

THE AWESOME OYSTER

LESSON OVERVIEW

OBJECTIVE

Students will practice observing trends in scientific data and calculating mean, median, and mode.

RECOMMENDED GRADE LEVELS

4-8

DURATION

25-45 minutes

MATERIALS

- Math worksheets (provided)
- Oyster measurement images (provided)
- Whiteboard & marker
- Tape

TOPIC BACKGROUND

Oysters are an important part of the aquatic food web and help filter, or clean, the water. One adult oyster can filter 50 gallons of water a day. Oyster populations in the New York Harbor declined significantly due to high levels of pollution in previous decades.

Although the waters have become less polluted, scientists are still determining how well oysters can survive and reproduce in these waterways today. Because oysters filter the water, the health of oysters helps assess the health of the water.

Scientists place **oyster gardens** in the water to study the health and growth of oysters. The oysters are monitored and measured routinely to assess rate of

growth and **mortality**. A healthy oyster may grow up to 1 inch per year.

When scientists collect a numerical set of data, they often calculate the **average**, also known as the **mean**. To further analyze data, scientists may determine the **median** and **mode**. The median is the middle number in an ordered dataset and the mode is the most frequent number occurring in the dataset. These **measures of central tendency** (mean, median, and mode) help to represent a large dataset with a single number.

Scientists often collect very large amounts of data at a time. Calculating the mean, median and mode helps them **interpret** the data and observe patterns.

GETTING READY

1. While at the park, remember to collect the students' data sheets after the end of the program so that they can analyze their data back in the classroom.
2. Print, cut, and laminate the 10 provided oyster images. (To be used if introducing how to calculate mean, median, and mode in a dataset)
3. Determine which activities in the lesson plan you will complete and print out a class set of the corresponding worksheets:
 - Activity 2 worksheet: Oyster Data: Mean, Median, Mode (1 page)
 - Activity 3 worksheet: Oyster Data: Percentages & Trends Over Time (2 pages)
4. Have a whiteboard and marker available to demonstrate any equations or record the averages calculated by students.

INTRODUCTION: FINDING AVERAGES AND INTERPRETING DATA

1. The math activities in this lesson plan involve calculating averages, percentages, and measures of central tendencies. Depending on age, some parts of these activities may be skipped or modified.
2. If introducing mean, median, and mode to students for the first time, use the provided oyster cut outs. Each oyster has a measurement listed in centimeters. Tape the 10 oysters on the board (place in a random order). Tell students that this is an example of a set of oysters measured at Brooklyn Bridge Park. Demonstrate or call a student up to arrange the oysters in number order from smallest to largest. Have students record this list in their notebooks or paper.
3. Tell students to look over these measurements. What measurement appears the most? *A: 5 cm, we call this the mode. Sometimes there can be more than one mode.* Remove two of the 5 cm oysters from the board. What is the mode now? *A: 4 and 6 cm, they both appear 3 times.*
4. Next have students count the number of measurements in their list. *A: 10* Ask what number is half way between 10? *A: 5 and 6, or 5.5* Have students figure out what the middle number, or median, is in this data set by crossing one number off from each side until reaching the middle or having students count to the 5th and 6th number. Explain to students that because we have an even number of measurements we will need to take the average of the 5th and 6th numbers. In this case, both numbers are 5 and therefore the median is 5.
5. Lastly, tell students that they will calculate the mean, which is just another word for average. Remind students that to find an average you add up all the measurements and divide by the number of measurements you have (10). What do you notice about the mean, median, and mode? *A: They are all 5 cm.*

ACTIVITY 1: FINDING AVERAGES AND INTERPRETING DATA

1. If your students have their oyster data sheets from their trip to Brooklyn Bridge Park, have students circle the number that appears most frequently on their datasheet. Have students draw a triangle around the smallest number and a square around the largest number.
2. Next tell students to write their measurements out in order from smallest to largest on a separate piece of paper. Have students determine the median number, providing instruction if needed.
3. Lastly, have students calculate the average length of the oysters they measured. For younger grades, remind or explain to students that the average can be found by adding up all the measurements and dividing by the number of measurements you took.
4. Ask students to raise their hands and share what their average was. Write these numbers on the board. If desired, you can use this new dataset created to calculate mean, median, mode, and range.
5. A healthy oyster will grow on average 1 inch or 2.5 cm per year. That means if a oyster is measured to be about 10 cm (4 inches) long, the oyster is probably around 4 years old. Have students look at the average size of the oysters they measured and estimate the age. Remember oysters grow 2.5 cm each year!

ACTIVITY 2: PRACTICING MEAN, MEDIAN, AND MODE

1. Give each student a copy of the one page worksheet, “Oyster Data: Mean, Median, and Mode.” Have students complete as a class or homework assignment.
2. For this activity to be done independently, students will need to know how to calculate mean, median, mode, and identifying outliers.

ACTIVITY 3: PRACTICING PERCENTAGES AND DATA TRENDS

1. For older groups, have students also complete the two page worksheet, “Oyster Data: Percentages and Trends Over Time.”
2. For this assignment, students should have experience calculating percentages and be able to interpret a set of data by observing changes and patterns over time.

RECOMMENDED WEBSITES

Billion Oyster Project
<https://billionoysterproject.org>

Oyster Lesson Plans
(Subject areas include: ELA, Math, Science, and Social Studies)
<http://platform.bop.nyc>

Estuaries 101 Curriculum
<https://coast.noaa.gov/estuaries/curriculum/>

VOCABULARY

Average: A number expressing the central or typical value in a set of data. To calculate, add up all of the numbers in a set and divide by the total number of items. Also known as the mean.

Interpret: To understand the meaning of significance of something. When scientists interpret data they are looking to draw conclusions about something they were studying.

Percent: A fraction where the denominator is 100. It can be written using the sign, %.

Proportion: An equation stating that two ratios are equivalent.

Mean: The average of all of the numbers in a sample. Add up all of the numbers in a set and divide by the total number of items to calculate a mean.

Measures of Central Tendency: A single value that can be used to describe the way in which a group of data cluster around a central value. There are three measures of central tendency: the mean, the median, and the mode.

Median: The middle number in a series of numbers that's ordered from least to greatest. If there's an even number of items in the data set, the median can be calculated by averaging the two middle numbers.

Mode: the number that appears the most times in the data set.

Mortality: The number of deaths in a given time or scenario.

Outlier: Something situated far away from the rest of the group. In math, this refers to a number much smaller or larger than the other numbers in a dataset.

Oyster Garden: A cage containing live oysters that are monitored by students or scientists.

Oyster Reef: A group of oysters growing together under the water.

Range: The difference between the highest and lowest values.

STANDARDS

COMMON CORE ELA

- Reading Informational Text
- Speaking and Listening
- Literacy in Technical Subjects
- Literacy in Science

COMMON CORE MATH

- Operations/Algebraic Thinking
- Number & Operations in Base 10
- Number & Operations-Fractions
- Counting and Cardinality

- Measurement and Data
- The Number System
- Expressions and Equations
- Quantities
- Ratios & Proportional Relationships

NAME: _____

OYSTER DATA: Mean, Median, and Mode

Oyster #1	Oyster #2	Oyster #3	Oyster #4	Oyster #5
7 cm	8 cm	7 cm	7.5 cm	6 cm
Oyster #6	Oyster #7	Oyster #8	Oyster #9	Oyster #10
5 cm	4.5 cm	1 cm	7 cm	7.5 cm

Write the measurements in order from smallest to largest:

What is the median (middle number)?

What is the mode (most frequent number)?

What is the mean (average)?

Are there any outliers? (a number much smaller or larger than the rest)

Why do you think one oyster measurement was so much smaller than the rest?

ANSWER KEY

OYSTER DATA: Mean, Median, and Mode

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7 cm	8 cm	7 cm	7.5 cm	6 cm
Oyster #6	Oyster #7	Oyster #8	Oyster #9	Oyster #10
5 cm	5 cm	1 cm	7 cm	7.5 cm

Write the measurements in order from smallest to largest:

1 5 5 6 7 7 7 7.5 7.5 8

What is the median (middle number)? **7**

What is the mode (most frequent number)? **7**

What is the mean (average)? **6.1**

$$1 + 5 + 5 + 6 + 7 + 7 + 7 + 7.5 + 7.5 + 8 = 61$$

$$61 \div 10 = 6.1$$

Are there any outliers? **Yes, 1. It is much further away than the rest of the data.**

Why do you think one oyster measurement was so much smaller than the rest?

Possible answers include: could have been a very young juvenile oyster, the oyster measured had actually died or been eaten and thus stopped growing while the rest of the cluster continued to grow, human error (reading the caliper incorrectly or measuring in inches instead of cm)

NAME: _____

OYSTER DATA: Percentages and Trends Over Time

A group of scientists monitored a cage in an oyster garden for 5 years. In year 1 they put 20 living oysters into the cage. Each year they returned to count the number of oysters alive and measure the size of each oyster. The scientists recorded the length of the living oysters only. If there were any dead oysters, the scientists left them in the cage.

Analyze the data below to answer the following questions.

	Year 1	Year 2	Year 3	Year 4	Year 5
ALIVE	20	19	11	10	10
DEAD	0	1	9	10	10
AVERAGE SIZE	5 cm	6 cm	6 cm	8.5 cm	11 cm

1. What percentage of oysters were alive each year?

HINT: Set up a proportion or use the following equation.

$$(\# \text{ Alive Oysters} \times 100) \div \text{Total \# Oysters} = \% \text{ Living}$$

Year 1 _____

Year 2 _____

Year 3 _____

Year 4 _____

Year 5 _____

2. The percentage of living oysters decreased dramatically between year 2 and year 3 and remained stable from year 4 to year 5. What might have caused this?

OYSTER DATA: Percentages and Trends Over Time

3. A healthy oyster will grow 1 inch per year (2.5 cm). Determine the average change in size each year. *HINT: YEAR 2- YEAR 1 = change in size from year 1 to year 2*

RATES OF GROWTH:

Year 1 to Year 2 _____

Year 2 to Year 3 _____

Year 3 to Year 4 _____

Year 4 to Year 5 _____

4. Did the oysters decrease in size at any point? When?

5. Did the oysters' growth stagnate (stop) at any point? When?

6. Based on the average sizes measured, what do you notice about oyster growth over the 5 years? Would you say this is a healthy growing population of oysters?

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$$(\# \text{ Alive Oysters} \times 100) \div \text{Total \# Oysters} = \% \text{ Living}$$

Year 1 100%

Year 2 95%

Year 3 55%

Year 4 50%

Year 5 50%

2. The percentage of living oysters decreased dramatically between year 2 and year 3 and remained stable from year 4 to year 5. What might have caused this?

Possible answers include: pollution or disease killed off many oysters, an increase in the number of predators, such as oyster toadfish. In the years following, percent die off may have decreased because the river returned to its normal water quality levels or predator numbers decreased.

ANSWER KEY OYSTER DATA: Percentages and Trends Over Time

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RATES OF GROWTH:

Year 1 to Year 2	<u>1 cm</u>	$6-5=1$
Year 2 to Year 3	<u>0 cm</u>	$6-6=0$
Year 3 to Year 4	<u>2.5 cm</u>	$8.5-6=2.5$
Year 4 to Year 5	<u>2.5 cm</u>	$11-8.5=2.5$

4. Did the oysters decrease in size at any point? When? **No.**
(A negative number for growth rate would indicate decrease in size.
I.e. 5 cm - 6 cm = -1 cm)
5. Did the oysters' growth stagnate (stop) at any point? When?
Yes. From year 2 to year 3 the average rate of growth was 0.
6. Based on the average sizes measured, what do you notice about oyster growth over the 5 years? Would you say this is a healthy, growing population of oysters?
The period where the oysters did not experience any growth coincides with the significant die off of the oyster population. This might suggest that the oysters were under a lot of stress (possibly from poor water quality) which was causing them not to grow and in some cases die.
- Between year 3 and year 5 we see oysters growing on average 2.5 cm per year. This is within the expected range for healthy oyster growth. Despite the incident in earlier years, the oysters appears to be growing regularly again.**



