

Using Spectral Data Worksheet **Answers**

Questions

1. Elements present in spectrum (a), Titan, are:
hydrogen and nitrogen
2. Elements present in spectrum (b), Saturn's rings, are:
hydrogen
3. Why is hydrogen so abundant in these spectra?
(Hint: What do you know about the structure of hydrogen and about its abundance in the universe?)
Hydrogen is the simplest and most abundant element in the universe, so we expect to find it in high concentrations throughout the solar system. The hydrogen signature in the ring spectra, however, actually comes from hydrogen present in interplanetary space. The light shines through the rings and isn't actually emitted by the rings themselves.
Supplemental question: What techniques could scientists use to remove the signature of interplanetary gas from their data?
Answer: Scientists can compare the spectrum of "empty" space to the spectrum of the object being observed and subtract off the interplanetary "background."
4. Why do you think nitrogen is present in the spectra from Titan but not in the spectra of Saturn's rings?
Titan has an atmosphere. The gravitational properties of a large moon like Titan are very different from those of a debris field like the rings. Titan's gravity captures atoms like nitrogen that would otherwise escape to space.
Fun Fact: Nitrogen is not always visible in Titan's spectrum; it can be seen only during a Titanian aurora, when electrons from the sun become trapped in Saturn's magnetic field and hit Titan's upper atmosphere. This energizes the nitrogen atoms and causes them to emit light.
5. Using information in the table below, compare and contrast the composition of Titan's atmosphere and Earth's atmosphere. What are some reasons these differences might exist?
Earth's atmosphere reflects its inhabitants, as well as complex chemical processes. Oxygen is present in Earth's atmosphere as a result, among other things, of photosynthesis, the process that plants use to breath. It uses carbon dioxide and gives off oxygen as a by-product. The oxygen in the atmosphere forms our protective ozone layer that shields us from incoming solar radiation.

Titan		Earth	
Nitrogen	95%	Nitrogen	78%
Methane	3%	Oxygen	21%
Argon	2%	Argon	1%