FISH ENGINEERING: BUILDING HOMES & HABITATS

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Grade Level
4th Grade

Subject Area
General Science

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.

National Science Foundation

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CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

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VIRGINIA INSTITUTE OF MARINE SCIENCE

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Title: Fish Engineering: Building homes and habitats

Focus: Constructing, collecting, and graphing data on a keystone species fish that creates habitats for other fish to use.

Grade Level: 4

Virginia Standards of Learning:

4.1 The student will demonstrate an understanding of scientific and engineering practices by

b) planning and carrying out investigations

- take metric measurements using appropriate tools

c) interpreting, analyzing, and evaluating data

- organize and represent data in bar graphs and line graphs
- interpret and analyze data represented in bar graphs and line graphs

d) constructing and critiquing conclusions and explanations

- Use evidence (i.e., measurements, observations, patterns) to construct or support explanations and to make inferences

f) obtaining, evaluating, and communicating information

- read and comprehend reading-level-appropriate texts and/or other reliable media
- communicate scientific information, design ideas, and/or solutions with others

4.3 The student will investigate and understand that organisms, including humans, interact with one another and with the nonliving components in the ecosystem. Key ideas include

a) interrelationships exist in populations, communities, and ecosystems;

c) changes in an organism's niche and habitat may occur at various stages in its life cycle;

Learning Objectives:

Students will:

- ✓ Construct fish nests using materials and guidelines
- ✓ Make observations about nest species, and measure lengths of nests
- ✓ Construct histograms representing nest sizes and abundance of nest species
- ✓ Interpret and analyze graph data
- ✓ Be introduced to ecosystem engineers and keystone species and their impact on the ecosystem

Total length of time required for the lesson: 70 minutes

Preparation for materials: 10 minutes

Vocabulary:

- **Species:** a group of individuals that have similar characteristics and are called a common name.
- **Mutualism:** a type of relationship between the two organisms, where both organisms benefit, and neither is harmed

- **Ecosystem Engineer:** organisms that change or create habitat for others
- **Keystone Species:** organisms that have a huge effect on the environment around them

Background Information:

Bluehead Chubs are a freshwater species in Virginia. They are ecosystem engineers, that build nests by picking up pebbles and rocks with their mouths and forming them into mounds in “safe” places along the creeks. These nests are not only used by chubs, but lots of other species that live in the ecosystem. Scientists are interested in learning the roles these ecosystem engineers play in their habitat, how many species use the nests, and how important bluehead chubs are for other species' survival. This mutualistic interaction between chubs and other fish species provides a protected space for fish to lay their eggs. Scientists have found a direct relationship between the size of the nest and the number of species that use the nest, as well as a direct relationship between number of species that use the net, and egg survival. Because of this bluehead chubs are not only ecosystem engineers but keystone species that help determine the success of many other fishes, making them important for the ecosystem.

Materials & Supplies:

- ✓ Clothes pins (1 per student)
- ✓ 1” Pompom balls (30 per student)
- ✓ Colored pencils/markers
- ✓ Rulers
- ✓ *Optional:* googly eyes (1 pair per student) & glue (if needed for googly eyes)

Teacher Preparation:

This activity can be done in groups or individually.

Each student should have a clothespin and googly eyes. Each student should have a *Nest Data Worksheet.* If you choose to have the students complete a histogram individually instead of together as a class, each student should have a *Histogram Handout.*

Shareables: colored pencils/markers, glue, pompoms (roughly 30 per student), and rulers/calipers

Procedure:

Step 1: (Slides 1-7) Give a brief overview of bluehead chubs and their role in the ecosystem. Describe what the bluehead chub looks like and how it builds the nests. ~ 10 minutes

Step 2: Optional Video to play (after Slide 7): https://www.youtube.com/watch?v=5500PjlqfgI ~2.20 minutes


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Step 3. (Slide 8) Describe the characteristics of the bluehead chub. Have the students create their bluehead chubs by attaching/drawing eyes onto the clothespin and coloring it accordingly. This can be done with markers, colored pencils, paint, etc. The eyes can be googly eyes (either ones with adhesive backs or glued on) or eyes can be drawn on. Please choose whichever works best for your student's capabilities and attention span. ~ 10 minutes

Step 4. (Slide 9) Have the students build a nest by using their bluehead chub clothespins to grab “rocks” (pompoms) as fast as they can. You can time the students 60 seconds with this activity to make it fun and simulate the urgency of building a nest with predators around, bad weather coming, etc. ~60 seconds

Step 5. (Slide 10, Nest Data Worksheet) Have the students record data on their nests using the handout. They need to measure the height and width using a ruler or caliper. Feel free to measure using whatever units match your students’ skill level. This is where you can tell them to be careful not to disturb the nest or move any pebbles, so they have accurate measurements, just like the scientists! Next have the students get an estimate of area by counting and recording how many pompoms were in their nests. A

screenshot of the data table on their worksheet is provided on the slide in case you need to walk them through it. ~15 minutes

Step 6. (Slide 12, Nest Data Worksheet, Nest Data Outcomes) As a class tally up the data and make a histogram reflecting the number of pebbles per nest. If you have a smartboard, you can fill in the outlined histogram in the PowerPoint, otherwise use a whiteboard/chalkboard to make the histogram. Optionally, the *Histogram Handout* is provided for students to fill in their own as the class fills it in. Do not forget to fill in a title and the numbers for the x and y axis. These are left blank as it will vary from class to class. For the x-axis, you can follow the measurement ranges used in the *Nest Data Outcomes* sheet or adjust according to your class's data. If time allows histograms for length and width of nest can be made. ~ 15 minutes

Step 7. (Slide 12, Nest Data Outcomes) Drumroll please! This is where you can make it fun. Award the student who had the most "pebbles" (pompoms), tallest nest, etc. Using the *Nest Data Outcomes* sheet, tell the class the number of species that would be in each size range of nests using the guide. This chart does not use real data but is proportional to real data sets. Feel free to adjust "number of pebbles" as needed for your class's data, it should reflect the x-axis ranges in the histogram. ~ 15 minutes

Step 8. (Slide 13, Nest Data Worksheet) Talk through the discussion questions with the class. Have the students use their critical thinking skills to make inferences about the data and answer the questions. The discussion questions will also be on the *Nest Data Worksheet* for the students to fill in individually if wanted. ~ 5 minutes

Assessment:

Collect students' handouts and assess participation and performance based on class engagement, accuracy, and critical thinking skills.

References:

Support for the lesson plan was provided by the Virginia Scientists & Educators Alliance. Scientific contributions were made by Madison Betts.

Worksheets/Handouts:

1. Nest Data Worksheet, Nest Data Worksheet Answer Key
2. Histogram Handout (Optional)

Teacher Documents:

1. Nest Data Outcomes

Nest Data Worksheet

Name:

Date:

Directions: Measure and record data on your fish nest using your ruler or caliper and the data table below. Do not forget to write down the units of measurement.

Data Table

Variable	Measurement/Count	Units
Height		
Width		
Area (# of “pebbles”)		

Class Discussion Questions

1. What do you think will happen to the number of species on the nest as the nest size increases? What if it decreases?

2. Do you think bluehead chubs affect other fish populations? Why or why not?

3. Do you think bluehead chubs are keystone species? Why or why not?

Nest Data Worksheet Answer Key

These questions can be answered as a class or written individually. Here are some guiding answers as the students think about the questions.

Class Discussion Questions

1. What do you think will happen to the number of species on the nest as the nest size increases? What if it decreases?

As the nest size increases, the number of fish in the nest will increase. If the nest is smaller, the number of species able to use the nest will be less.

2. Do you think bluehead chubs affect other fish populations? Why or why not?

Yes. If other species depend on the bluehead chub's nest to lay their eggs, if there are no nests, that may affect other species' ability to reproduce.

3. Do you think bluehead chubs are keystone species? Why or why not?

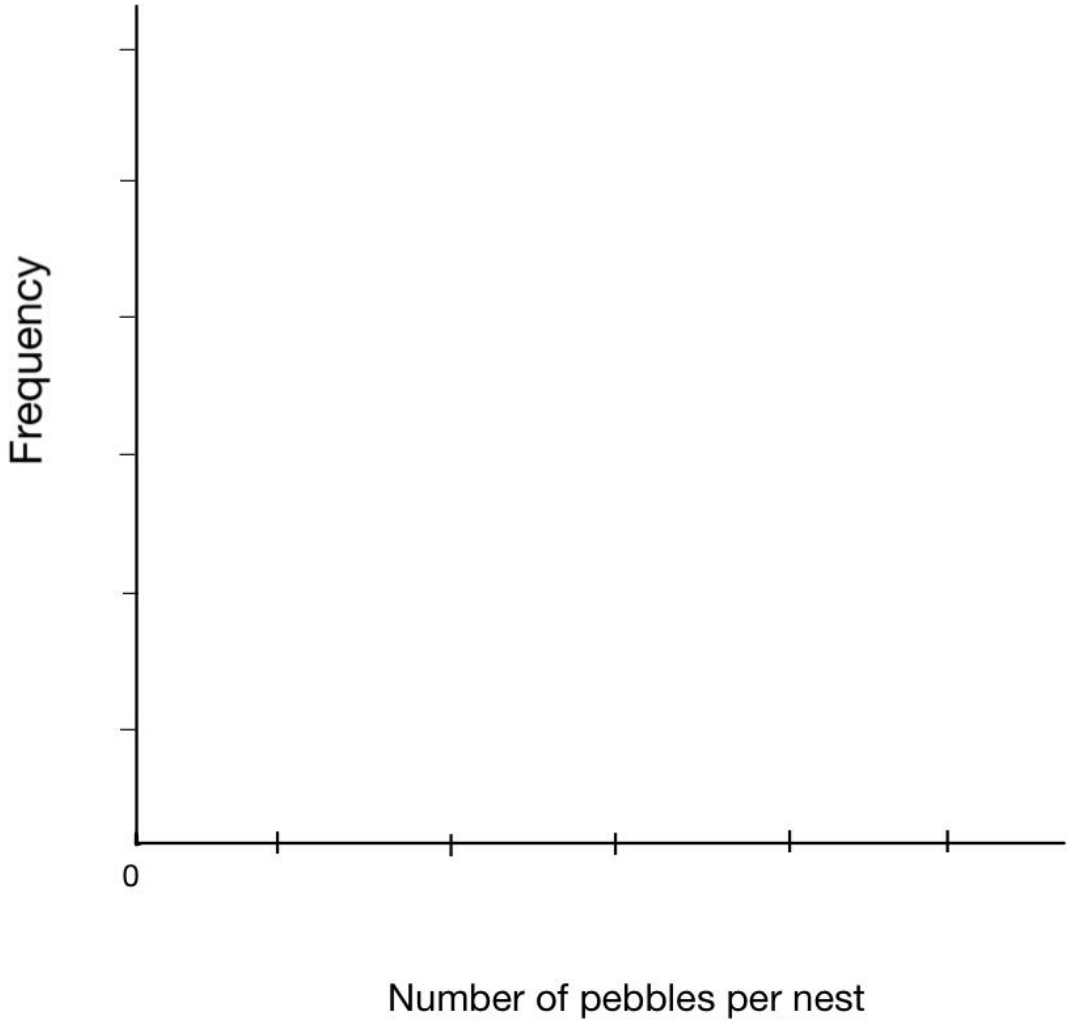
Yes, bluehead chubs seem to have a significant impact on other species in their habitat, which would qualify them as keystone species.

Histogram Handout

Name:

Date:

Title:



Nest Data Outcomes

Directions: Give awards to students with the tallest nest, most pebbles used, etc. Read out the chart below to let students know how many fish would have used their nest and how many eggs would have been laid on their nest.

This chart does not use real data but is proportional to real data sets. Feel free to adjust the "number of pebbles per nest" range as needed for your class's data. It should reflect the x-axis range in your histogram.

Number of pebbles per nest	Number of fish on nest	Number of eggs laid on nest	Number of species
1-10	5	2,000	4
11-20	23	9,200	10
21-30	46	18,400	25
30+	60	24,000	40