



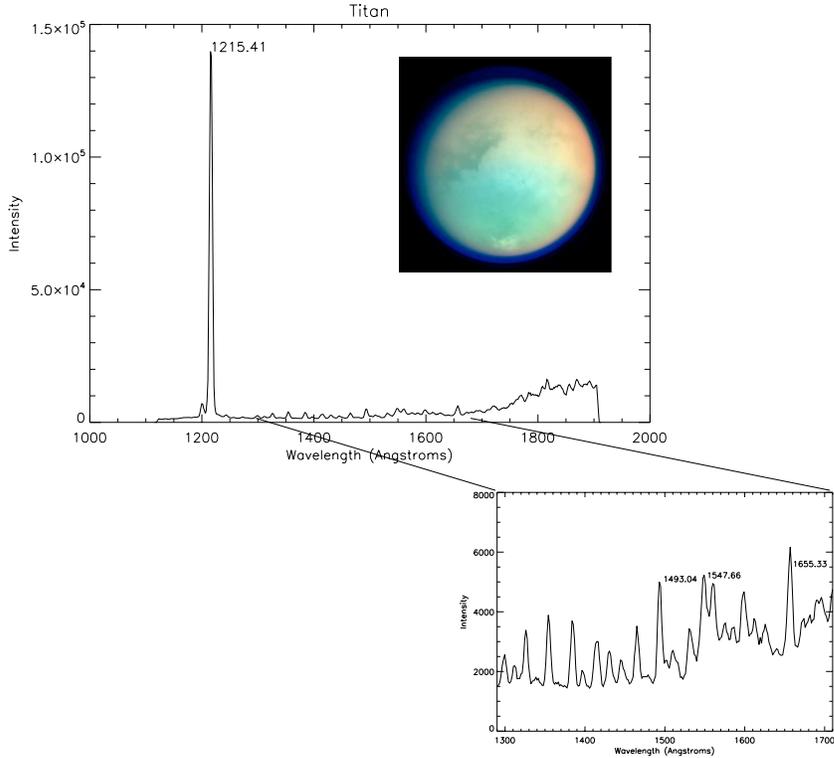
Using Spectral Data to Explore Saturn and Titan

Students Directions

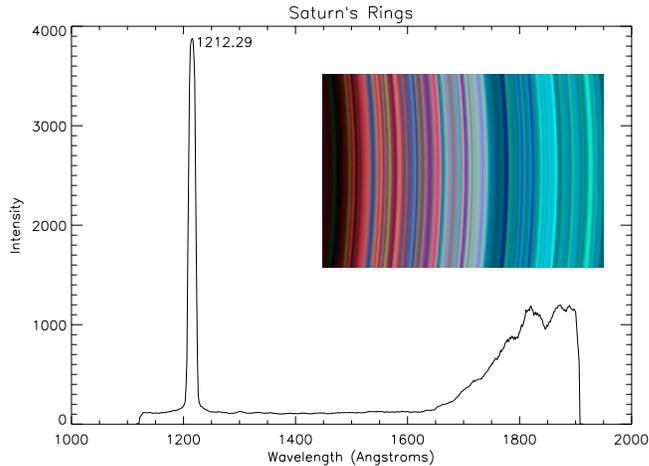
Name _____

Directions: Look at the data on page one and two. Page one shows the spectra of Titan and Saturn's rings. Page two shows known spectra of specific elements. Compare both pages and determine what elements are present in Titan's atmosphere and in Saturn's rings and answer the questions on page three.

a) Titan, October 26, 2004



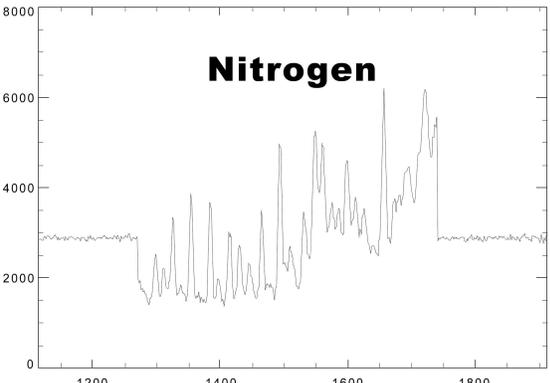
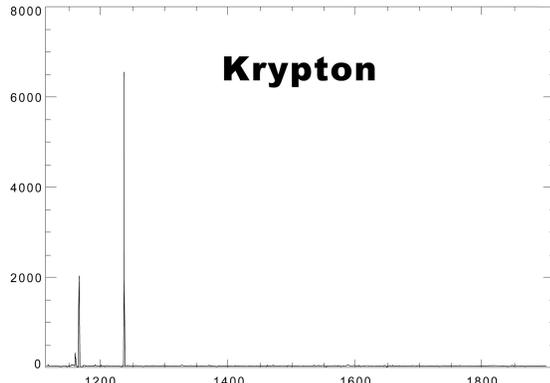
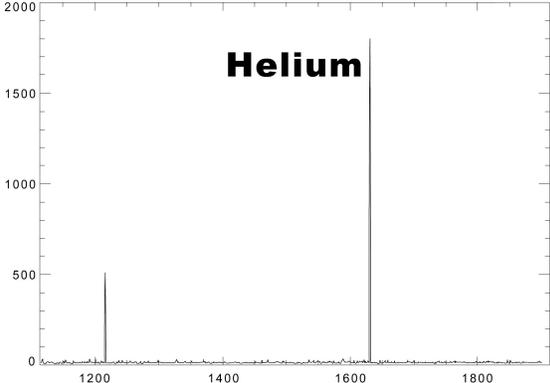
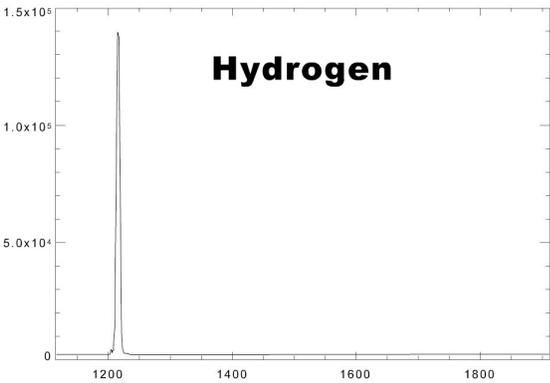
b) Saturn's rings, June 30, 2004





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Known Spectra with wavelength in Angstroms on the x-axis and intensity on the y-axis.





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Worksheet

1. Elements present in spectrum (a), Titan, are:

2. Elements present in spectrum (b), Saturn's rings, are:

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?)

4. Why do you think nitrogen is present in the spectra from Titan but not in the spectra of Saturn's rings?

5. Using the tables below, compare and contrast the composition of Titan's atmosphere and Earth's atmosphere. What are some reasons these differences might exist?



Using Spectral Data to Explore Saturn and Titan

Titan

Nitrogen 95%
Methane 3%
Argon 2%

Earth

Nitrogen 78%
Oxygen 21%
Argon 1%



Answer key

1. Hydrogen and nitrogen
2. Hydrogen
3. 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. 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 isn't 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. 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.