared Waves

22. If you were to watch television tonight, how would you be utilizing infrared waves?

23. What is the name for the type of imaging that occurs when infrared waves are collected, and translated into visible images? (This type of imaging is useful for measuring temperatures of objects from a distance.)

Visible Light

24. List the seven colors in order from **shortest** to **longest** wavelength:

- (1) _____
- (2) _____
- (3) _____
- (4) _____
- (5) _____
- (6) _____
- (7) _____

25. Absorption lines present in a spectrum gives us evidence of specific elements located within light producing objects in space, such as stars. What element has an absorption line present at the transition between green and blue?

Ultraviolet Waves

26. Some insects, reptiles, and birds are able to see portions of the ultraviolet spectrum that humans can not. What tool do we use, which emits UV light in order to attract and trap certain “pest” insects?

27. Ultraviolet waves have enough energy to put _____ and other types of cellular damage at risk if overexposed.

28. What is the upper atmosphere gas which protects us from ultraviolet waves?

X-Rays

29. Bones are able to absorb more x-rays than skin due to bone having a higher _____ than skin.



30. When the sun ejects _____, they can be swept up by the earth's magnetosphere (magnetic field). This can cause an _____ which can include, among other types of light, x-rays.

Gamma Rays

31. Gamma rays have the _____ wavelengths and the _____ energy of any waves in the EM spectrum.

32. How are gamma rays quite different from visible and x-ray waves? What object do they not interact with?

33. A _____ is an event that can, in 10 seconds, release more energy than our sun will release during its entire, expected, 10 billion year lifetime.

