SCIENCE·3D

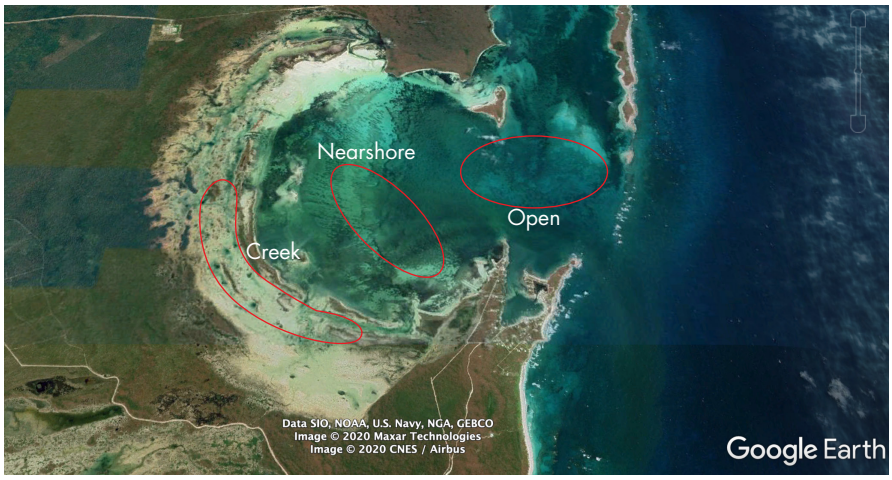
SEA TURTLE WORLD

In this packet, sample student answers are provided in red and notes to teachers are in blue.

In this **Science Mission**, students will use data from Abaco, The Bahamas to investigate how nutrients affect plant growth and how the amount and quality of food influences where sea turtles are found. They will also explore how predators might influence the behavior of sea turtles. This mission challenges students to develop hypotheses and test their predictions using data.

Green turtles of Abaco, The Bahamas live in an incredibly beautiful marine environment. How do they get enough high-quality food to eat? How do they decide where to spend their time? It's up to you to help the team find out!

The first step in our investigation is to learn more about where the turtle's seagrass food is found and where it is the most nutritious!



Activity 1: Do Sea Turtles Spend Time Where There is the Most Seagrass?

Biologist Dr. Beth Whitman and her team divided up turtle habitats into different zones and measured the amount of seagrass in each area. They do this by recording how much of the area inside a square is covered by seagrass. The square is one meter long on each side. This is called the "cover score." They score the amount of seagrass inside the square on a scale of 0 to 5. If the score is 0, there is no seagrass. If it is 5, the entire bottom is covered. These data are in Table 1.

1. **Calculate** and **record** the average score for each habitat in Table 1 below.

Table 1. Seagrass cover scores in three habitats off of Abaco, The Bahamas

Seagrass Sample Number	Creek	Nearshore	Open Water
1	1	3	1
2	4	4	5
3	3	2	0
4	4	2	5
5	1	2	0
6	2	0	5
7	4	2	4
8	4	0	5
9	2	2	5
10	0	3	5
Average	2.5	2	3.5

2. Look at the data in Table 1. Why do you think it was important that Beth and her team collected ten samples at each location? Use evidence from the table to explain.

The measurements within each habitat are very different. If enough samples were not taken, the average may have been wrong. For example, Samples 3 and 5 of open water had no seagrass while samples 2 and 4 had a lot. The more samples you take, the more accurate the average will be.

3. Use the data in Table 1 to **draw** a bar graph of the average cover score of seagrass in each location. Remember to label the axes and caption the figure.

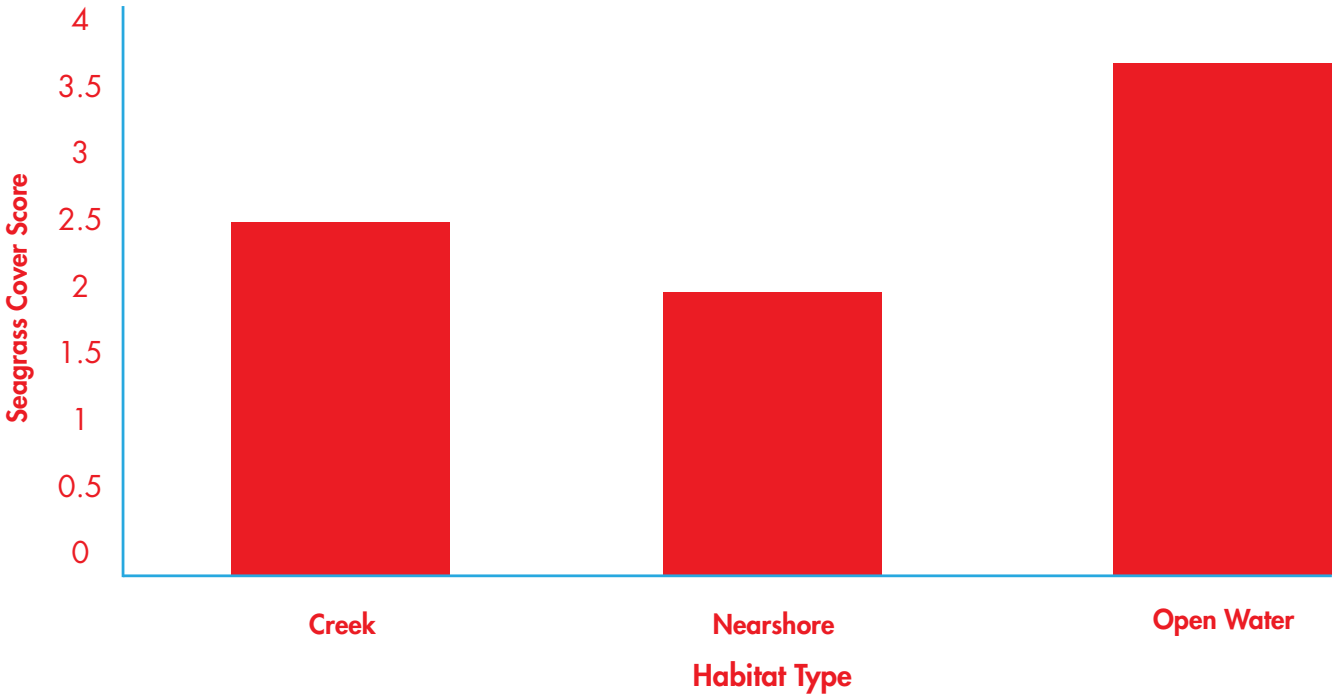


Figure 1. Differences in seagrass cover scores in three habitats

4. **Describe** where you think sea turtles should be found if they are most interested in finding a lot of seagrass. Use the data in the figure you made in question 3. Be sure your answer describes which habitat should have the most turtles, the second most turtles, and the fewest turtles.

If sea turtles are most interested in finding a lot of seagrass, there should be the most turtles in open waters. Creeks should have fewer turtles than open waters, but more than nearshore waters because that habitat had the least seagrass. Note: Student responses here are dependent on the work they did in questions 1 and 3. If they struggled, you may need to go back and help them calculate the averages. Students should suggest that sea turtles should be found in the area with the highest amount of seagrass.

Activity 2: Testing Your Predictions

The turtle team has repeatedly flown drones with cameras over the top of the different habitats. The drones are flown in lines called transects. Table 2 shows the data from 20 drone flights in each habitat. Each flight covered 1 square kilometer of area, and the drone was flown at the same speed during all transects.

1. **Calculate** and **record** the average density of turtles (turtles per square kilometer) in the three habitats.

Table 2. Turtle counts in three habitats off of Abaco, The Bahamas

Flight Number	Creek (turtles per km^2)	Nearshore (turtles per km^2)	Open Water (turtles per km^2)
1	150	125	5
2	75	50	0
3	100	75	0
4	200	50	5
5	50	100	0
6	25	25	0
7	100	20	25
8	125	5	10
9	150	0	5
10	175	0	10
11	200	35	0
12	150	100	0
13	225	75	0
14	100	25	0
15	50	100	0
16	175	25	5
17	75	75	0
18	25	50	0
19	150	20	5
20	100	5	0
Average	120	48	3.5

Extend the Lesson: Have students look at the table and make an argument for why the drone needed to be flown many times in each habitat. Students should notice the variance in counts within each habitat.

2. Use the data in Table 2 to draw a bar graph of the average number of turtles in each location. Remember to label the axes and caption the figure.

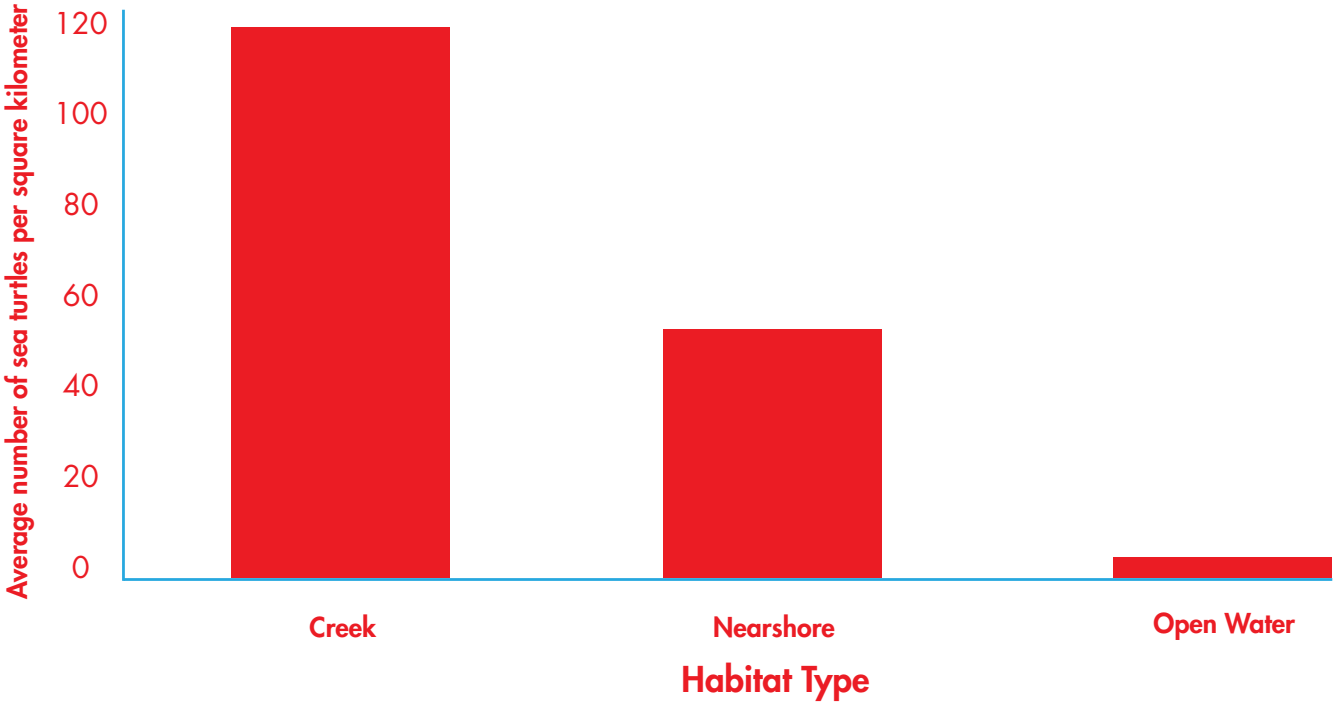


Figure 2. Differences in turtle counts in three habitats

3. Was your prediction about where turtles would spend their time supported? Support your claim with evidence from the graphs you drew.

My prediction was not supported. I thought that there would be the most turtles in open waters. Instead, there are very few there. Note: If students made a different prediction, this answer may vary. Make sure that there is logical consistency between the prediction and the test.

Activity 3: What's Up With That?

Were your predictions correct? Don't worry! It's okay to be wrong! In science, we often learn the most when our predictions are not correct the first time. We just have to come up with new hypotheses and get the data to test them!

1. **List** at least two other factors that could influence where sea turtles spend their time.

Accept all reasonable answers. Examples include: people disturbing turtles, predators (sharks), the quality of their food (or how nutritious their food is), water depth, water temperature, or turtles keeping other turtles away from good habitats.

Let's test some additional possible turtle influencers. Maybe turtles are looking for *good* food, with lots of nutrients, instead of just locations with the *most* food. The crystal-clear waters of The Bahamas may be beautiful, but clear water usually means fewer nutrients. Seagrass needs nutrients to grow. And, the more nutrients there are (as long as there are not so many to cause the water to get too cloudy and block the sunlight) the more nutritious the seagrass is for turtles. One of the most important nutrients for turtles and seagrass is nitrogen.

2. **Calculate** and **record** the average % of nitrogen present in the three habitats.

Table 3. Amount of nitrogen in seagrass of Abaco

Seagrass Sample Number	Creek (% nitrogen)	Nearshore (% nitrogen)	Open Water (% nitrogen)
1	1.5	2.5	2
2	2.5	1.5	2
3	2	1.5	2.5
4	2.5	2.5	2
5	2	2	2
6	2.5	1.5	1.5
7	2.5	2	1.5
8	2.5	1.5	1.5
9	2	2	2
10	2.5	1.5	1.5
Average	2.25	1.85	1.85

Extend the lesson: Have students calculate and compare the range of values (max - min) among habitats. Then have students focus on the maximum value in each habitat. They should see that there are some places in the nearshore waters where there is nutritious food.

3. Based on the data in Table 3, **predict** where turtles should be found if they are looking for the most nutritious food. Explain the reasoning for your prediction.

Accept all reasonable answers. The actual prediction is not as important as that it is logical and testable. Some examples include: The turtles should all be in creeks, because that is where the highest average food quality is found. Most turtles should be in creeks and there should be equal numbers in open and nearshore waters because creeks have the most nutritious food and open and nearshore waters have the same average nutrition. Activity 1 suggests that more turtles should be in open waters than nearshore waters because they are equal in nutrition but there is more seagrass in open waters.

4. **Compare** your prediction to the figure you drew in Activity 1. **Describe** whether the data support your prediction or not.

Most students will say the data do not support their prediction. In fact, there are fewer turtles than they would have thought in open waters based on the amount of seagrass.

Activity 4: What About Sharks?

It looks like we need to keep looking for factors that might affect where turtles spend their time. What about predators? How does the number of sharks that might eat turtles differ across the habitats? Dr. Beth and the team placed many cameras underwater in the different areas. Figure 1 shows the result.

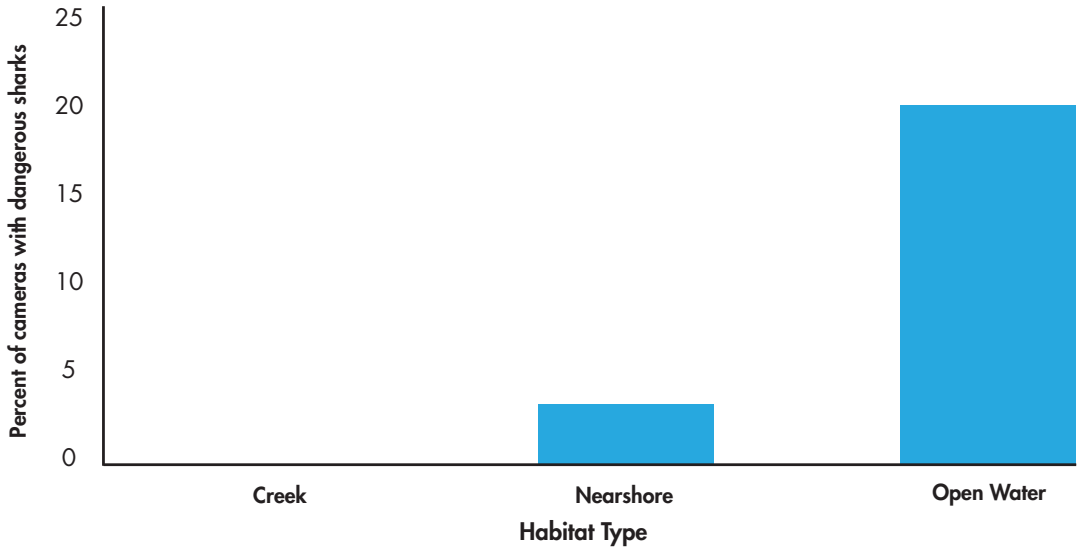


Figure 1. Percent of cameras in each habitat that revealed a shark big enough to eat a turtle

1. Based on the data in Figure 1, do you think that turtles avoid dangerous sharks?

It looks like turtles do avoid the most dangerous habitat. There are few turtles in the open water habitat where there are the most sharks. Some students might notice that some turtles do go into open areas, so they don't avoid tiger sharks altogether.

2. Based on your investigation so far, what do you think is the best habitat for turtles? Provide evidence to support your claim. *Hint: think about the conditions in the different habitats and where turtles are found.*

I think creeks are the best habitat. They are the safest because they have the fewest number of sharks. They have the seagrass with the highest average amount of nutrients. They don't have the most seagrass, but they have almost as much as open water habitats. The largest number of turtles is found in creeks.

Extend the lesson: Lead a discussion about whether there is enough evidence to say if turtles like creeks because they are safe or because they have the most nutritious food. Students may say *yes* and provide evidence, or they may say *no* because creeks are the best for both conditions. The latter explanation is better. Have students discuss what evidence they would need to tell which factor is more important. They propose ideas for experiments to see what seagrass turtles like. Sample ideas include having robot sharks scare turtles and using the data from the turtle cameras they saw in the video to see how they react to sharks. The key is to have students attempt to come up with a way to test their ideas.