Chapter 8 Dynamics of Climate Change

Materials

Please see the teaching notes for each activity for a list of the materials required. Please see page TR-31 for a summary of the materials required in this chapter and other chapters.

Advance Preparation

- Gather relevant materials several days before beginning each of the activities. Ensure you have enough materials for the number of groups you will have in each activity.
- For Activity 8-4, collect photos from library books or use your own. Ensure you have enough photos for the number of groups you will have. Make sure there are plenty of extra sticky notes of all colours, because students will use them up quickly.
- Test all electrical equipment and the stands and clamps before beginning Plan Your Own Investigation 8-B and Problem-Solving Investigation 8-C.
- Students can review the Key Terms in Chapter 8 using **BLM 8-1 Chapter 8 Key Terms.**

In this chapter, students will describe heat transfer in Earth's systems, identify feedback loops that affect climate, explore how oceans transfer heat around Earth, and learn about greenhouse gases. They will also differentiate between the natural and the anthropogenic greenhouse effects. Finally, students will explore the carbon and nitrogen cycles.

Using the Chapter Opener (Student textbook pages 308 and 309)

- The image of the cow may generate significant discussion. Discussion about collecting gas emissions from livestock may initiate humour. It may be necessary to draw students' attention to the significance of the problem of livestock emissions. Students may be surprised to learn that globally livestock emit more greenhouse gases than cars. Many students will be aware of campaigns to reduce the use of cars. They may not be familiar with campaigns to mitigate against livestock.
- During reading, ask students to make connections to prior knowledge to help them relate what they already know to what they will learn. Conduct a class discussion on the *What You Will Learn* and *Why it Matters* sections. Have students consider livestock and agricultural processes in the context of the chapter overviews.
- Initiate a discussion on the positive and negative effects agriculture has on Earth's systems. It is estimated that livestock are responsible for 18 percent of greenhouse gas emissions. Livestock are also associated with many other critical environmental issues, such as air and water pollution, deforestation, land degradation (from overgrazing), and loss of biodiversity. Grazing occupies 26 percent of Earth's land surface and producing feed for livestock uses about 30 percent of arable land.
- Some students may be vegetarians and react strongly to more support for not eating meat. Begin a discussion about the food chain and the roles of producers, primary consumers, and higher-level consumers. When the energy lost at every level in the food chain is considered, reducing meat consumption is a positive decision.
- Begin a list of technologies that help mitigate emissions of greenhouse gases. Students will be aware of technologies for renewable sources of energy, and may be aware of other technologies such as carbon sequestration. Add emissions capture to the list. Encourage students to continue to add to the list throughout the unit.
- Draw students' attention to the Study Toolkit. Divide the class into groups and have each group develop a short presentation on using one of the tools. Ensure that they provide at least one example from the chapter.

Activity 8-1 Modelling Balance in Systems (Student textbook page 309)

Pedagogical Purpose

Balance is present in a system if the inputs match outputs. The activity models the flow of matter and energy through a system.

Planning		
Materials	Basin or tub Ruler Pencil with point	Plastic or paper cup 1 L of water in a pitcher
Time	20–30 min	
Safety	Ensure students are careful when poking the hole in the cup. You may wish to do this yourself. Water will be spilt in this activity. Be prepared with a water clean-up kit. Ensure students clean up spills immediately and do not slip.	

Background

Any system will stay in balance if the amount of matter and energy entering the system matches the amount leaving the system. Most systems can accommodate short-term variations in inputs of energy and matter, but over the long term if the inputs or outputs change, the system will become imbalanced and respond in some way.

Earth and natural systems on Earth (such as ecosystems) have responded to changes many times throughout geologic history, and will again in the future. Natural events can alter energy and matter, and can improve or destroy natural systems.

Activity Notes and Troubleshooting

- Ensure that students are responsible in the way they are pouring water.
- The hole in the cup should be small enough to allow water to run through slowly, but large enough that the water in the cup will not run over during the first part of the activity. You may wish to experiment yourself with different-sized holes, and then show students the best size, or even pre-prepare the cups.

Additional Support

- DI Spatial and bodily-kinesthetic learners will enjoy this activity. You may wish to pair them with other students who may bring a different perspective to the activity.
- ELL Have students paraphrase the directions back to you to ensure they understand the process.
- Students may have trouble expanding the concept of balance from the example of the water running through the cup to larger natural systems. Challenge students to describe other models that could be used to show systems in and out of balance. Provide students with **BLM G-17 Using Models and Analogies in Science.**
- Check with students often for comprehension of the purpose of this activity and how it may relate to climate change.
- Use **BLM A-1 Making Observations and Inferences Checklist** for assessment.

Study Toolkit

Strategy	Page Reference	Additional Support
Making Connections to Visuals	After looking at Figure 8.19 on page 331, students can consider what they recycle at home and the reasons they recycle. Students can consider what is to be learned about recycling and its benefits from the visual and supporting text.	Have students reread the text on page 331 and the caption for Figure 8.19. Then, ask them the text question, "How does the garbage you throw out each week add to greenhouse gas emissions?"
Synthesizing	Students can use the flowchart to synthesize information about the main topic in Section 8.1 on page 311.	Refer students to the Study Toolkit Overview, in particular the section Reading Graphic Text, on page 560 of the student textbook.
Word Parts	Students can break the word *thermohaline* on page 316 into parts. Students can make up their own definition based on the roots of the word. Section 8.2 (pages 323–332) contains many words that can be broken down, including chemical names (carbon dioxide, halocarbons) and the term *anthropogenic greenhouse* on page 329.	Refer students to Study Toolkit 3, Word Study, on page 564 of the student textbook. Provide students with **BLM G-40 Word Study**.