



PROBLEM SOLVING ACTIVITY: WHAT CAUSES ICE AGES?

What is an ice age? An ice age is a period in Earth's history when the ice on the polar caps significantly expands due to a lowering of the Earth's global temperatures. Over the course of millions of years, scientists believe that the Earth has experienced at least five major ice ages. During these periods land in North America and Northern Europe were covered by giant ice sheets and glaciers. Earth is currently in an ice age called the Quaternary Ice Age which began around 2.5 million years ago and is still going on. We are currently in an interglacial stage of this ice age. The periods within ice ages are defined as:

- + **Glacial**- A glacial period is a cold period when the glaciers are expanding.
- + **Interglacial**- A warming period when the glaciers and ice sheets are receding.



INTERGLACIAL PERIOD



GLACIAL PERIOD

Student Sheet 2

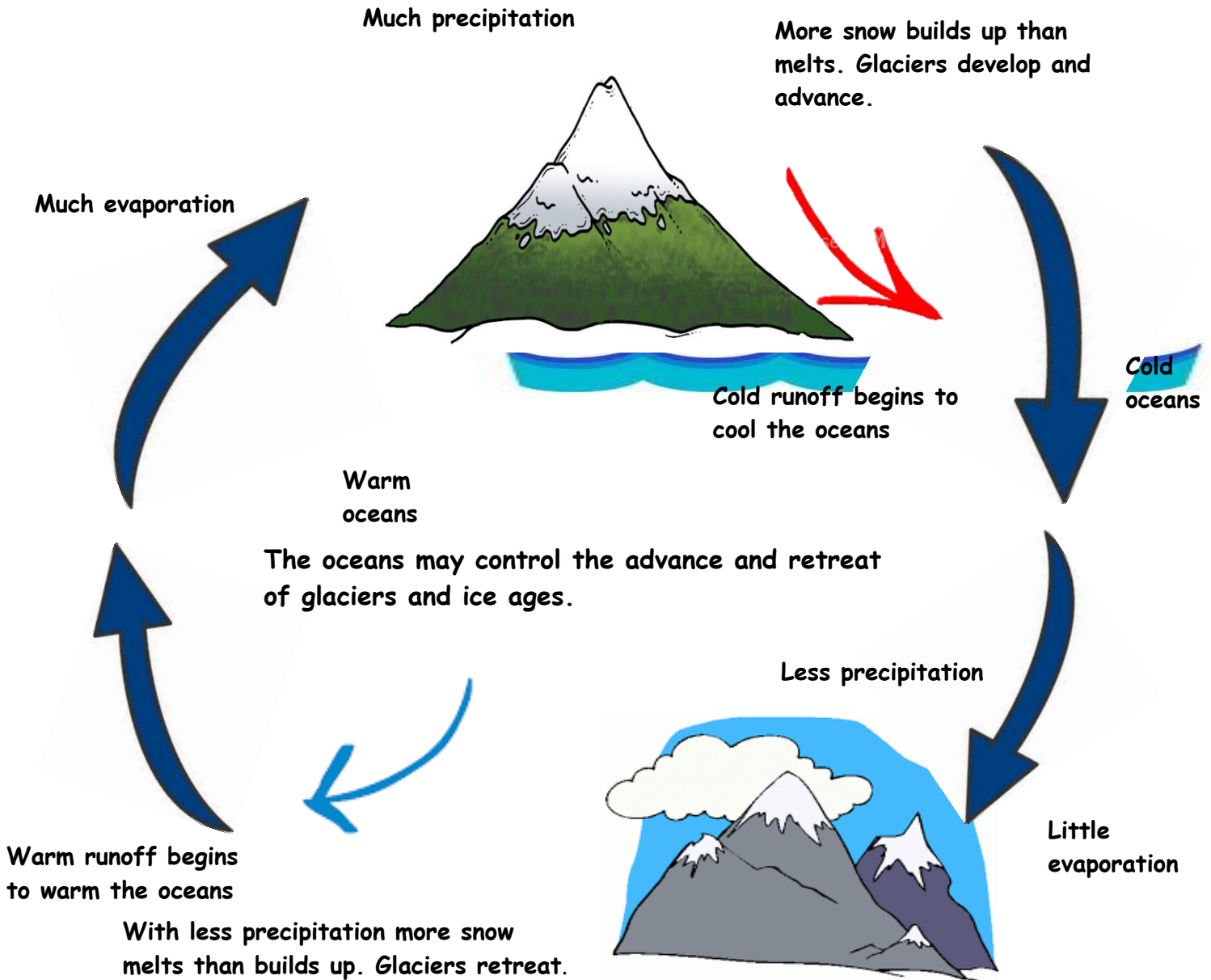
What causes an ice age? The Earth is constantly undergoing changes. These changes can impact the global climate. Some of the changes that can influence an ice age include:

- + **Earth's orbit** - Changes in the Earth's orbit (called Milankovitch cycles) can cause the Earth to be closer to the Sun (warmer) or further from the Sun (colder). Ice ages can occur when we are further from the Sun.
- + **Solar energy** - The amount of energy output by the Sun also changes. Low cycles of energy output can possibly help in producing an ice age.
- + **Atmospheric composition** - Low levels of greenhouse gases such as carbon dioxide can cause the Earth to cool leading to an ice age.
- + **Ocean currents** - can have a great impact on the Earth's climate. Changes in currents can cause ice sheets to build up.
- + **Volcanoes** - introduce huge amounts of carbon dioxide into the atmosphere. The lack of volcanoes can cause an ice age. Increased volcanic activity can put an end to an ice age as well

There really is no simple answer to the question of why ice ages occur; there are many different and interconnected causes. In general, it is felt that ice ages are caused by a chain reaction of **positive feedbacks** triggered by periodic changes in the Earth's orbit around the Sun. These feedbacks, involving the spread of ice and the release of greenhouse gases, work in reverse to warm the Earth up again when the orbital cycle shifts back. The last ice age ended about 12,000 years ago. The next cooling cycle would be expected to start about 30,000 years or more into the future.

Many theories have been proposed to explain the causes of ice ages. Any credible theory must explain what caused the ice to build up, how and why the ice advanced and retreated at different times during a glaciation and why the ice eventually disappeared. One theory that tries to explain these phenomena is the **Ocean-Control Theory**. The diagram on the next page illustrates this theory.

THE OCEAN-CONTROL THEORY



ANALYSIS: Study the feedback loop of the Ocean-Control Theory of ice age formation and then complete the following activities.

1. Could the ice age formation process be considered a cycle? Explain why.
2. What is the major controlling factor for the Earth's heating and cooling system according to this theory?
3. How is it possible for a major warming trend rather than a cooling trend to bring about an ice age?
4. Why would cold runoff be considered a negative feedback in the glacial formation process?
5. Which factor would be considered the positive feedback in the process? Why?
6. Which major biogeochemical cycle is involved in ice age formation?
7. List the processes in that cycle which are included in the diagram?
8. In your own words, explain the ocean control theory of glaciation.
9. How might global warming affect the functioning of the Ocean-Control Theory? Write or draw an explanation.
10. Write out an explanation or create a flow chart of the events occurring in the Ocean Control Theory and number each event in order of its occurrence.