Atmospheres Activity

Some helpful websites include:

Cassini Solstice Mission, http://saturn.jpl.nasa.gov/
Exploring the Planets: Venus, http://www.nasm.si.edu/research/ceps/etp/venus/
Exploring the Planets: Earth, http://www.nasm.si.edu/research/ceps/etp/earth/
Exploring the Planets: Mars, http://www.nasm.si.edu/research/ceps/etp/mars/
HiRise Mars, http://hirise.lpl.arizona.edu/
Mars Exploration Program, http://mpfwww.jpl.nasa.gov/
Mars Worldbook at NASA, http://www.nasa.gov/worldbook/mars_worldbook.html
NASA Scientist Confirms Light Show on Venus, http://www.nasa.gov/vision/universe/solarsystem/venus-20071128.html
NASA Solar System Exploration, http://solarsystem.nasa.gov/planets/
Phoenix Mars Mission, http://phoenix.lpl.arizona.edu/index.php
Storms in the Tropics of Titan, http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=45410#
Titan: A Moon with an Atmosphere, http://www.nasm.si.edu/research/ceps/etp/saturn/sat_titan.html
Titan Worldbook at NASA, http://www.nasa.gov/worldbook/titan_worldbook.html
Venus Worldbook at NASA, http://www.nasa.gov/worldbook/venus_worldbook.html
Wikipedia Earth, http://en.wikipedia.org/wiki/Earth
Wikipedia Greenhouse Gas, http://en.wikipedia.org/wiki/Greenhouse_gas
Wikipedia Mars, http://en.wikipedia.org/wiki/Mars
Wikipedia Titan, http://en.wikipedia.org/wiki/Titan_(moon)
Wikipedia Venus, http://en.wikipedia.org/wiki/Venus

In this activity you will explore Venus, Mars, and Titan. Each, like Earth, has a significant atmosphere, but each is also very different from Earth and not currently habitable. **No credit will be given for any part of this assignment if any of the responses to questions 13, 14, 15, and 16 are missing and/or references are missing. No exceptions!**

1. What gas is present in the atmospheres of Venus, Earth, Mars, and Titan? The answer is **not** oxygen or carbon dioxide.

2. How does the composition of greenhouse gases in an atmosphere affect its temperature?

3. What atmospheric and geologic features affect a planet's or a moon's reflectivity?

4. How are mass, surface gravity, and escape velocity related? What patterns can you identify in the data in Table 1? Be specific.

5. Why is Venus referred to as "Earth's sister" planet? What physical characteristics does it share with Earth?

6. What are the 3 geologic epochs in martian history? Be sure to describe what happened during each.
   a.

   b.

   c.

7. What is unique about Titan when compared with all of the other moons in our solar system?

8. Objects with low surface gravity, low escape velocities, and high temperatures are usually unable to retain an atmosphere because it is easy for their energetic, hot, atmospheric gases to escape into space. Compared with Venus, Earth, and Mars, Titan has both a low surface gravity and a low escape velocity. Why is Titan able to retain its atmosphere?

The "no greenhouse" temperature T_{ng} in kelvins for a solar system object is calculated using the equation:

$$T_{ng} = 280\ K\ x\ \sqrt[4]{\frac{(1 - reflectivity)}{d^2}}$$

where *reflectivity* = the fraction of incoming sunlight reflected from an object's surface and d = distance of the object from the Sun in AU. An AU is an astronomical unit, the average distance between the Earth and the Sun, about 1.496×10^8 km. You will calculate the "no greenhouse effect" temperatures for Venus, Earth, Mars, and Titan.

9. Calculate T_{ng} using the equation above. Complete column F of Table 2, below.

10. To convert T_{ng} which is in kelvins, to the corresponding centigrade temperature, subtract 273 from T_{ng}. Complete column G of Table 2, below.

11. Complete column H of Table 2, below. Atmospheric features does **not** mean gases. Atmospheric features include clouds, storms, hurricanes, sand storms, precipitation, etc.

12. Complete column I of Table 2, below. Geologic features include craters, volcanoes, earthquakes, plate tectonics, erosion, glaciers, deserts, dunes, oceans, coronae, etc.

You are now the chief scientist on an interplanetary mission to explore Venus, Mars, or Titan. Write a double-spaced, typed, one to two page report on one of these solar system objects that you will submit to scientists on Earth, waiting for your results. Staple it to this assignment. In your report you need to include all of the following listed in 13, 14, 15, and 16 below:

13. Explain *why* you chose your destination. Your rationale needs to be more than "because it looks interesting."

14. Decide whether or not you are going to land on the surface or remain in orbit, how much time you will need to explore, why that time is required, and what your *specific plan* is for exploration.

15. Explain *what data* you and your crewmates will collect, and how you will collect it, which depends on whether or not you will land on the surface. What instruments will you use? Why? What features of the atmosphere and geology make the use of these instruments necessary?

16. Describe the atmospheric and geologic features, including in *how they are similar to and different from those on Earth*.

You **are required to reference at least three sources other than the text book** in your response. You may include pictures and/or information obtained from additional sources, however, you **must** also include those references, as well as any references listed by the instructor. **References used to obtain only an image of the chosen solar system object do NOT count as one of the three required references.** The response to this question **MUST be typed** in order to receive credit! Failure to follow these instructions will result in a grade of 0 for the **entire assignment**.

Table 1 Solar System Object Physical Data

A	B	C	D	E	F	G	H	I
solar system object	average distance from the Sun in km	average distance *d* from the Sun in AU	equatorial radius in km	mass in kg	density in g/cm^3	equatorial surface gravity in m/s^2	escape velocity in m/s	sidereal rotation period in days or hours
Venus	1.082×10^8	0.723	6,052	4.87×10^{24}	5.24	8.87	10,360	-243 days
Earth	1.496×10^8	1.000	6,378	5.97×10^{24}	5.52	9.77	11,180	23.934 hours
Mars	2.279×10^8	1.524	3,397	6.42×10^{23}	3.94	3.69	5,020	24.62 hours
Titan	1.200×10^9	8.021	2,575	1.35×10^{23}	1.88	1.35	2,640	15.9 days

Table 2 Solar System Object Atmospheric Data

A	B	C	D	E	F	G	H	I
solar system object	minimum surface temp-erature in ^{0}C	maximum surface temp-erature in ^{0}C	reflectivity	atmospheric composition	"no greenhouse" effect temperature in K	"no greenhouse" effect temperature in ^{0}C	atmospheric features	geologic features
Venus	462	462	0.75	CO_2, N_2				
Earth	-88	58	0.29	N_2, O_2				
Mars	-87	-5	0.16	CO_2, N_2, Ar				
Titan	-178	-178	0.70 (est.)	N_2, CH_4				