# The Atmosphere of Venus

### Part 1: The History of the Atmosphere of Venus

1. Because Venus is closer to the Sun, it would have received about 40 percent more more solar energy than Earth. This would have made the surface temperature of early Venus warmer than that of early Earth. Would you expect liquid water to be as widespread on the surface of Venus as on Earth?

2. On Earth, most of the carbon dioxide in its early atmosphere was, over time, dissolved by Earth’s oceans and deposited into ocean sediments which became carbonate rocks. Do you think this same process would have removed significant carbon dioxide from Venus’ atmosphere?

3. The amount of radiation from the Sun has slowly increased, by about 25-30% over the last four and a half billion years. How would this affect your answers to the first two questions above?

4. Venus has an active geology, with volcanism up to the geologically “recent” past, possibly continuing to the present. Active volcanoes release quantities of new gas like carbon dioxide into the atmosphere, a process called “outgassing.” How do you think this would have affected the amount of carbon dioxide in Venus’ atmosphere over the long term?

5. Based on the “Planetary Atmospheres and Escape of Gas” activity, what do you think the effect of outgassing would be on the gas pressure in the atmosphere of Venus?

### Part 2: The Greenhouse Effect on Venus

Based on the “Greenhouse Effect and Climate Change” activity, we see that greenhouse gases such as carbon dioxide and water vapor absorb and re-emit infrared radiation, raising the surface temperatures of a planet. Raising the amount of greenhouse gases in an atmosphere can increase this effect.

6. Given your answer to questions 3 and 4, would there be enough greenhouse gases in the atmosphere of Venus to significantly raise its surface temperatures?

7. What would you expect to happen to any liquid water on the surface of Venus due to changes in the planet’s surface temperature?

8. Given that water vapor is also a greenhouse gas, what effect do you think your answer to question 8 would have on the surface and atmospheric temperatures of Venus?

9. The term “***runaway*** greenhouse effect” is sometimes used to describe conditions in the atmosphere of Venus. Explain the meaning of this term based on your answers to the questions above.

10. Based on the “Planetary Atmospheres and Escape of Gas” activity, what would you expect to happen in the long term to most of the water vapor in the atmosphere of Venus as the atmospheric temperatures increased over the lifetime of the planet?

11. Two students are having a discussion.

*Student 1: “Due to the runaway greenhouse effect, Venus has a surface temperature of 460 C and a surface atmospheric pressure over 90 times that of Earth. Life could never have arisen there under such extreme planetary conditions.”*

*Student 2: “Venus formed from the same materials at almost the same mass as Earth. Thus, early conditions may have been similar to Earth’s, and there could have been life on Venus.”*

Would you agree with either student, both, or neither? In what respects? Explain.