UNDERSTANDING THE CARBON CYCLE

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REFLECTION

Understanding the Carbon Cycle is key to understanding Climate Change, impacts of climate change and strategies to address climate change. Climate Change can be integrated into all NSW Senior Geography physical and human Geography topics including biophysical interactions; global challenges such as natural resource use, population, development and political geography; and all HSC topics - urban places, ecosystems and economic activity.

Before the Year 11 Geography Course it is worth asking your students this question.

> '*After 10 years of schooling including studies of Science and Geography, do you understand the Carbon Cycle and Climate Change?*'

The Quick Quiz will help you assess student knowledge and understanding so gaps can be filled, and misconceptions overcome early in the senior course. The following Poster Pack activities are designed to deepen student knowledge and understanding.

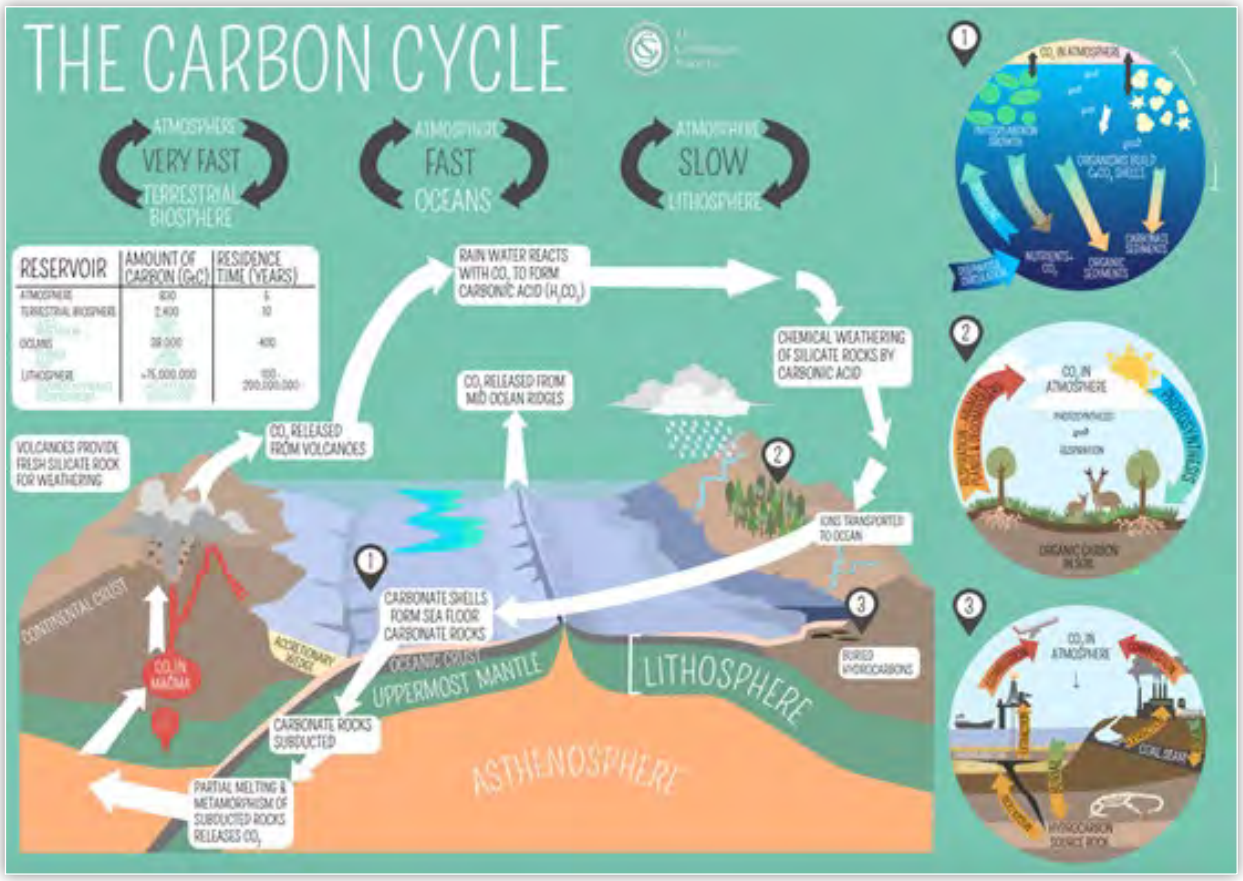
THE CARBON CYCLE and CLIMATE CHANGE

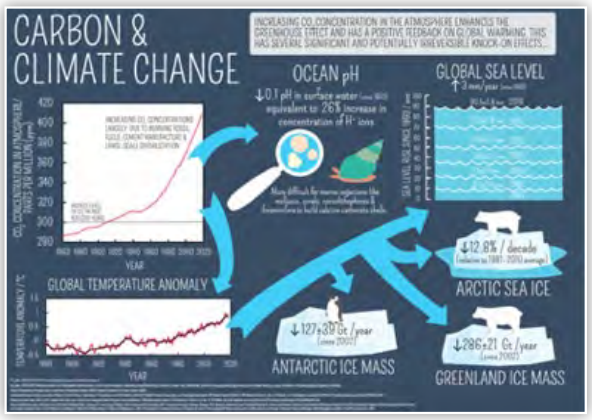
A. True or False. Justify each answer in the space provided on the worksheet.

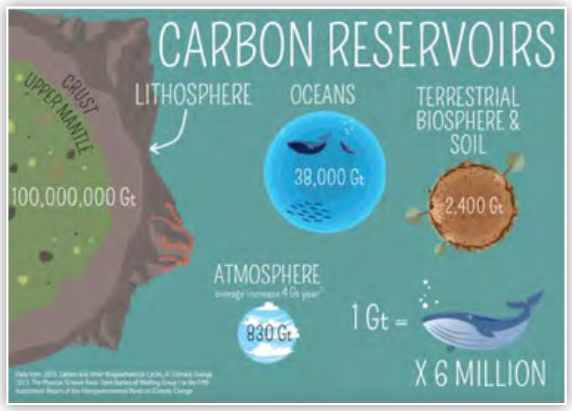
1. Without carbon life in Earth would not exist.
2. The amount of Carbon on Earth is infinite – more carbon is created over time.
3. Most carbon is stored in Earth's biosphere (plants and animals).
4. Oceans are a carbon sink – they absorb carbon.
5. Carbon dioxide is a greenhouse gas.
6. Erosion and volcanoes release carbon into the atmosphere.
7. Carbon is naturally stored as hydrocarbons in the lithosphere.
8. Earth's natural systems effectively remove carbon from the atmosphere.
9. Carbon reduction technology is an experimental solution to removing carbon from the atmosphere.
10. I can draw a simple diagram of the Carbon Cycle without supporting resources.

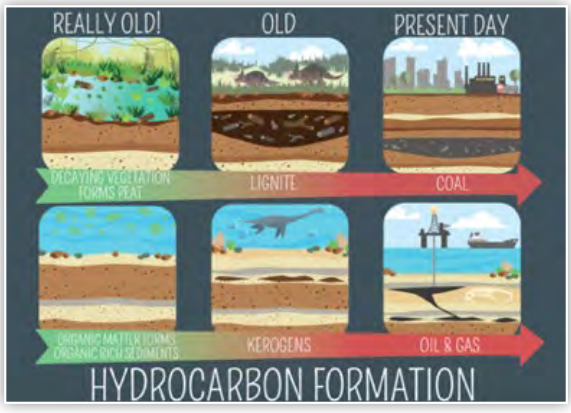
All activities are included in a STUDENT WORKSHEET on the GTANSW & ACT website. Some Suggested Answers are also provided.

Figure 1: GTA NSW & ACT POSTER PACK









Posters printed with permission from the Geological Society UK by GTANSW & ACT for Geography Education in Australian schools.

B. Poster Pack Activities

Use a classroom poster display to challenge students, get them moving and thinking.

The following activities refer to the GTANSW & ACT Carbon Cycle Posters Pack. For these activities set up stations around the room to facilitate visits by small teams of students.

Teamwork: After discussing the correct T & F answers, divide students into small groups to complete the following activities.

1. Write an agreed definition for each term below.
   phytoplankton, photosynthesis, respiration, hydrocarbon, combustion, calcium carbonate, carbonic acid, chemical weathering, subduction (crustal), gigaton, reservoir, pH, anomaly
2. Draw a diagram of the natural carbon cycle without using any resources. Label each sphere on the diagram – atmosphere, lithosphere, biosphere and lithosphere. (Provide an A3 sized sheet of paper)
3. Each team member in turn will visit the large carbon cycle poster and return to the team with additional information to ADD TO or CORRECT the team diagram. Discuss each addition before adding content to you diagram. Continue until the diagram mimics or improves on the wall poster.

Refer to your Carbon Cycle Diagram:

- Describe how the rate of carbon exchange between spheres varies. Suggest reasons for this variation.
- Explain ONE pathway in which carbon cycles between the atmosphere and the lithosphere and back to the atmosphere.
- Describe how carbon moves to and from deep ocean storage.
- How is buried hydrocarbon released into the atmosphere?

Visit each of the small carbon posters to complete the next worksheet questions.

Refer to the **Carbon Reservoirs** poster:

- List the global storages of carbon from highest to lowest stores.
- Calculate the total weight of global carbon (in Gt)
- Calculate the % of global carbon in each reservoir and represent in a PIE GRAPH (Sector Graph)
- Identify two sources of carbon in the biosphere.
- Calculate the total amount of atmospheric carbon in 50 years.
- Explain potential sources of this additional carbon.

Refer to the **Hydrocarbon Formation** poster:

- Describe steps in the formation of coal over time
- Describe steps in the formation of oil and gas over time
- Explain what is happening to hydrocarbon storages in the 'present day'
- Make a judgement about the rate of change for the 'Really old" and 'Present Day' stages of hydrocarbon formation.
- Suggest the implications of present-day human activities for global carbon distribution.

Refer to the **Carbon and the Greenhouse Effect** poster:

- Identify four Greenhouse gases
- What feature of Greenhouse Gases is most important for life on Earth?
- What happens to solar radiation (light) when it reaches Earth?
- What happens to the infrared radiation emitted from earth and its atmosphere?
- State two differences between solar radiation and infrared radiation.
- Explain how an increase in Greenhouse gases changes the natural process known as the Greenhouse Effect.

Refer to the **Carbon and Climate Change** poster:

- Calculate the change in Atmospheric CO2 concentrations between 1860 and 2020.
- Describe the trend in Global Atmospheric CO2 Concentrations since 1940.
- Explain the link between CO2 concentrations and Ocean pH (acidity). Explain the impact of changing Ocean pH?
- Describe the anomaly shown in the Global Temperature Anomaly Graph.
- What the connection between CO2 concentration and the Global Temperature Anomaly?
- Why is the relationship between Atmospheric Carbon Concentrations and the Global Temperature Anomaly called a 'positive feedback'.
- List FOUR 'knock on effects' of the Global Temperature Anomaly.
- Differentiate between Sea Ice AND an Ice Mass (Greenland and Antarctica).
- Where has Ice Mass loss been greatest? Use statistics in your answer.
- Assess the Validity AND Reliability of the information in this poster.

4. On your **Carbon Cycle diagram** show at least one human change to each sphere that interrupts the natural carbon cycle.
5. On completion of your Carbon Cycle diagrams and worksheet **compose an original paragraph** for your team to explain the Carbon Cycle and connections to Climate Change to Year 10 students. Allocate each team member something to say. Test your team explanation with another class group or a selected year 10 class. You can incorporate the posters into your presentation.

   Alternatively, students may use a digital program such as Explain Everything to present their team explanation.

Read the Abstract from National Geographic as a model of what students might include in their explanation.

Poster packs for sale HERE

https://www.gtansw.org.au/wp-content/uploads/2021/03/Posters-for-sale_amended-postage_11.03.21.pdf

Figure 2: A sample explanation

The Carbon Cycle. An abstract from National Geographic

https://www.nationalgeographic.org/encyclopedia/carbon-cycle/

'Carbon is in a constant state of movement from place to place. It is stored in what are known as reservoirs, and it moves between these reservoirs through a variety of processes, including photosynthesis, burning fossil fuels, and simply releasing breath from the lungs. The movement of carbon from reservoir to reservoir is known as the carbon cycle.

Carbon can be stored in a variety of reservoirs, including plants and animals, which is why they are considered carbon life forms. Carbon is used by plants to build leaves and stems, which are then digested by animals and used for cellular growth. In the atmosphere, carbon is stored in the form of gases, such as carbon dioxide. It is also stored in oceans, captured by many types of marine organisms. Some organisms, such as clams or coral, use the carbon to form shells and skeletons. Most of the carbon on the planet is contained within rocks, minerals, and other sediment buried beneath the surface of the planet.

Because Earth is a closed system, the amount of carbon on the planet never changes. However, the amount of carbon in a specific reservoir can change over time as carbon moves from one reservoir to another. For example, some carbon in the atmosphere might be captured by plants to make food during photosynthesis. This carbon can then be ingested and stored in animals that eat the plants. When the animals die, they decompose, and their remains become sediment, trapping the stored carbon in layers that eventually turn into rock or minerals. Some of this sediment might form fossil fuels, such as coal, oil, or natural gas, which release carbon back into the atmosphere when the fuel is burned.

The carbon cycle is vital to life on Earth. Nature tends to keep carbon levels balanced, meaning that the amount of carbon naturally released from reservoirs is equal to the amount that is naturally absorbed by reservoirs. Maintaining this carbon balance allows the planet to remain hospitable for life. Scientists believe that humans have upset this balance by burning fossil fuels, which has added more carbon to the atmosphere than usual and led to climate change and global warming.'

Web resources for the Carbon Cycle and Climate Change

- Climate change science. The carbon cycle and how we are changing it. https://publications.csiro.au/rpr/download?pid=csiro:EP128406&dsid=DS1
- National Geographic: The carbon cycle https://www.nationalgeographic.org/encyclopedia/carbon-cycle/
- What is the carbon cycle? https://oceanservice.noaa.gov/facts/carbon-cycle.html
- The Carbon Cycle https://www.noaa.gov/education/resource-collections/climate/carbon-cycle
- Climate and the Carbon Cycle https://serc.carleton.edu/eslabs/carbon/lab_overviews.html
- Carbon Cycle diagram with numbers https://scied.ucar.edu/image/carbon-cycle-diagram-doe-numbers