HISTOGRAMS ON THE HALF-SHELL

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Grade Level
7th Grade

Subject Area
Life Science & Mathematics

VA SEA is a collaborative project between the Chesapeake Bay National Estuarine Research Reserve, the Virginia Institute of Marine Science's Marine Advisory Program, and Virginia Sea Grant. The VA SEA project is made possible through funding from the National Science Foundation and William & Mary's Society of 1918 Endowment.

Title: Histograms on the Half-Shell

Focus: Learn about survey design and graphing histograms by copying the Virginia Oyster Stock Assessment surveys

Grade Level: 7th Grade Life Science, 7th Grade Mathematics

Virginia Science Standards of Learning:

LS.1 The student will demonstrate an understanding of scientific and engineering practices by
c) Interpreting, analyzing, and evaluating data

LS.8 The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic and change over time. Key ideas include
a) organisms respond to daily, seasonal, and long-term changes; and
b) changes in the environment may increase or decrease population size

Virginia Mathematics Standards of Learning:

7.PS.2 The student will apply the data cycle (formulate questions; collect or acquire data; organize and represent data; and analyze data and communicate results) with a focus on histograms.

c) Determine how sample size and randomness will ensure that the data collected is a sample that is representative of a larger population.
d) Organize and represent numerical data using histograms with and without the use of technology.

Learning Objectives:

- Students will sample an oyster population
- Students will measure each oyster
- Students will create a length frequency distribution (histogram) using the lengths of each oyster
    - Alternatively, students can create a dot plot if a histogram is too advanced. However, **histograms are required in the 7th grade Virginia Mathematics Standards of Learning.**
- Students will interpret their histograms
- Students will identify trends in oyster populations over time

Total length of time required for the lesson:

Initial preparation of materials: 40 minutes

- 10 minutes to prepare oyster populations, only needs to be done once
- 30 minutes to prepare graphs

Total time for lesson: 45-60 minutes, or one class period. Class discussion may lengthen this estimate.

Vocabulary:

- **Fisheries science**: Fisheries science includes the study of the biology of marine species, marine food webs, the number of animals you can catch, the size of the animals you catch, the amount of money people earn catching and selling seafood, and the laws that say what you can keep when fishing (ex: fish, oysters, crabs)
- **Overexploitation**: using a resource too much to the point it can no longer replace itself (common with animals and forests)
- **Quantitative**: something that can be measured or counted using numbers
- **Gametes:** special cells used in reproduction
- **Spat:** oyster larvae that have permanently attached to a hard surface (ex: oyster shell, rocks, concrete, etc.)
- **Socioeconomic:** the social (family, education, community) and economic (money and resources) factors that influence a person's life
- **Patent tong**: a claw-like tool to grab oysters at the bottom of water
- **Sample:** a subset of individuals from a larger population
- **Population:** the entire group of individuals
- **Frequency**: the number of times an observation has been recorded. This is plotted on a histogram.
- **Histogram:** a type of chart that shows the frequency of measurements across a range of numerical values. Those measurements are grouped into bins that are arranged along the x-axis.
- **Bin:** A range of numeric values
- **Bin boundary:** The upper and lower limits of a bin
- **Left bin boundary:** The lower limit of a bin
- **Length frequency distribution:** A histogram showing the number of individual animals of a sample in each length bin. This is commonly used in fisheries science.

Background Information:

The eastern oyster (*Crassostrea virginica*) has played an important ecological, and cultural role in the Chesapeake Bay and its estuaries for over 10,000 years. Natural oyster populations have been negatively affected by a combination of diseases, overexploitation, decreasing water quality, and habitat loss over the past 150 years. Oysters release their gametes into the water column to be fertilized. Once fertilized, oysters become microscopic, multi-cellular, free-

swimming larvae. Oysters need hard substrate (*e.g.,* oyster shell, rocks, concrete) to settle on to continue growing. Once oyster larvae have settled on a hard substrate, they are called spat.

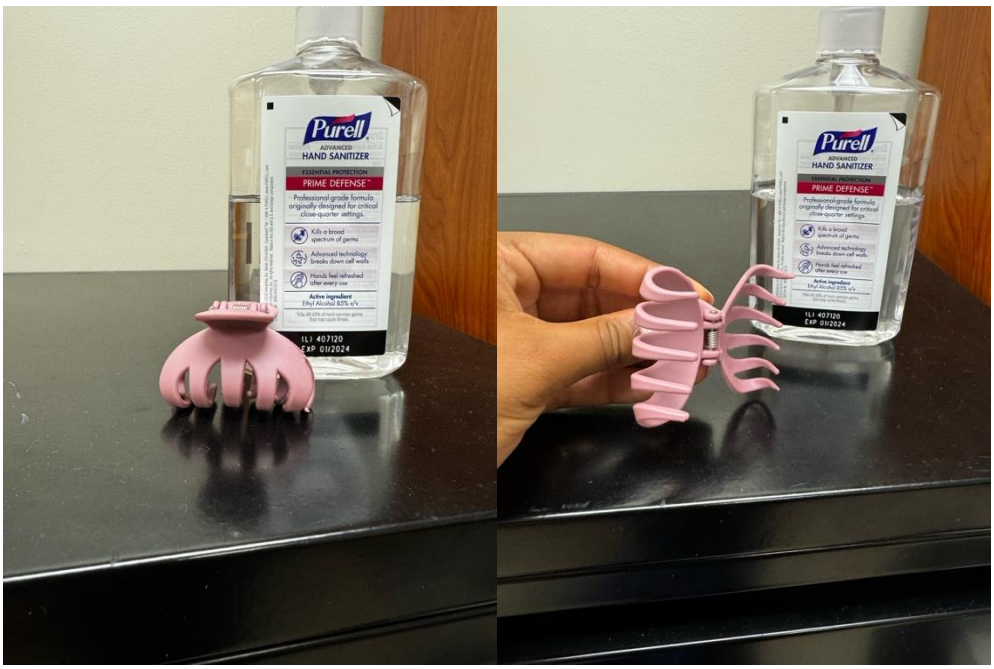
Oyster restoration efforts have targeted population rebuilding since the 1920s. One method of oyster restoration is to collect oyster shells and plant them across Chesapeake Bay so that oyster spat have more hard surfaces to attach to. To monitor the oyster population, VIMS, and the Virginia Marine Resource Commission (VMRC) conduct a yearly survey to measure the size and abundance of the oyster population in Virginia's Chesapeake Bay.

Fisheries science is the study of marine species so that they can be sustainably managed. This includes studying an animal's life history, reproductive strategy, predator/prey dynamics, fishery history, management history (*e.g.,* size and gear limits), and socioeconomic factors that drive the fishery. Many fisheries scientists are quantitative scientists, and their research focuses on statistical modeling and data visualization using long-term surveys.

Materials & Supplies:

- 6 paper plates/bowls (1 per group)
- 30 rulers (1 per student)
- 6 small hair clips (1 per group)*
- 6 Ziploc bags
- 1 lb. bag of dry split peas
- 1 lb. bag of dry black beans
- 1 lb. bag of dry lima beans
- Large wall graphing paper (1 sheet per group)
- Markers
- 6 calculators (1 per group)
- 1 tablespoon measuring spoon

*Reference images of appropriate size hair clips shown below



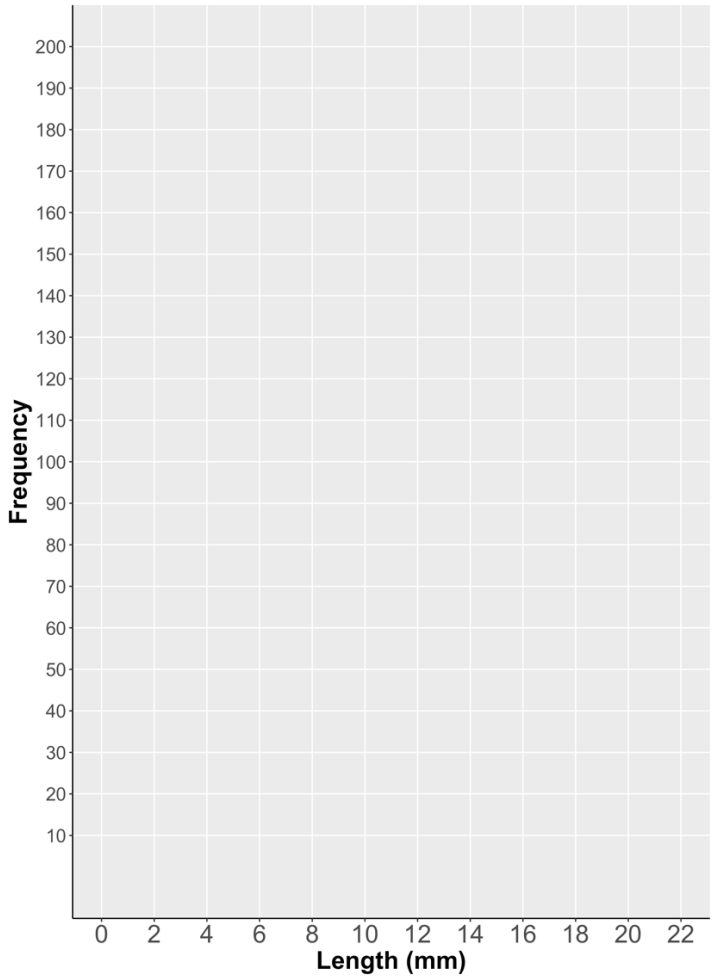
Teacher Preparation:

- Prep each population of oyster spat using the guidelines below. The amount of beans in each row should go in the same bag, with the year labeled on it. Place one hair clip and one paper plate in each bag. Each year represents the oyster population at that time. Each group works with data from different years. This only needs to be done once.

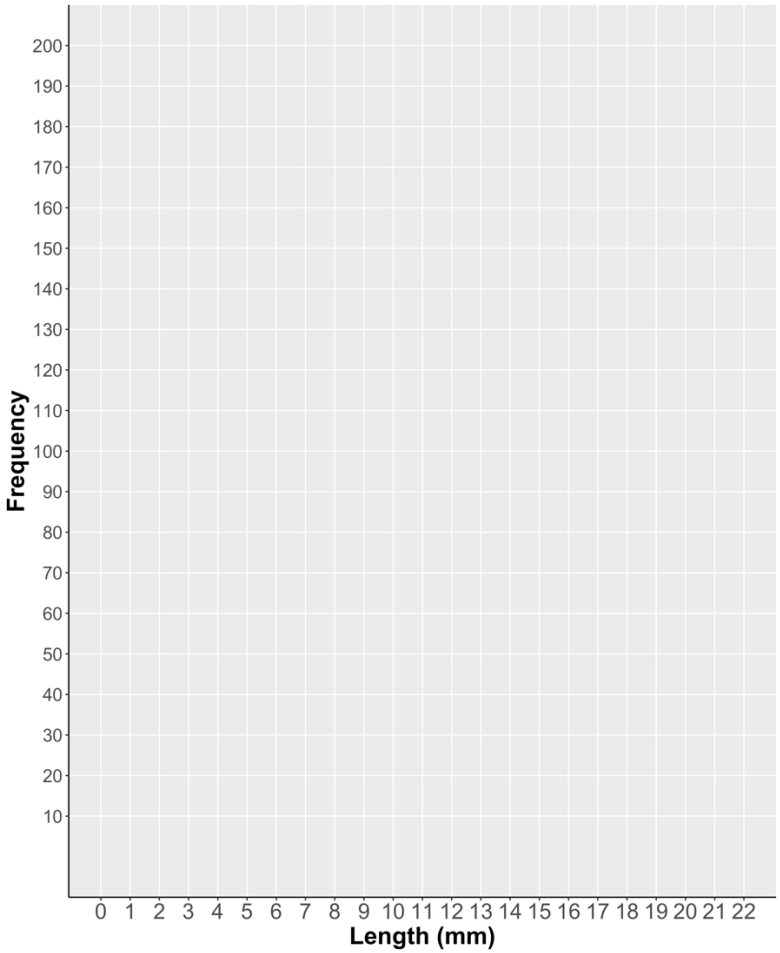
Year	Amt. split peas	Amt. black beans	Amt. lima beans
2006	2 tbsp	1 tbsp	0
2008	3 tbsp	3 tbsp	0
2011	0	4 tbsp	0
2015	4 tbsp	0	0
2020	0	3 tbsp	6 tbsp
2022	0	0	8 tbsp

- Each student gets an individual data sheet to record the lengths of the spat THEY measured (1. Individual Data Sheet [Part 1] and 2. Individual Data Sheet [Part 2]).
- Each group gets a data sheet to organize their data to ease graphing (3. Group Data Sheet).

- Each group gets a large graphing paper to plot their **histogram**. In advance, draw the axes as shown below. Leave room underneath the x-axis so students can write their observations.



- If taking the **dot plot** approach, draw the axes as shown below. Leave room underneath the x-axis so students can write their observations.



Procedure:

1. Split the class into six groups.
2. Introduce the problem, the field of fisheries science, the definition of spat, and show the video of a patent tong [Slides 3-8].
3. Distribute the population bags to each group and individual data sheets (1. Individual Data Sheet [Part 1]) to each student [Slide 9].
4. Discuss directions for the sampling portion of the activity and guide students through sampling and measuring each oyster [Slide 9-10].
    a. Students should remove the hair clip and paper plate from their bag but **keep the beans in the bag.**
    b. One student in each group should reach into the bag with the hair clip (patent tong), grab a sample of beans (oysters), and place their sample on their paper plate. Repeat for their second sample (a different student can do this if they want)
    c. Each group should work as a team to measure all the beans (oysters) in their sample. **Each student** should round their measurements to the nearest whole mm on their individual data sheet (1. Individual Data Sheet [Part 1]).
    d. Refer to slide 10 for a demonstration of how to measure beans with a ruler.

5. Allow the class to finish measuring their beans and recording their data. Once complete, ask the class to brainstorm why they can't use a bar chart for this activity [Slide 11]
    a. Reveal the bar chart vs animation figure
    b. Briefly discuss bar charts vs histograms, emphasizing that **bar charts are for categorical data and histograms are for numerical data.** Since we are looking at the size of oysters over time, histograms are a better fit.
6. Dissect the anatomy of a histogram [Slides 12-13]. Emphasize the following key components:
    a. Frequency [Slide 12]
    b. Informative title [Slide 12]
    c. continuous x-axis [Slide 12]
    d. bins [Slide 12]
    e. bin boundaries (left and right) [Slide 13]
    f. length frequency distributions are synonymous with histograms in fisheries science [Slide 13]
7. Walk students through the examples to take the data from their individual data sheets and consolidate them into 2-mm size bins [Slides 14-20].
    a. Make sure to emphasize that values on the bin boundary will be placed in the **left** bin boundary *(i.e.,* a 6 mm oyster belongs in bin 6-8).
    b. Recommend using tally marks on their data sheet.
8. Hand every student an Individual Data Sheet Part 2 (2. Individual Data Sheet [Part 2]).
9. Give students time to place their individual measurements into the appropriate bins [Slide 21].
10. Pass out 1 group data sheet to each group (3. Group Data Sheet) [Slide 21].
11. Instruct students to sum the frequencies in their individual bins (2. Individual Data Sheet [Part 2]) in the "Scratch Work" column on their group data sheet (3. Group Data Sheet). Then, record the sum in the "Total Frequency" column on their group data sheet (3. Group Data Sheet). [Slide 21].
12. Pass out one large graphing sheet to each group [Slide 22].
13. Instruct groups to plot the data from their group data sheet onto their assigned large graphing paper [Slide 22]. Students can make a first draft on loose leaf paper first if needed (4. Draft Histogram Sheet)
    a. Instruct them to write an "informative title" (described in slide 12) on their large graphing sheet
    b. Instruct them to write 2-3 observations they can make from their group's histogram
14. Hang completed histograms around the room in chronological order [Slide 22]
15. Each group should briefly present their observations to the class and discuss long-term trends [Slide 23]
16. Optional: Ask students to hypothesize what could be driving the changes seen in the oyster population over time [Slide 23]
17. Optional: Reveal factors that are currently influencing the oyster population [Slide 24]

Assessment:

Students will be assessed on their completion of the data sheets, their contribution to their group histogram, and their participation in the group discussion at the end of the class.

Handouts/Worksheets:

Name: _____ Group (Year): _____ Date:_____

Individual Data Sheet (Part 1)

Fill in this table to keep track of your data. Every row may not be used.

Oyster	Length (mm)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
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36	
37	
38	
39	
40	
41	
42	

Name: _____ Group (Year): _____ Date:_____

Individual Data Sheet (Part 2)

Refer to your Individual Data Sheet (Part 1). Count the frequency of measurements in each of the following bins.

Note: values on a bin boundary will be assigned to the left bin boundary

Examples:

- A 5 mm oyster is in bin “4-6”
- A 4 mm oyster is in bin “4-6”
- A 6 mm oyster is in bin “6-8”

Bin (mm)	Frequency
0-2	
2-4	
4-6	
6-8	
8-10	
10-12	
12-14	
14-16	
16-18	
18-20	
20-22	

Group (Year): _____ Date:_____

Group Members: _____

Group Data Sheet

As a group, total your frequencies in each bin and record them in the table below. List each member's frequencies in the correct row and then add them.

Examples:

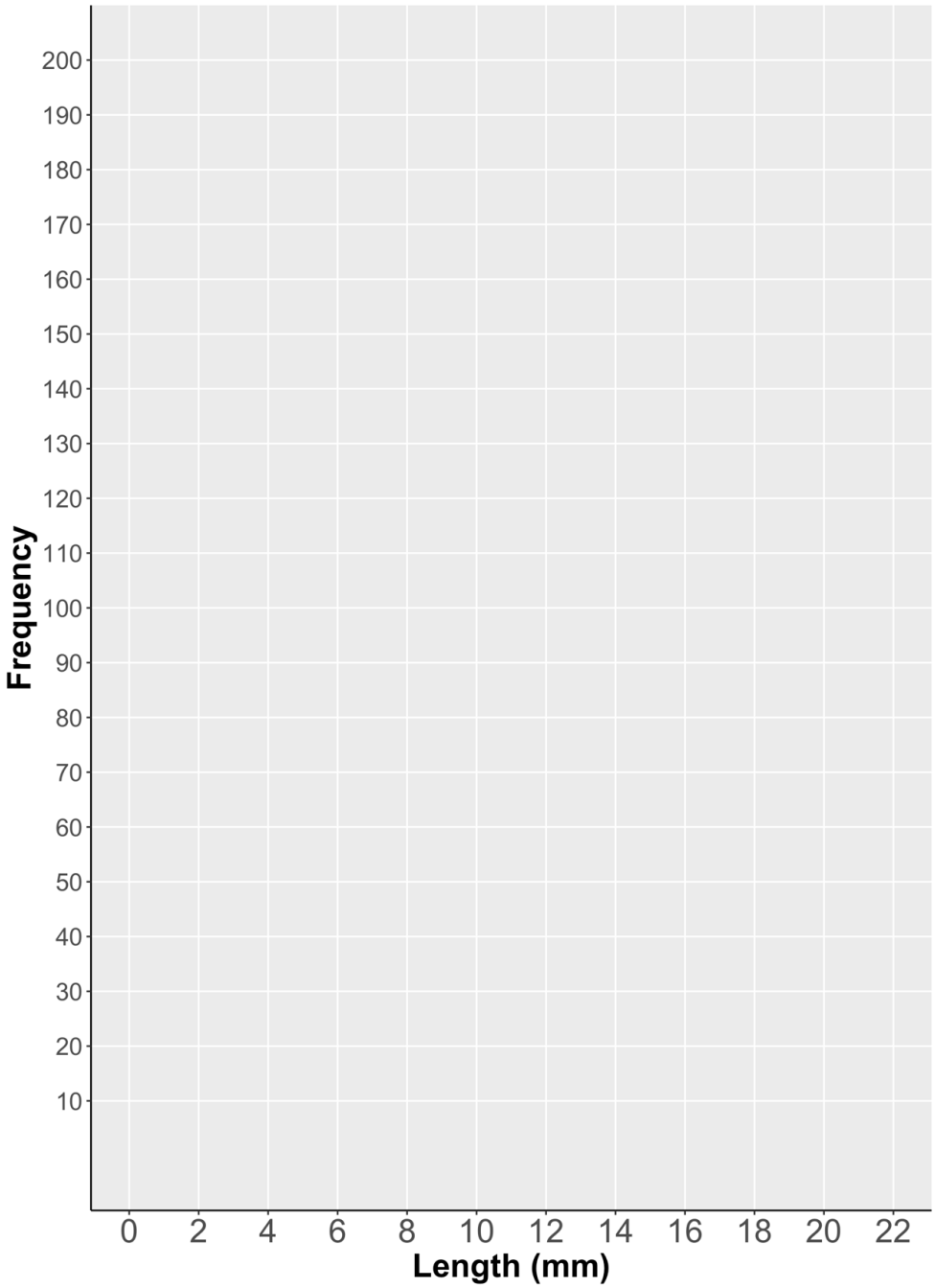
Bin (mm)	Scratch Work	Total Frequency
0-2	10 + 3 + 19 + 8 = 40	40

Bin (mm)	Scratch Work	Total Frequency
0-2		
2-4		
4-6		
6-8		
8-10		
10-12		
12-14		
14-16		
16-18		
18-20		
20-22		

Group (Year): _____ Date:_____

Group Members: _____

Draft Histogram


Frequency
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
22
Length (mm)

Answer Keys:

The following answer keys are examples for what student data sheets and histograms may look like but are not exact and answers will vary.

Name: _____ Group (Year): 2006 Date:_____

Individual Data Sheet (Part 1)

Fill in this table to keep track of your data. Every row may not be used.

Oyster	Length (mm)
1	6
2	5
3	4
4	5
5	3
6	6
7	4
8	4
9	3
10	7
11	3
12	6
13	8
14	4
15	5
16	8
17	6
18	8
19	3
20	7

21	7
22	4
23	6
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	

Name: _____ Group (Year): _____ Date: _____

Individual Data Sheet (Part 2)

Refer to your Individual Data Sheet (Part 1). Count the frequency of measurements in each of the following bins.

Note: values on a bin boundary will be assigned to the left bin boundary

Examples:

- A 5 mm oyster is in bin “4-6”
- A 4 mm oyster is in bin “4-6”
- A 6 mm oyster is in bin “6-8”

Bin (mm)	Frequency – *this section could be recorded as tally marks*
0-2	0
2-4	4
4-6	8
6-8	8
8-10	3
10-12	0
12-14	0
14-16	0
16-18	0
18-20	0
20-22	0

Group (Year): 2006 Date: _____

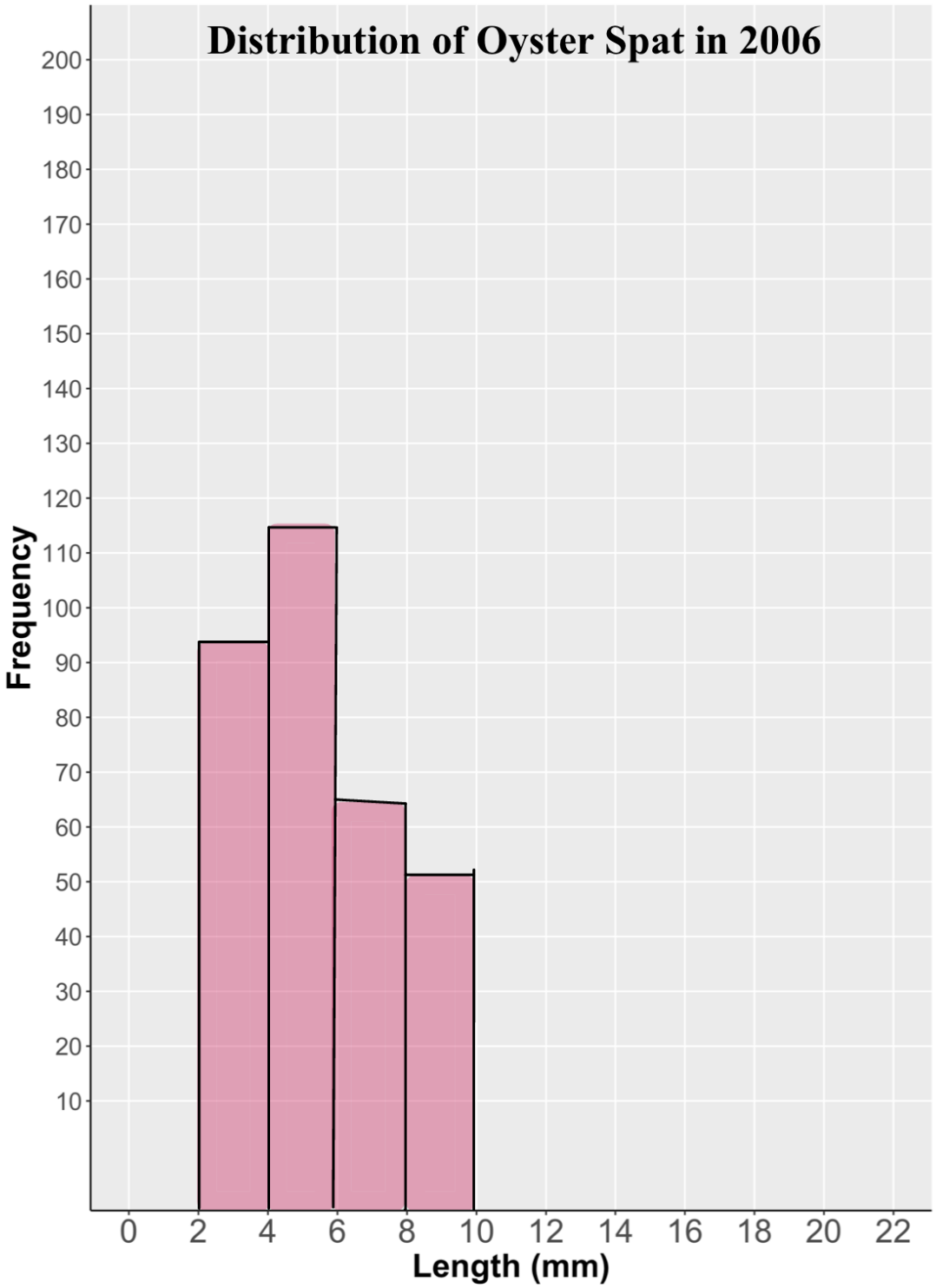
Group Members: _____

Group Data Sheet

As a group, total your frequencies in each bin and record them in the table below.

Bin (mm)	Scratch Work	Total Frequency
0-2		0
2-4	20 + 15 + 18 + 22 + 17 = 92	92
4-6	25 + 30 + 18 + 21 + 20 = 114	114
6-8	12 + 8 + 15 + 10 + 18 = 63	63
8-10	10 + 8 + 12 + 6 + 15 = 51	51
10-12		0
12-14		0
14-16		0
16-18		0
18-20		0
20-22		0

Example histogram from the data above, including a descriptive title and interpretation:



- Majority of oysters are between 4 and 6 mm
- The spat population in 2006 is mostly small sized

Reference histograms for each year (group):