Looking for Signs of Life Answer Key

1. What gases do you think would be in the atmosphere of a habitable planet?
   Student answers will vary. Students may think that scientists should search for the gases that are present on Earth. Others may think that scientists should look for gases that were present on Earth when life was just starting. Others may suggest that the atmosphere could be entirely different because other planets may have entirely different forms of life.

2. Waves in the electromagnetic spectrum vary in size from very long radio waves, the size of buildings, to very short gamma rays, smaller than the nucleus of an atom. How does the model show the differences between longer-wavelength infrared radiation and shorter-wavelength visible light?
   The infrared radiation is shown as a dotted black line squiggle. Visible radiation is shown as squiggles in the colors of the visible light.

3. How does the wavelength change when you move the slider from infrared to ultraviolet?
   The wavelength gets shorter as you move from infrared to ultraviolet. The infrared is the longest wavelength in this model, and the ultraviolet is the shortest. The wavelength (distance from peak to peak of the wave [the squiggle]) gets shorter.

4. In the model, what type of light was absorbed by and emitted from the atoms?
   green

5. What happened to the photons that were not absorbed by the atoms?
   The photons that were not absorbed by the atoms passed right through them. This is because atoms absorb only specific frequencies. Other photons pass right through the mixture.

6. Which of the mixtures in the model contains hydrogen?

Hydrogen Absorption Spectrum

   Mixture D

7. Explain your answer.
   Each of the mixtures made a series of lines on the spectrometer. Each of them had lots of lines, but only Mixture D had all of the lines shown in the hydrogen spectrum.

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8. There are many different elements in the gases of stars and planetary atmospheres. A particular star is composed of hydrogen and neon. What would its absorption spectrum look like?
   The absorption spectrum of a star that contains neon and hydrogen would look like a combination of the hydrogen spectrum and the neon spectrum.

9. Explain your answer.
   Because both hydrogen and neon are present, both hydrogen and neon would be seen in the absorption spectrum. It would look like a combination of the two spectra.

10. The absorption spectrum from a star is shown below.

A planet transits in front of the star and scientists measure the absorption spectrum of the planetary atmosphere. If the planet has an atmosphere, how should its absorption spectrum compare to the star's spectrum?
It should have more absorption lines.

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11. Explain your answer.
    If the planet has a different atmospheric composition than the star, more lines will appear on the planet's atmospheric spectrum. The substances in the planet's atmosphere would absorb specific wavelengths. When those wavelengths are absorbed, more lines appear on the spectrum.

12. How certain are you about your claim based on your explanation?
    Student answers will vary.

13. Explain what influenced your certainty rating.
    Student answers will vary. Scientific evidence includes specific references to absorption spectra or the model that shows that elements absorb only specific frequencies of light. Students may be uncertain that the spectrum of the star was taken without any planets in front of it (making it a sample of just the star, not the star plus one or more planets).

14. What combination of substances in a planet's atmosphere would suggest that the planet might be suitable for life? Choose all that apply.
    ozone
    oxygen
    carbon dioxide
    methane
    nitrogen
    sulfur compounds
    nitrogen compounds
    water

15. Explain your answer.
    Student answers will vary. They may include a combination of the following:

    Ozone can absorb ultraviolet radiation that can mutate DNA. This could indicate that the surface is suitable for life.

    Oxygen is a necessary component for aerobic life on Earth, but it is not necessarily a sign of habitability. There are many organisms that can live without oxygen. Oxygen may indicate that life exists on the planet, as oxygen didn't exist on Earth until photosynthetic organisms changed the atmosphere.

    Carbon dioxide is a greenhouse gas that can stabilize the temperature of the planet. On Earth, aerobic organisms produce carbon dioxide as a waste product, and photosynthetic organisms use it as a building block of carbohydrates.

    Methane is a greenhouse gas that can stabilize the temperature of the planet. Methane may also be evidence of life on the planet, although there are also non-biological sources of methane.

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Nitrogen is a necessary building block of proteins. Earth's atmosphere is mostly nitrogen.

Sulfur compounds may indicate the presence of life. Sulfur compounds are a waste product for some organisms on Earth.

Nitrogen compounds may indicate the presence of life. All organisms on Earth produce nitrogen compounds in their waste.

Water is necessary for life as we know it. If the planet's atmosphere has water, it may be suitable for life. Water in the atmosphere is a sign of water on the surface.

16. How certain are you about your claim based on your explanation?
    Student answers will vary.

17. Explain what influenced your certainty rating.
    Student answers will vary. Scientific evidence includes specific reference to the functions that such compounds play in life on Earth. Students may be uncertain that life on other planets will be like life on Earth.

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