## Physics of the greenhouse effect

Jean Baptise-Fourier is generally credited with the discovery of the greenhouse effect: the process by which the presence of an atmosphere acts to raise the surface temperature of a planet. This was extremely simplified at the time, and the term greenhouse did not appear in his writings of 1827, but he did establish the effect that the atmosphere had on incoming light and outgoing infrared (heat) radiation, and that some heat was absorbed by the atmosphere which was opaque in the infrared but transparent to incoming solar energy. We've made a lot of progress since then: Svante Arrhenius began to quantify the phenomenon nearly 75 years later and the work of Stefan and Boltzmann established the relationship between an object's temperature and its outgoing radiation. The role of convection, water vapour and clouds are important to more complex models developed later. The pioneering paper by Arrhenius, entitled *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground*, the famous work of 1896, investigated what the effects of doubling atmospheric $CO_2$ content would be. At that time, most of the interest in the subject was in solving the mystery of the coming and going of ice ages. Like most pioneering efforts, Fourier or Arrhenius did not have the last word, and we still have much to learn today, but they provided a big leap forward in how we understand planetary temperatures and the role of the atmosphere in radiative balance. Fourier was one of the first to speculate that human activities could influence climate, and such topics are rather important in modern times.

(Taken from http://chriscolose.wordpress.com/2008/03/09/physics-of-the-greenhouse-effect-pt-1/)

## EXCERCISES

### 1 True or false?

**a.** The greenhouse effect involves the lowering of the surface temperature of a planet. T F

**b.** Svante Arrhenius began to quantify the greenhouse effect at the beginning of the twentieth century. T F

**c.** Arrhenius's 1896 paper investigated the effects of doubling atmospheric $CO_2$ content. T F

**d.** Nobody added anything to greenhouse effect knowledge after Fourier's studies. T F

### 2 Complete.

Jean Baptise-Fourier is ..... to be the ..... of the greenhouse effect, ..... though he didn't directly ..... this name to the ....., in his papers. At the beginning, ..... in this topic was linked to ..... the mystery of the coming and ..... of ice ..... Fourier has been the first to ..... that human ..... can influence climate. Since that .....many physicists and other ..... have studied the greenhouse effect.

*ages • phenomenon • scientists • interest • going • considered • solving • discoverer • speculate • even • give • activities • time*

### 3 Match questions and answers.

| QUESTIONS | | ANSWERS | |
|---|---|---|---|
| A | What did Jean Baptise-Fourier establish in 1827? | 1 | Stefan and Boltzmann established this relationship through their work. |
| B | How can we describe the atmosphere, according to Fourier's discoveries? | 2 | He established that the atmosphere was subject to incoming light and outgoing infrared radiation. |
| C | Who established the relationship between an object's temperature and its outgoing radiation? | 3 | The atmosphere is opaque in the infrared but transparent to incoming solar energy. |

| A ..... | B ..... | C ..... |
|---|---|---|