Lesson Plan - Healthy Reefs Over Time

Module Summary
This module dives into some of CCMI's long-term coral reef monitoring efforts and the lessons learned over more than 20 years. A team of CCMI educators will guide virtual students LIVE from a coral reef along the coast of Little Cayman in the Cayman Islands. As students explore this fascinating ecosystem, they will be taught various underwater field research methodologies, lessons learned from those research projects, and how sharing that data can help with the creation or expansion of Marine Protected Areas. We will also discuss what everyone can do to help keep coral reefs healthy for years to come. CCMI has provided an in-class activity sheet for students to complete during the live lesson to assist with the comprehension of our learning objectives.

Year 4, 5 & 6

Learning Objectives

- Describe how to create a bar graph
- Understand the significance of parrotfishes on coral reefs
- Recognize the importance of long-term data collection
- Identify actions that can be taken by individuals to minimize impact on coral reefs and oceans

The Cayman Islands - Science National Curriculum Alignment

- Recognize that environments can change and that this can sometimes pose dangers to living things (Year 4).
- Investigate a local habitat, including the relationship between the animals and plants found there, and develop skills in classifying animals and plants by observing external features (Year 4).
- Students, through firsthand experiences and using a range of resources, identify and classify locally occurring species of animals and plants using observable features (Year 5).
- Find out about other animals, including how they grow, feed, move and use their senses (Year 5).

Working Scientifically Skills (Cayman Islands – Science National Curriculum):

- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate (Skill 2) (Year 4)
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs (Skill 3) (Year 5 & 6)
- Reporting and presenting findings from enquiries, including conclusions, causal relationships, and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations (Skill 5) (Year 5 & 6)
- Identifying scientific evidence that has been used to support or refute ideas or arguments (Skill 6) (Year 5 & 6)

Ocean Literacy Principles Alignment

- Ocean Literacy Principle #5: The ocean supports a great diversity of life and ecosystems.
- Ocean Literacy Principle #6: The ocean and humans are inextricably interconnected.
- Ocean Literacy Principle #7: The ocean is largely unexplored.

Description of Live Lesson

This module will take place on a coral reef ecosystem along the coast of Little Cayman in the Cayman Islands, where a CCMI host will communicate between the remote audience and our underwater educator. This team will guide students through a series of learning objectives discussing CCMI's long-term coral reef monitoring efforts and results from a 20-year dataset, all in alignment with the Science National Curriculum of the Cayman Islands and the Ocean Literacy Principles. Students will have a worksheet to complete during the live lesson which they are encouraged to ask questions about to the host or educator at any time during the broadcast. Pre-recorded footage may be used to show key concepts, should these observations not be discovered naturally during the live lesson. During this module, students will be shown underwater field research methods and review key messages learned from that data collection. The virtual audience will be encouraged to share suggestions for how individuals can help make a positive impact on our planet and on our coral reefs.

Live Broadcast Outline (40 mins)

00:00 – 05:00	Opening video & Host welcomes students and introduces the RGL team
05:00 – 15:00	Host and Educator discuss long-term monitoring projects & results
15:00 – 18:00	Questions or comments
18:00 – 28:00	Discussion of how everyone can help coral reefs in a changing world
28:00 – 30:00	Questions or comments
30:00 – 37:00	Host and Educator recap the live lesson and concludes the module
37:00 – 40:00	Closing credits and video roll

In-class materials needed

- Internet connection
- laptop (or cell phone)
- projector
- speakers
- paper
- Scissors, ruler & pencils/pens
- CCMI activity sheet
- CCMI lesson place

Useful additional resources

- The Cayman Islands Department of Environment, EpiCollect5 Urchin Health Cayman App: https://five.epicollect.net/project/urchin-health-cayman
- Mass, Christina. (2014) A Parrotfish's Tale. http://www.parrotfishpublishing.com/books
- Daley, Ben. (2005) Changes in the Great Barrier Reef since European settlement: implications for contemporary management.
- Andradi-Brown DA, *et al.*, (2020) Editorial: Coral Reefs in the Anthropocene – Reflecting on 20 Years of Reef Conservation UK. Frontiers in Marine Science, 7:364. doi: 10.3389/fmars.2020.00364.

Additional Activities

Put students in pairs. One of the pair is given a piece of paper, pencil, coloured pens and instructed to face the back of the classroom. The other student is instructed to face the front. Display a map of the Cayman Islands Marine Protected Areas (MPAs) on the whiteboard at the front of the classroom found here: https://doe.ky/wp-content/uploads/2021/04/Marine-Parks-Brochure-21-April-2021.pdf. Have the student facing the board look at the screen for 30 seconds, before allowing the image to disappear. The student facing the front of the room then must describe the image they have seen to their partner, who will attempt to draw the map of the Cayman Islands MPAs. Allow a few 30 second intervals for students to view the map until students are starting to produce images that look similar to the map on the board. Ask the students who cannot see the image what they think they have drawn. Highlight the importance of knowing and understanding the boundaries of a MPA along with their significance. Alternatively, just show the Little Cayman map as a simpler activity.

Stretch & Higher Ability Challenge:

If you have higher ability students, provide them with a diagram of the reef inside and outside of an MPA. Ask students which reef is healthier and explain quantitatively why this is? Ask how they can prove this scientifically with unbiased data collection and if there is a significant difference between the two areas.

To make the graphing activity more challenging ask higher ability students to add error bars to their graphs as shown in CCMI Healthy Reef Report Card, available here: https://reefresearch.org/our-results/ccmi-reports/

Lower Ability

For classes that may struggle with the activity as individuals, this can also be completed as a class activity. Have the reef diagram inside and outside the MPA, from the worksheet provided, up on the whiteboard. Select students to come up to the board (as individuals or in pairs) to measure the size of fishes to the nearest 10cm. Everyone records the data in their table and plots a graph.

“Healthy Reefs Over Time” Key Terms

The CCMI educators may refer to the below key terms, which will be defined throughout the live broadcast. Some of these terms may be used in the accompanying worksheet that can be completed during the Reefs Go Live broadcast. Listen for your opportunity to learn some new vocabulary about our coral reef ecosystems!

Biodiversity – the variety of life in a particular area/ecosystem, in this case referring to different species

Biomass – the total mass (determined by the size and weight) of organisms in a given area, eg. Fish Biomass, the total mass of fish in a given area

Density – the total number of individuals within a given area, eg. Fish Density, is the number of fishes in an area

Ecosystem – a community of living organisms in conjunction with the non-living parts of their environment, interacting as a system

Evolution – a well-accepted scientific theory of documented genetic change in a population over time due to environmental factors

Herbivore – an organism that feeds mostly on plants; vegetation is the main part of its diet

Keystone Species – an organism that plays a critical role in an ecosystem, often with a disproportionate effect on other organisms in that system

Marine Protected Areas – a natural space protected and managed by governing authorities for several reasons including economic resources, biodiversity conservation, or species protection

Reef Health – a simple observation of the status of coral reefs using key indicators, scientific measurements, and the presence or absence of certain organisms

Species – taxonomic group containing individuals that resemble one another, can interbreed, and their offspring are also able to reproduce

Worksheet - Healthy Reefs Over Time

Become a CCMI Marine Biologist

1. Follow the Scientific Method

At CCMI our scientists have been collecting data on the fish populations on the coral reefs of Little Cayman since 1999! Researchers use specialised equipment, one of which is called a T-bar. They use a tape measure on the reef, then swim along the tape with the T-bar to count the number and size of fish that swim within the 1 metre area in front of the T-bar. They measure the size of the fish using the 10cm intervals marked on the T-bar, to give a rough size estimate to each fish counted.

On the next page we have two dive sites, one inside a Marine Protected Area (MPA) and one outside of an MPA. Scientists continuously ask questions, so be sure to answer the questions below while referencing the reefs on the next page.

1) Are the fish inside the MPA bigger or smaller overall?

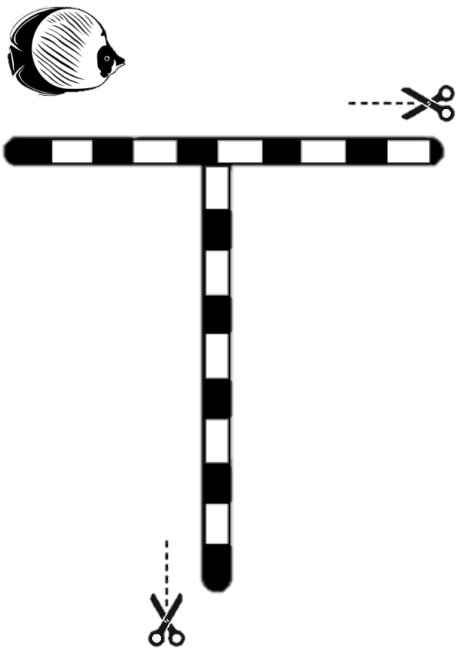
2) Do you think that is a good or bad thing, and why?

3) Were there more fish inside or outside the MPA?

Now we need to prove our observed or qualitative theories by collecting quantitative or raw data. Follow the scientific method below.

Scientific Method:

1. Use scissors to cut out the T-bar on right.
2. Use the T-bar to measure all the fish inside the Marine Protected Area (MPA). For example, the fish on the right is the size of three intervals on the T-bar. Therefore, the fish is 30cm.
3. Record the size of all the fish inside the MPA in the table. *Remember scientists never put units in the table, they put the unit at the top of the column.
4. Repeat steps 2-3 for outside the MPA.
5. Hint: The T-bar is a fantastic tool to quickly gain size estimates underwater. The T-bar is 1 metre long and 1 metre wide with 10cm intervals. Each coloured band represents 10cm.

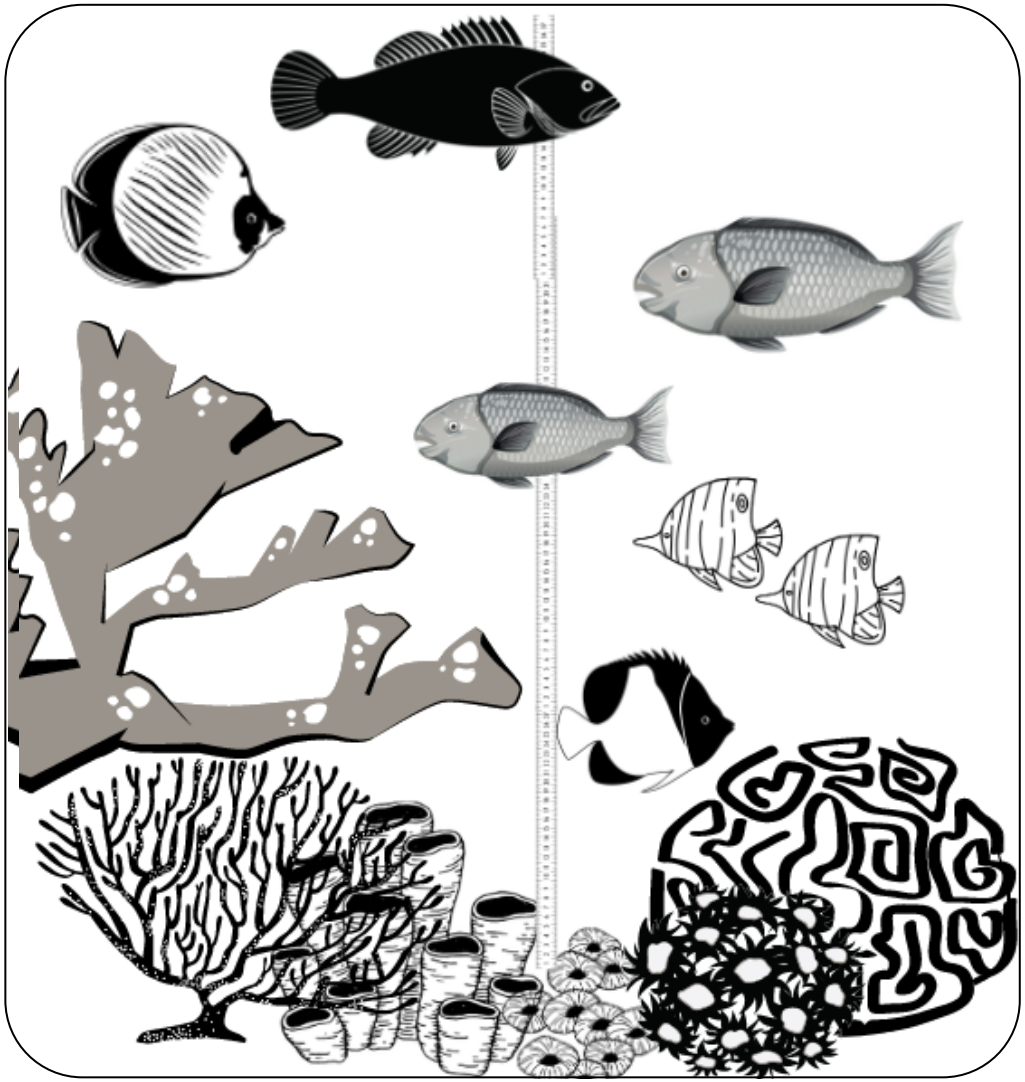


6.

Inside Marine Protected Area

Outside Marine Protected Area

**Please note diagram is not to scale, not all fish are Caribbean species. All images are sourced from Canva.*



2. Collect & Analyze Data

Inside Marine Protected Area	
Fish Number	Size of fish (cm)
1	80
2	50
3	80
4	60
5	40
6	40
7	40

Outside Marine Protected Area	
Fish Number	Size of fish (cm)
1	60
2	50
3	40
4	30
5	30

Once you have filled out the table, calculate the average size of fish inside the MPA and outside the MPA. To do this, add the fish sizes all together and divide by the total number of fish in the area. This average is also called the mean.

Mean fish size inside the MPA:

*Show your working out

80+50+80+60+40+40+40= 370

370/7 = 52.85 = 53

The average fish size inside the MPA is 53cm

Mean fish size outside the MPA:

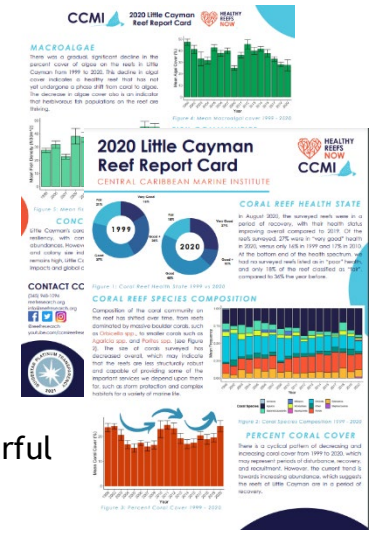
60+50+40+30+30=210

210/5= 42

The average fish size outside the MPA is 42cm

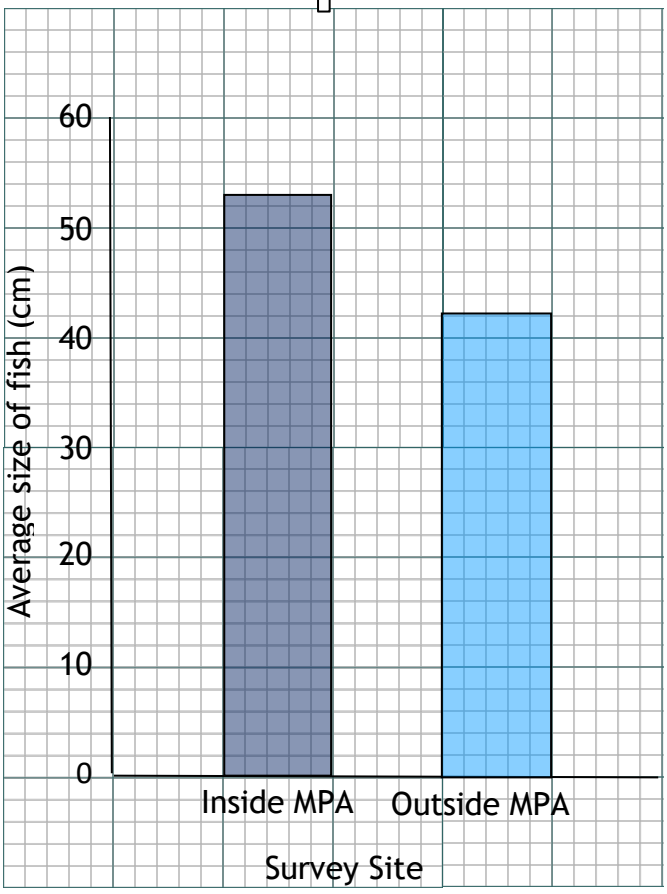
Explain what your results show:

3. Publish your Findings!



Now that you have collected your data and recorded it into a table, you need to share your findings with the public! Every year CCMI publishes our findings in our annual Reef Report Card open to the public, as we want everyone to know how fantastic and healthy the reefs are in Little Cayman! As you can see from the image on the right, our reports are full of bright and colorful graphs, with a description of the findings our graphs show. From the data you have collected use the space below to create a colourful graph and write a description of your findings.

2022 Little Cayman Reef Report Card



Title:

Description of method:

Description of results:

Conclusion drawn from results:

As with all scientists you need to share your findings, so make sure you show your reef report card to family and friends! Once you have done this you can say you are officially a **CCMI Marine Biologist**! You have collected data using the scientific method, organized the data into a table and graphed it, developed a conclusion from your findings and shared these findings with the public. Well done!

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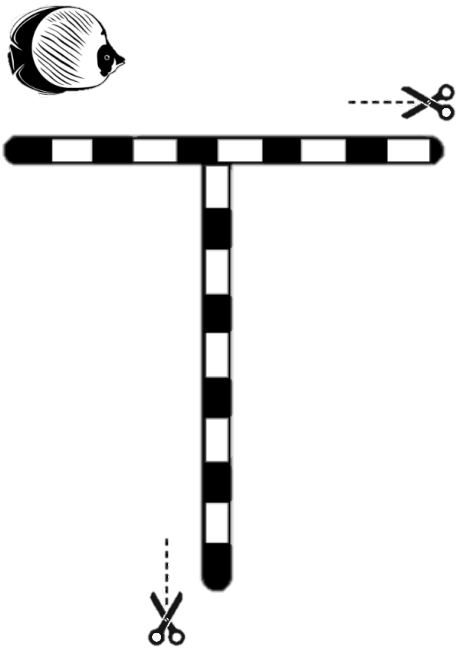

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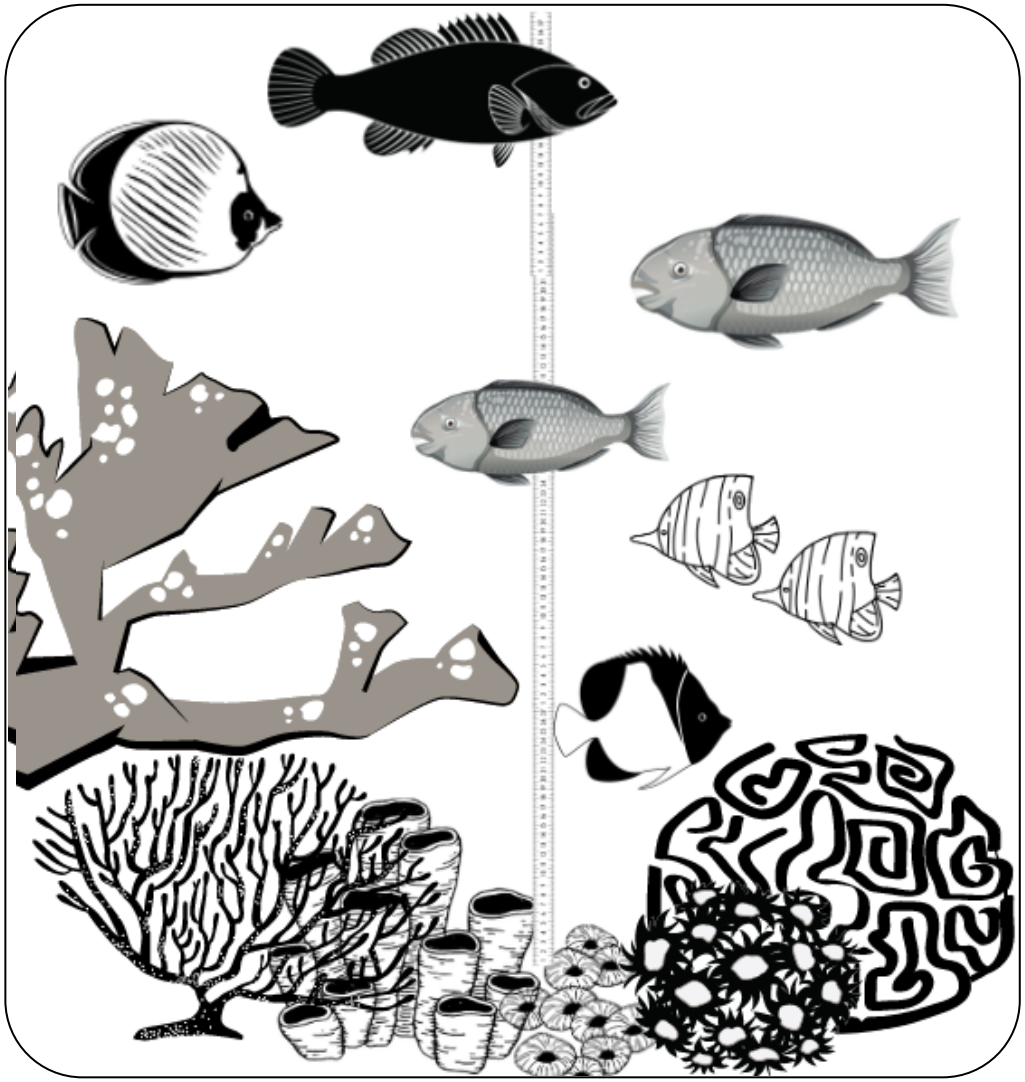

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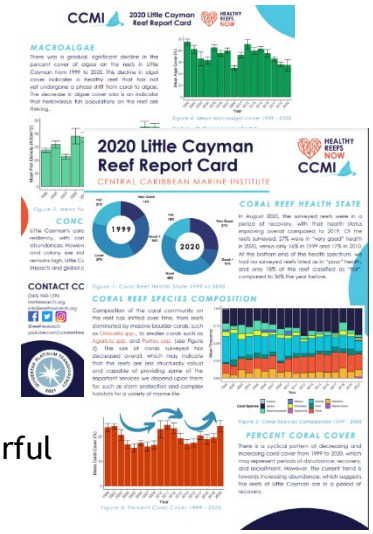

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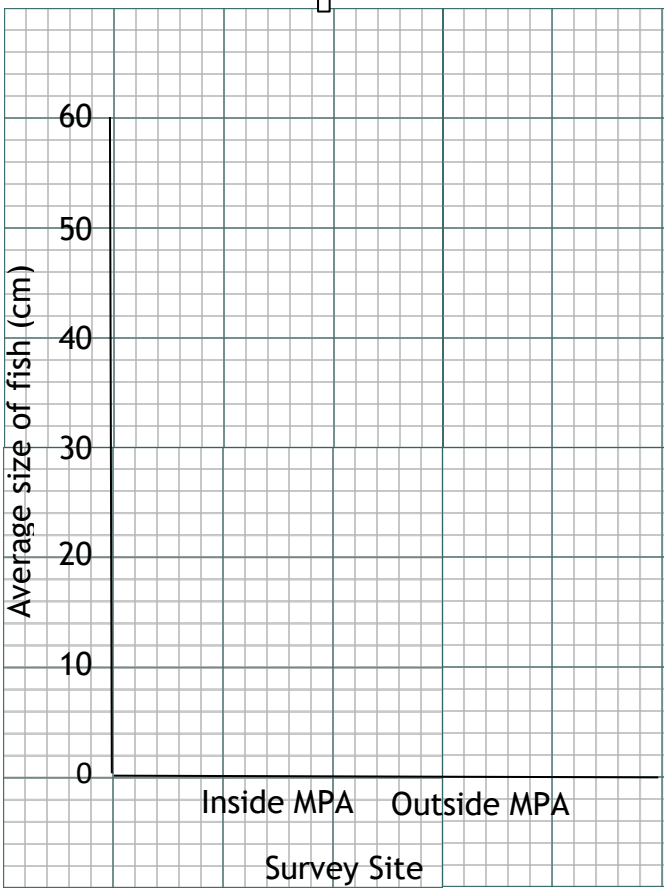

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