**Lesson 2.3 | How does climate change affect the oceans?**

**Prior Requirements:**
It is highly recommended that students have completed AU Topic 1 and AU2.1 and AU2.2.

**Learning Objectives:**

Students will understand how climate change is affecting the oceans.

Students will explore the concepts of ocean acidification, temperature change and sea level rise.

Students will reflect on the ways this may impact the Cayman Islands.

**NC Links:**

**Social studies:**

Identify and explain local and global environmental problems and individual roles in minimizing them.

**Science:**

Students are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Recognise that environments can change and that this can sometimes pose dangers to living things.

**Success Criteria**. *In 'child friendly' language*

I can explain the ways in which climate change is affecting the oceans.
I can explain what ocean acidification is.
I can explain what ocean temperature rise is.
I can explain what sea level rise is.
I understand some ways in which this may impact the Cayman Islands.

**Key Language**

Climate change, ocean acidification, temperature rise, sea level rise, marine life, impacts, data collection.

**Sea Level Rise**: The increase in the average level of the world's oceans due to the effects of global warming.

**Ocean Acidification:** The ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide ($CO_2$) from the atmosphere.

**Carbon Dioxide ($CO_2$):** A colourless and odourless gas that is vital to life on Earth. Its increased levels are a major contributor to the greenhouse effect and global warming.

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**Ocean Temperatures:** The measure of how warm or cold the ocean water is.

**Anticipated learning misconceptions/ difficulties:**

Students may have a hard time applying what they have learned in these small-scale experiments to the ocean itself.

Sea level rise is not yet incredibly obvious here in the Cayman Islands, students may question why they are not seeing these changes happening.

The students may have a hard time connecting the consequences of ocean acidification and the 'fizzing' of shells in vinegar to increased absorption of CO2 into the ocean.

**Materials:**

- Two identical cups of water
- Thermometers
- Ice cubes
- Tupperware container
- Raise platform (e.g., a small box or books)
- Handout with three columns (predictions, what happened, how that might affect Cayman)
- Seashell or Piece of Coral
- Vinegar

**Introduction** (15 mins)

1. Explain to students that they will be conducting demonstrations to observe the effects of climate change on ocean temperatures and sea level rise.
2. Conduct a short class discussion based on the key questions - gauge current understanding and discuss any misconceptions.

Predictions on Handout:

3. Distribute the handout with three columns: Predictions, What Happened, and How that might affect Cayman.

**Key Questions**

*In what ways do you think the changing climate affects our oceans?*

*Why would the climate have an impact on the oceans?*

*Why are the oceans important to us?*

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**Main Activities** (30 minutes)

Demonstration #1 - Temperature Change:

Use two cups of water, one to be placed outside where it receives direct sunlight and one to be placed in a location away from the sun (e.g., a cupboard or closet).

- Have students place a thermometer in each cup of water and record the initial temperatures on their handouts.
- Students should fill out the predications section on the handout about what will happen to the water.
- Place the cups in the designated locations and wait for about 10-15 minutes.
- Move on to Next Demonstration.

Demonstrations #2 - Sea Level Rise

- Bring the students outside or to an area with a window where they can observe the demonstration.
- Place a Tupperware container with water on ice cubes to the container to represent melting ice from glaciers. The ice should be raised out of the water on a block or cup – either way, make sure the melting water will flow into the container.
- Place an item in the water just at water level - so when the water rises it will be underwater.
- Record the water level either by measuring it with a ruler or by marking the Tupperware.
- Have students observe the water level in the Tupperware container and make predictions on their handouts about what they think will happen as the ice melts.
- Move on to the next activity letting ice melt.

Demonstration #3 -Ocean Acidification

- Using the presentation, introduce the concept that the ocean absorbs a lot of the C02 that humans put into the atmosphere and explain how it is a consequence of climate change.
- Demonstrate the effects of CO2 on water by placing a seashell or piece of dead coral in a cup of vinegar. The seashell or coral will begin fizzing after 2-3 minutes.
- Have students write on their handouts predictions about what they think will happen.

Over time, the vinegar (acidic) will start to dissolve the seashell, simulating the effects of ocean acidification on marine life.

Take the time to fill out the “What happened” Section of their handout before moving on to the graphs.

**Optional Extension:**

- *Provide students with ocean acidification activity sheets containing graphs guiding questions about the data they are looking at.*
- *2 Graphs- One of C02 concentrations in the oceans over time and one of C02 concentrations in the atmosphere*
- *In pairs or small groups, students analyse the graphs and answer the questions on the activity sheets.*
    - *What do you notice about the atmosphere?*
    - *What is happening to the level of C02?*
    - *What do you notice about the oceans?*
    - *What do you think will happen as more C02 is put into the atmosphere?*

**Results** (10 minutes)

- Gather the class and return to the cups of water and measure the new temperatures of each cup.
- Discuss the difference between the two temperatures.
- Students to complete handout - “What Happened”.

Return to the Tupperware and measure the water level.

- Discuss the amount of change and what happened.
- Ask - What does the item in the water represent?
- Students to complete “What Happened” section.

Students to work with a partner to discuss each demonstration and how this might affect Cayman.

**Conclusion** (5 minutes)

1. Encourage students to reflect on how these changes in ocean temperatures and sea level rise might impact the Cayman Islands and its marine life.
2. Have students complete the third column of their handouts, considering the potential effects of climate change on the local environment

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