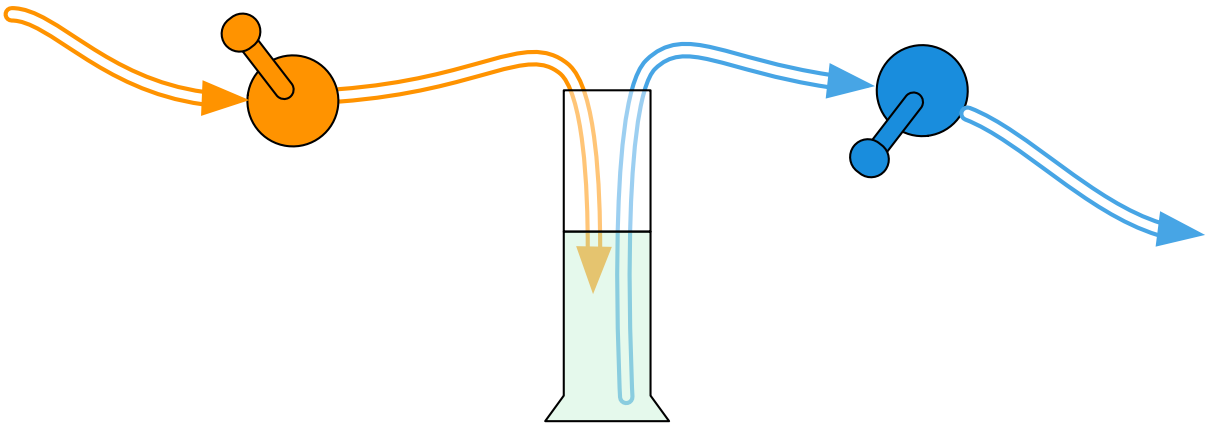
The Carbon Cycle

Tubs & Pumps



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Overview

In this activity you are going to build a model of the natural carbon cycle, and then look at the role that burning fossil fuels has on the level of carbon in the atmosphere.

You should have:

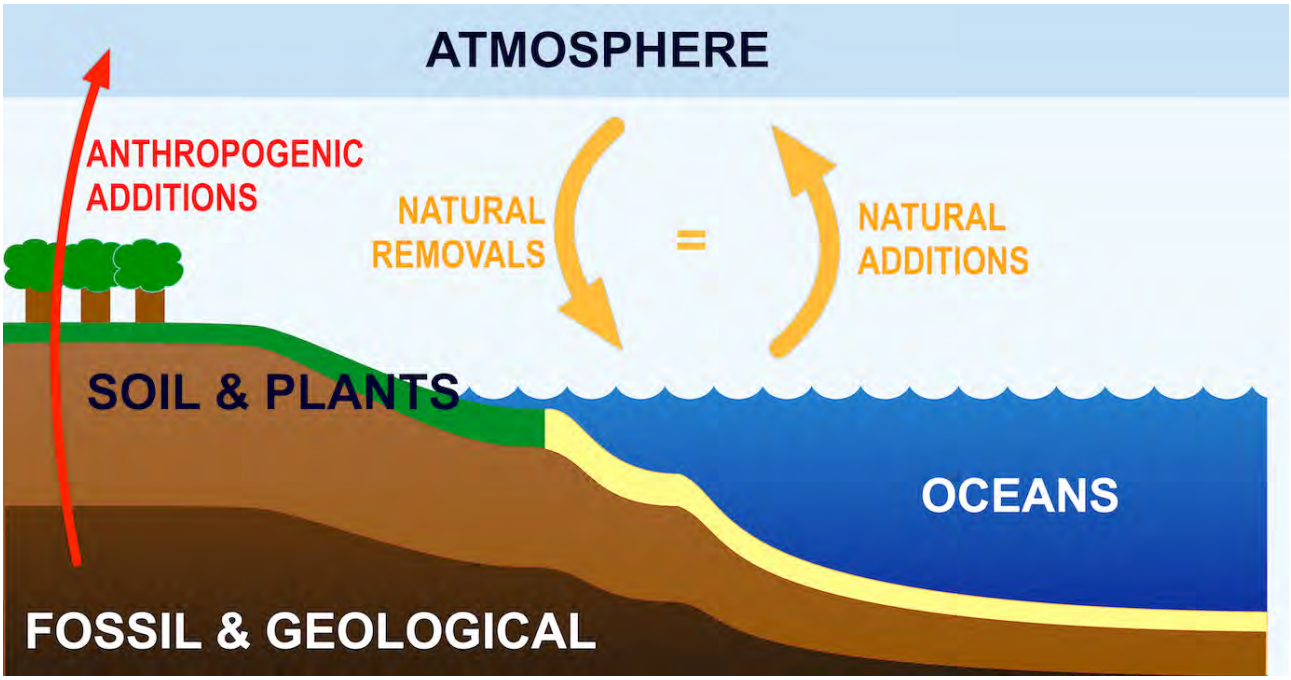
- one larger tub
- one smaller tub
- three hand pumps
- pipes to connect the pumps to the tubs
- water

Some rules:

- explore the model by playing with it
- while playing, there are no ‘wrong’ answers
- remember to have fun!

Introduction to the Carbon Cycle

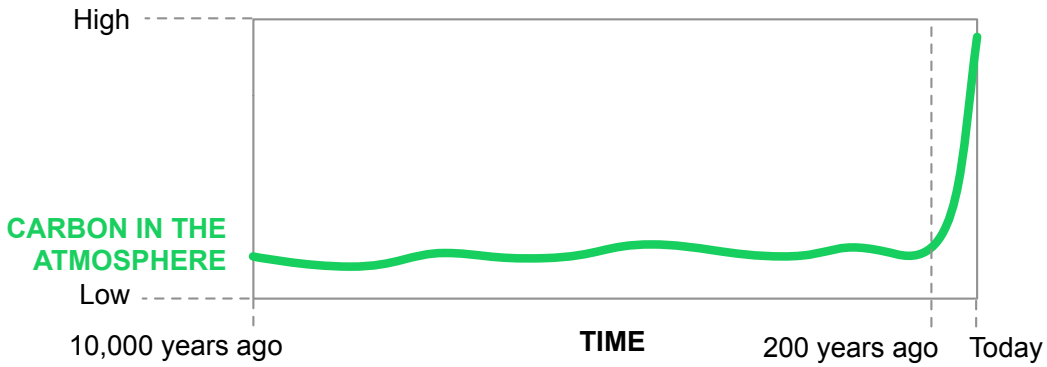
Carbon moves naturally between stocks, such as the oceans, soil, plants and the atmosphere. The atmosphere holds many times less carbon than the combined stocks in the oceans, soil and plants, but changes in the atmospheric carbon level can change the Earth’s climate. In the natural cycle, the carbon additions to and removals from the atmosphere are approximately the same. The burning of fossil fuels adds carbon to the atmosphere, but the amounts are relatively small compared to those involved in the natural cycle.



Behaviour Over Time

The amount of carbon in the atmosphere has remained approximately the same for the last 10,000 years. However, the level has increased significantly over the last 200 years due to human activity, such as the burning of fossil fuels.

Carbon in the atmosphere over the last 10,000 years



The carbon level in the atmosphere has risen significantly in the last 200 years.

The burning of fossil fuels has increased over this time with a rise in material consumption, and continues to do so. At the same time, natural sources of carbon removals such as forests are being depleted. As the level of carbon in the atmosphere increases, heat becomes trapped and the surface temperature gradually increases.

Task 1: Assemble Your System

As a group, take the labels that you have and stick them to the part of the system that is represented by each label.

Once you have assembled your group's system, get your facilitator to check and give you water before you start Task 2.

While you are waiting, assign a person to be in charge of each pump, and someone to read the instructions. If you have extra members in your group, they can observe the level of water in the tubs.

Tips for assembly:

- the **terrestrial stock** (plants, soil, oceans) of carbon is many times larger than the **atmospheric stock**.
- when attaching the pumps to pipes, they should each draw water from the bottom of a tub

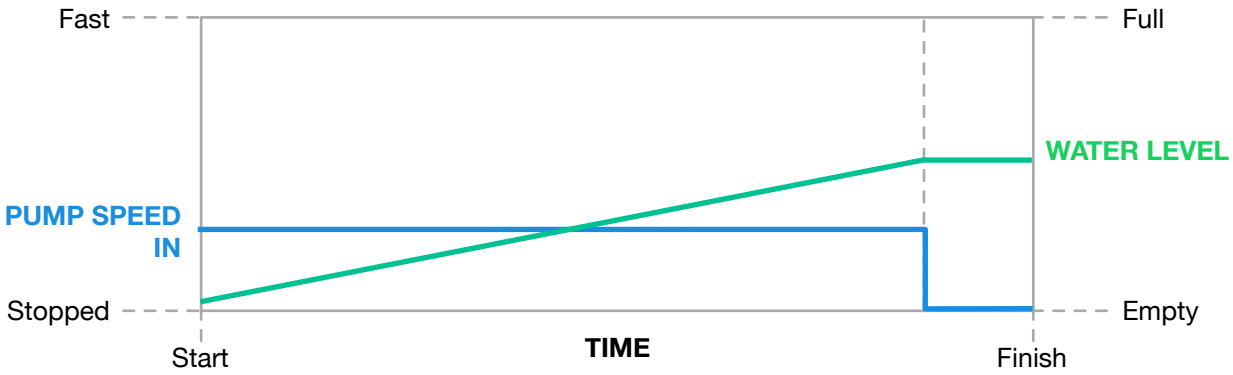
Question: What real-world thing does the water in your system represent?

Task 2: Getting Started

To get started, make sure that all of the carbon (water) is in the terrestrial stock.

1. Pump the **Natural Additions** at a steady speed to lift the **atmospheric stock** to **half full**, then stop

The changing water level with a steady Natural Additions pump in

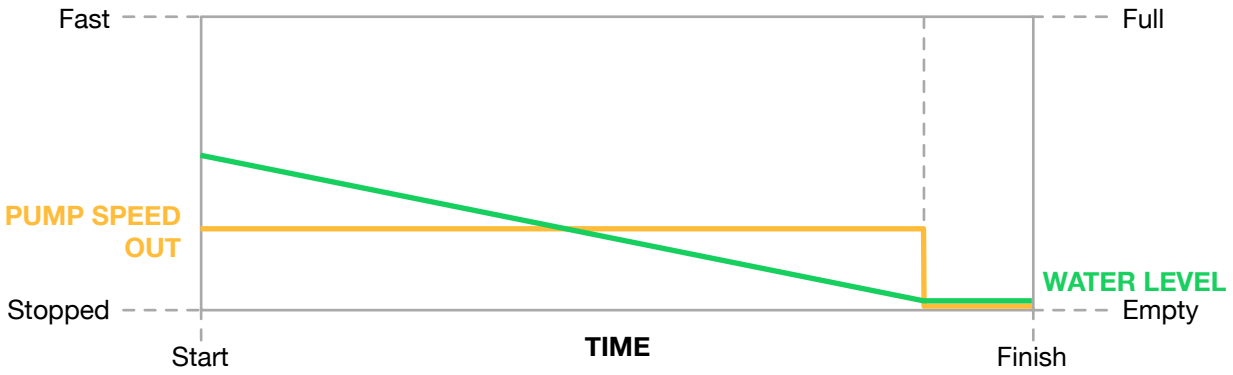


The water level gradually increases with a steady pump in.

2. Pump the **Natural Removals** to drain the **atmospheric stock**, then stop

The changing water level with a steady Natural Removals pump out

The changing water level with a steady Natural Removals pump out



The water level gradually decreases with a steady pump out.

3. Pump the **Anthropogenic Additions** at a steady speed to lift the **atmospheric stock** to **one-third full**, then stop

You can now move on to Task 3.

Task 3: Simulate the Natural Carbon Cycle

To simulate the natural carbon cycle, the **Natural Additions** and **Natural Removals** need to pump at the same average speed.

1. In your group, simulate the natural carbon cycle with the **atmospheric stock** held at approximately **one-third full**.
2. Then discuss what kinds of real-world things are represented by the **Natural Additions** and **Natural Removals** pumps. What happens when one of the pumps is running faster or slower than the other?

The water level with equal Natural Additions and Natural Removals

The water level should stay approximately the same

Task 4: Simulate the Burning of Fossil Fuels

To simulate the anthropogenic disruption to the natural carbon cycle, the **Anthropogenic Additions** pump will need to start slow, and get gradually faster. In this task, the behaviour of the **atmospheric stock** should look similar to the graph on page 2.

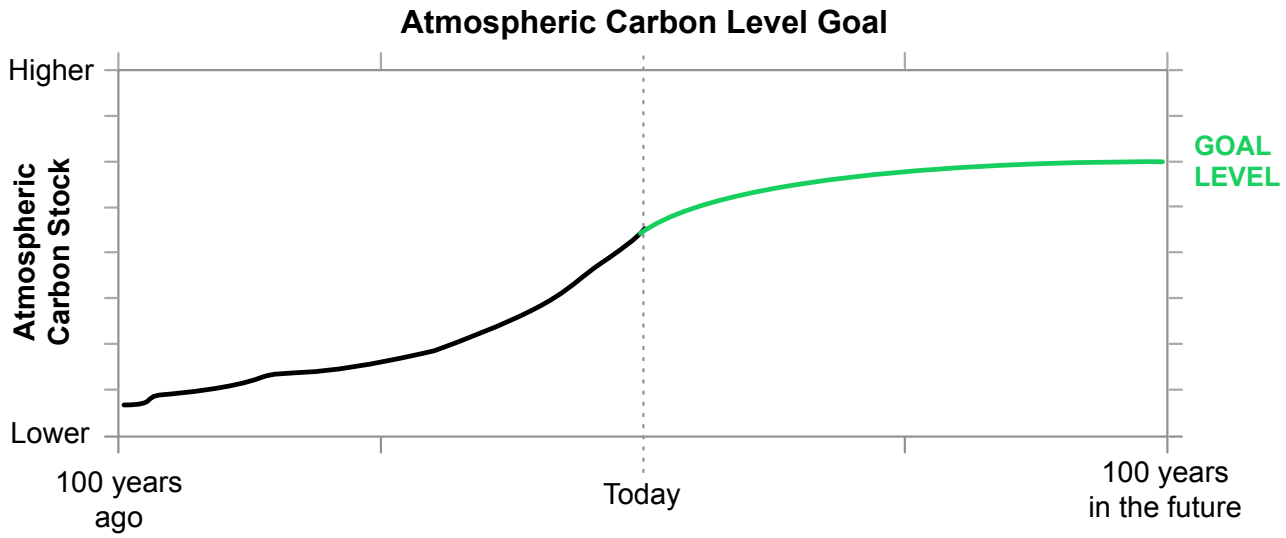
Remember, the **Natural Additions** and **Natural Removals** pumps represent the natural carbon cycle, and so need to keep running at the same average speed.

1. In your group, simulate the anthropogenic disruption of natural carbon cycle.
2. Stop when the **atmospheric stock** is almost full.
3. Then, open the **Scenario Cards** and use them to guide your discussion of how your group could stop the atmospheric stock from overflowing.
4. See if your selected strategy works by playing with the pumps.
5. If you have time, see what happens in other strategies.

Non-scenario card treatments 'discuss' this step

Task 5: What now?

In Task 4, your group was asked to stop the atmospheric stock from overflowing. This level was your 'goal' level.

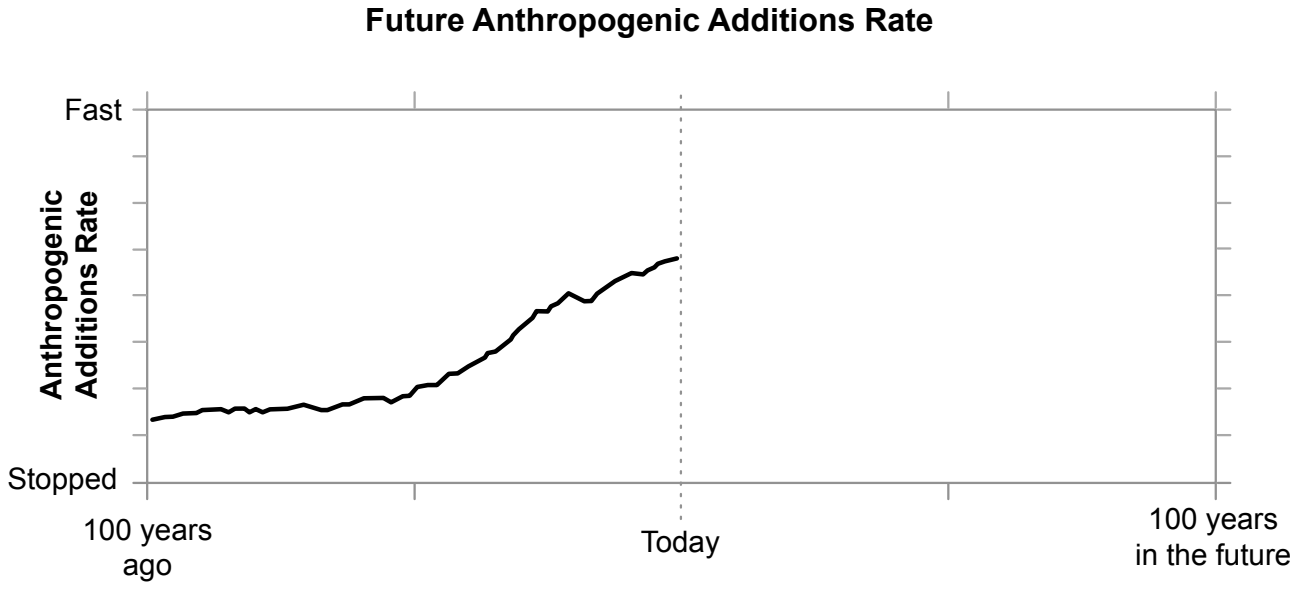


The atmospheric carbon stock should not exceed the goal level.

Describe what needs to happen to the **Anthropogenic Additions** pump to ensure that the goal level is not exceeded (assume that the **Natural Additions** and **Natural Removals** remain approximately the same):

Sketch what you think the future Anthropogenic Additions pump rate should be to reach the goal level:

Additional Group Diagram task



Sketch the Anthropogenic Additions rate to reach the atmospheric carbon level goal