Name: _____ Date: _____ Period: _____

Lesson E&S 5.1 – Observing Matter in Space

Evidence Notebook

Key Ideas

1. What is the advantage of using a satellite observatory verse a ground-based telescope?

2. What would be the best method of obtaining images and direct measurements of nearby objects?

3. Reflecting telescopes make objects seem bigger.
    a. However, the main job is to make objects _____.
    b. Illustrate how a reflecting telescope works.

    c. Why would increasing the size of a reflecting telescope make it easier to see faint objects?

4. Electromagnetic spectrum
    a. How is wavelength and energy related?

    b. Place the following forms of radiation in order on the illustration below:
    Infrared, gamma ray, visible, radio wave, microwave, x-ray, ultraviolet

    c. Place the following colors in order from highest energy to lowest energy:
    Orange, green, red, purple, blue, yellow

5. When observing galaxies, what can information can x-rays offer better than visible light?

6. When observing galaxies, what can information can infrared radiation offer better than visible light?

7. Match the following telescopes with the type of radiation they detect:

Fermi Gamma-ray Space Telescope	a. X-rays
VLA (Very Large Array)	b. Gamma rays
NuSTAR	c. Radio waves
Spitzer Space Telescope	d. Microwaves
Planck Telescope	e. Infrared

8. Why is the VLA the only telescope listed above that is suitable to be place on Earth's surface?

9. _____ spectrum comes directly from the light source. _____ spectrum is the result after light has passed through a dust cloud.
10. The Doppler Effect is the change in frequency of something in motion.
    a. Illustrate how waves change due to motion

    b. If an object is moving toward the observer the waves get _____. If an object is moving away from the observer the waves get _____.
    c. What color is the shift when a star or galaxy is moving away from the observer?

    d. What color is the shift when a star or galaxy is moving toward from the observer?

11. A _____ is the difference in the apparent position of an object viewed along two different lines of sight.
    a. *Circle the correct words:* Closer | Distant objects will shift more than closer | distant objects.
    b. Illustrate an example of stars viewed in space at different times of the year:

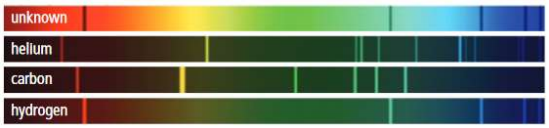
12. Color and temperature
    a. As an object that emits radiation gets hotter, explain what happens to its color?

    b. As an object that emits radiation get hotter, what happens to the intensity?

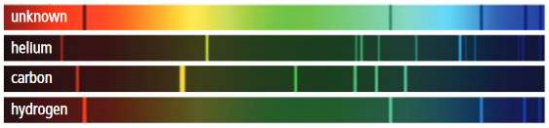
CHECKPOINTS

13. *Select and record the correct responses to complete the following statements*.
    Suppose an ambulance is approaching and then passes you and drives away without changing speed. As an ambulance approaches, the sound waves (expand, compress), resulting in a (higher, lower)-frequency wave. As the ambulance passes, the pitch (increases to a higher frequency, drops to a lower frequency).
14. Which of these statements describes a way scientists can study an object in space regardless of its distance from Earth?
    a. A spacecraft is sent to visit and analyze matter from the object.
    b. Scientists collect and analyze matter from the object that reaches Earth.
    c. A telescope in orbit concentrates electromagnetic radiation from the object, and a spectrograph or other instrument is used to analyze the EM radiation.
    d. A telescope on the ground concentrates electromagnetic radiation from an object that gives off only x-rays.

15. Suppose you observe absorption spectra from three galaxies. All contain the same number of absorption lines. The lines have the same spacing in all three spectra. Lines in the first spectrum show blueshift, lines in the second match laboratory emission lines, and lines in the third show redshift. Which of the following statements is correct?
    a. The differences in the line positions are due to differences between absorption spectra and emission spectra.
    b. The differences in the line positions show that the galaxies are composed of different elements.
    c. The blueshifted lines of the first galaxy show that it is moving away from Earth.
    d. The redshifted lines of the third galaxy show that it is moving away from Earth
16. Analyze the line spectrums below and determine which element the unknown is:



17. Analyze the line spectrums below and determine if the unknown is an emission or absorption spectrum:



18. In addition to the elements present in a star, what other information might scientists obtain by studying the star's spectrum?

19. What can parallax be used to determine?
    a. the composition of stars based on the spectra of their starlight
    b. the distance to a star that is within 1,000 light years of Earth
    c. the temperature of the surface of a star that is within 1,000 light years of Earth
    d. the distance to extremely distant stars
20. Several of the world's most powerful reflecting telescopes are located at the summit of Mauna Kea in Hawaii, nearly 14,000 feet above sea level.
    a. What ranges of the EM spectrum can be observed at such a location?

    b. What ranges are not observable even at that height?

21. Blue giants and red giants are two major categories of stars. Based on what you have learned about the relationship between temperature and color, which of these types of stars would you expect to be hotter? *Explain your reasoning*.

22. What happens to the spectrum of a star that is moving away from Earth?
    a. Unchanged
    b. Loses its color
    c. Shifts toward red
    d. Shifts toward blue
23. What happens to the spectral lines of a star that is moving toward Earth?
    a. The waves spread out, and the frequency of each line increases.
    b. The waves spread out, and the frequency of each line decreases.
    c. The waves compress, and the frequency of each line increases.
    d. The waves compress, and the frequency of each line decreases.

24. Scientists determine the composition and temperature of stars:
    a. through magnetic testing
    b. by analyzing the vibrations that stars emit
    c. through samples of matter on the surface of stars
    d. by analyzing the spectra of the light that stars emit
25. What problem is solved by sending telescopes into space?
    a. interference of dry air in detecting electromagnetic radiation
    b. interference of gamma rays in detecting electromagnetic radiation
    c. inability of Earth telescopes to detect invisible electromagnetic radiation
    d. interference of Earth's atmosphere in detecting electromagnetic radiation
26. How will the spectra lines recorded on Earth be shifted for a light-emitting object that is moving neither toward nor away from Earth?
    a. They will have redshift.
    b. They will have blueshift.
    c. They will have greenshift.
    d. They will not be shifted at all.
27. What has happened to light that has been blueshifted?
    a. Its amplitude has been increased.
    b. Its amplitude has been decreased.
    c. Its wavelength has been increased.
    d. Its wavelength has been shortened.
28. If a dense, non-light producing, interstellar gas were to move between a star and Earth, what would happen to the spectra of the light from the star as measured on Earth?
    a. The spectra would show greater redshift.
    b. The spectra would become a continuous spectra.
    c. The number of spectra lines would likely increase.
    d. The number of spectra lines would likely decrease.
29. Photons form emission spectra when they are released from atoms. Why do atoms emit these photons?

30. What does a continuous spectrum imply about the space between a spectrograph and the light-emitting object?