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Digesting Data - Subjects: Life Science / Biology Grade Level: 6-8

Amanda Bromilow
Virginia Institute of Marine Science

DIGESTING DATA

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Grade Level
Middle School

Subject area
Life, Environmental or Marine Science

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Focus: Predator-Prey Interactions: The Influence of Predators on Prey Population Dynamics

Subject: 7th Grade Life Science

VA Science Standards addressed:

(SOLs can be found at www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml)

LS.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which:

a) data are organized into tables showing repeated trials and means;
c) triple beam balances and electronic balances, thermometers, metric rulers, graduated cylinders, and probeware are used to gather data;
h) data are organized, communicated through graphical representation, interpreted, and used to make predictions;
i) patterns are identified in data and are interpreted and evaluated.

LS.8 The student will investigate and understand interactions among populations in a biological community. Key concepts include the relationship between predators and prey.

Learning Objectives:

- ✓ Students will measure the mass of their prey items using a triple beam balance.
- ✓ Students will identify the most important prey item for their fish species by creating a bar graph of the prey item masses.
- ✓ Students will draw conclusions about the predation impacts of their fish species on the blue crab population.

Total Time Required: 1 hr

Vocabulary:

Definitions are offered for terms that are included in the standards of learning, in addition to specialized vocabulary relevant to the lesson.

- **Population** – A group of individuals of the same species inhabiting the same area. Adapted from www.dictionary.com.
- **Mass** – A measure of how much matter is in an object or organism. Adapted from www.dictionary.com.
- **Bar graph** – A graph that uses columns of different heights to show and compare different amounts. Adapted from www.dictionary.com.
- **Predator/Predation** – An animal that obtains its energy by eating other animals; the act of one animal eating another. Adapted from www.dictionary.com.
- **Watermen** – People who make their living from the water, as by fishing. Adapted from www.merriam-webster.com.
- **Juvenile** – Refers to blue crabs < 60 mm carapace width. Adapted from http://dnr2.maryland.gov.
- **Plankton** – The very small organisms (plants and animals) that float or drift in great numbers in bodies of salt or fresh water. Adapted from www.dictionary.com.

Background Information:

The instructor should read the introduction of the activity worksheet (Appendix I) for background on the research purpose. Scharf and Schlight (2000) provides further background information on the stomach analysis procedure and how the data are used to understand changes in prey populations (see references below). The predator diets analyzed in this activity are based on estimates of relative prey abundances seen in ongoing research at the Virginia Institute of Marine Science. Red drum and striped bass are well-known predators of juvenile blue crabs such that blue crabs are likely to make up a large portion of their diets, having a relatively large impact on the blue crab population (Orth et al. 1999; Scharf & Schlight 2000; Overton et al. 2009). Atlantic croaker also consume juvenile blue crabs, but crabs make up a much smaller proportion of their diet such that croaker have a relatively small impact on the blue crab population (Orth et al. 1999). Atlantic menhaden are filter-feeders so they do not consume blue crabs at all and therefore do not have any impact on the blue crab population in terms of predation (Murdy et al. 1997).

Student Handouts:

- ❒ Digesting Data Worksheet (Appendix I)

Materials:

- ❒ Play-Doh (4 colors)
- ❒ Beads (3 different shapes/colors)
- ❒ Paper plates/plastic trays
- ❒ Plastic knives
- ❒ Triple beam balances

Classroom Set-up:

Large working tables for groups of students are ideal. There should be plenty of space at each table for students to use a triple beam balance.

Procedure:

1) **Advance preparation of materials:** 15 mins
   - First, identify a bead color or shape for each prey type: crab, fish, and plankton. The bead color or shape will need to be specified on the Dissecting Data Worksheet by editing the Word document (Appendix I). Separate the beads into small piles with the appropriate prey item ratios for each fish species as follows:

Red drum:	70-100% crab	0-30% fish	0% plankton
Striped bass:	50-80% crab	20-50% fish	0% plankton
Atlantic croaker:	10-30% crab	70-90% fish	0% plankton
Atlantic menhaden:	0% crab	0% fish	100% plankton

   Note: The ratios for red drum, striped bass, and Atlantic croaker are approximate and there should be some variation from stomach to stomach. If using standard beads of different colors, ratios can be determined by number; however, if using different bead shapes, ratios should be determined by weight to account for weight differences between bead shapes.
   - Next, identify a Play-Doh color for each fish species, and mold bowls out of the Play-Doh for the stomachs. Fill each bowl with the appropriate ratio of prey item beads for the fish species and pinch the bowl closed to make the stomach. Depending on class size, the instructor may choose to make a stomach for each individual student or have students work together in pairs. The species colors will need to be accurately identified on the worksheet by editing the Word document (Appendix I).

2) **Lab Set-up:** 5 mins

   Set out triple beam balances, dissecting trays (paper plates), scalpels (plastic knives), and the Play-Doh stomachs.

3) **Introduction:** 5 mins
   The instructor may choose to create a PowerPoint presentation to briefly introduce predator-prey interactions. Otherwise, the instructor may read through the introduction and directions on the worksheet, or have the students read through it on their own. The instructor should demonstrate how to properly use a triple beam balance if they have not yet done so.

4) **Activity/Assessment:** 15 mins

Pass out the Digesting Data Worksheet to each student. Each student (or pair) will receive a fish stomach to dissect. Students will identify their fish species based on the stomach color, and then cut open the stomach with the scalpel and collect the prey items. Students will then separate their prey items based on bead shape/color using the key on the worksheet. Then, using the triple beam balance, students will measure the mass of each group of prey found in their fish, record their data, and make a bar graph of the prey masses on the worksheet. Students will use this graph to answer the following questions:

1. What is the most important prey item for your fish?
2. Do you think your fish species could have an important impact on the blue crab population? Why or why not?

The answers to these questions are dependent on the species examined. Blue crabs are typically the most important prey item for red drum and striped bass; Atlantic croaker and Atlantic menhaden feed primarily on fish and plankton, respectively. Red drum and striped bass are most likely to have important impacts on the blue crab population because they feed more heavily on juvenile blue crabs than croaker or menhaden.

5) **Discussion:** 10 mins

When the worksheets are complete, have students discuss their findings and their conclusions as a class or in groups. The instructor should facilitate the discussion and may ask additional questions to generate further discussion. Potential questions include:

1. How might fishing of predator species influence the blue crab population?
2. Based on our data, can we conclude that predation by a certain species has caused the blue crab population decline?
3. What other factors, besides predation, might affect the blue crab population?

Instructors may also have students pool their data to look at the means of prey consumption for each predator species to introduce the concepts of variation and replication.

6) **Breakdown & Clean Up:** 10 mins

Have students place their beads back in their fish stomach and pinch it closed again. If the activity will not be done again in the near future, have students put the beads and Play-Doh away in appropriate containers.

References:

Murdy, E. O., Birdsong, R. S., & Musick, J. A. (1997). *Fishes of Chesapeake Bay*. Washington, DC: Smithsonian Institution Press.

Orth, R. J., van Montfrans, J., & Fishman, J. (1999). A preliminary study of predation on blue crabs by three fish predators in a seagrass bed. Virginia Institute of Marine Science. Report to the Virginia Marine Resources Commission. http://web.vims.edu/bio/sav/bluecrabpred/

Overton, A. S., Margraf, F. J., & May, E. B. (2009). Spatial and temporal patterns in the diet of striped bass in the Chesapeake Bay. *Transactions of the American Fisheries Society*, 138, 915-926.

Scharf, F. S., & Schlight, K. K. (2000). Feeding habits of red drum (*Sciaenops ocellatus*) in Galveston Bay, Texas: seasonal diet variation and predator-prey size relationships. *Estuaries*, 23, 128-139.

Appendices:

Appendix I Digesting Data Worksheet

Digesting Data

Introduction: Ms. Bromilow is studying the blue crab, *Callinectes sapidus*, which is an important species in Chesapeake Bay because many people like to eat them. In recent years, the blue crab population has declined and Ms. Bromilow wonders why. She has heard that watermen are finding many juvenile blue crabs in fish stomachs. Ms. Bromilow thinks predators might be eating the young blue crabs, causing the population decline. She decides to collect fishes from seagrass beds to see if they are eating the juvenile crabs that live there, and to determine how important the blue crab might be in their diet.

Instructions: Dissect a fish stomach and identify the prey items within using the key below. There are 4 possible fish species to dissect: striped bass, red drum, Atlantic croaker, and Atlantic menhaden. Use a triple beam balance to determine the mass of each prey type, e.g. all of the fish pieces. Record your data. Graph the mass of each prey type and answer the questions using the data that you collected.

Predator Key:

Striped bass = Blue

Red drum = Red

Atlantic croaker = Yellow

Atlantic menhaden = Green

Prey Key:

Fish = Blue beads

Crabs = Red beads

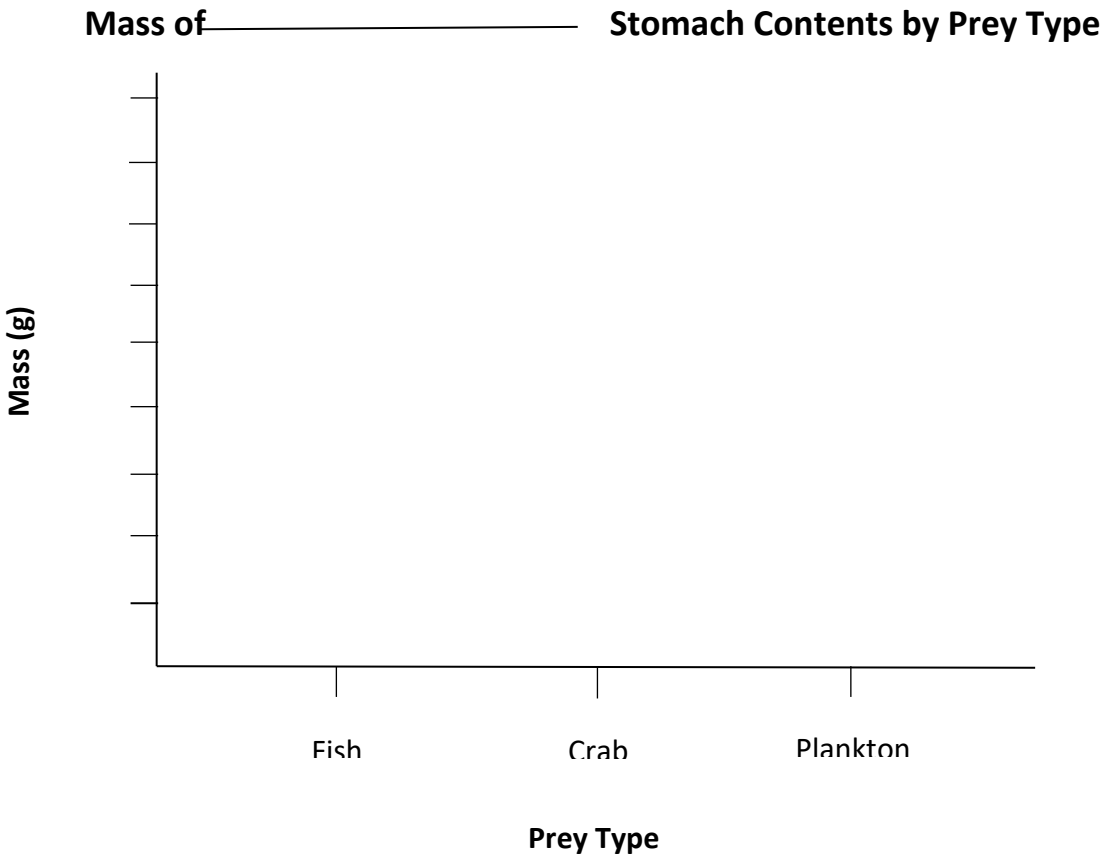
Plankton = Green beads

Record your data:

Species	Fish Mass (g)	Crab Mass (g)	Plankton Mass (g)

Make a bar graph of the mass of each prey type found in your fish's stomach.

Fill in the blank in the title with your species' name.



What is the most important prey item for your fish?

Do you think your fish species could have an important impact on the blue crab population? Why or why not?