

**7th Grade Math Data Visualization (7DVM)**

“*Crab Friend or Foe*?”

Crab Aquarium Challenge

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| **Module Description** | Students model scientific investigation data of blue crab mating and predator events. Students graph the modeled data, analyze rate of change, and reason quantitatively to select the mix of predators that will balance the ecosystem of the aquarium display. The module covers basic GSE concepts in proportional relationships and rate of change.  *Module features the work of Georgia Tech Professor, Dr. Marc Weissburg in the School of Biology on predator-prey behavior mediated by chemical cues.* | |
| **Supported**  **Georgia Standards of**  **Excellence** | ***MGSE7.RP.1*** *Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.*  ***MGSE7.RP.2*** *Recognize and represent proportional relationships between quantities.*  ***MGSE7.RP.2a*** *Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.*  ***MGSE7.RP.2b*** *Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.* | |
| **Module Timeline** | **50-minute class periods:**  5 days  Day 1: Section 1  Day 2: Section 1  Day 3: Section 2  Day 4: Section 3  Day 5: Section 3 & 4 | **90-minute blocks:**  3 days  Day 1: Sections 1  Day 2: Section 2 & 3  Day 3: Section 3 & 4 |
| **Documents**  **Included in the Download** | **Student Materials Folder**   * Student Edition *(recommended to be printed double sided)* * Student Worksheet Packet *(recommended to be printed single sided)*   **Teacher Materials Folder**   * Materials List * Annotated Teacher’s Edition * Teacher’s Preparation Guide * Videos | |

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| **5E Stage** | **Student Activities**  How will students engage actively in the three dimensions throughout the lesson? | **Teacher Activities**  How will the teacher facilitate and monitor student learning throughout the lesson? |
| ***Engage***  How does the lesson capture student interest, activate prior knowledge, and connect to a complex question, global issue, or real world problem? | * Students are introduced to the challenge (recommend the best predators to include in the blue crab aquarium display to maintain a good ecological balance of crabs and predators). *(1.1)* * Students are introduced to a simulation or model of how the blue crab and predators will react in the natural environment. *(1.2)* | * Guide students through text. * Introduce using models to simulate real-life situations. * Facilitate a discussion on their thoughts of the contents of the dropper. *(1.2)* * Facilitate discussion of the meaning of key terms and have students give examples of other food webs, identifying the predator and prey in each. |
| ***Explore***  How does the lesson allow students to develop a common base of experiences by actively investigating the phenomenon or problem? | * Students will investigate the effect that different pheromone concentrations have on how many times the crabs mate, compared with how many times they are eaten by predators through the simulation. *(1.3, 3.1)* * Students separate color counters and record data appropriately. (1.2) * Each group shares their data with the class so that everyone can fill in their data tables. * Students discuss the questions box. *(1.3)* | * Divide students into groups of 3, explain how to conduct the simulation and record the data. * Verify that each member of a group chooses a predator. * Remind students to record their data in the appropriate pheromone concentration % on their data sheet. |
| ***Explain***  How does the lesson allow students to develop, share, critique, and revise their own explanations before connecting those to accepted scientific explanations and terminology? | * Students learn that inconsistent data differences in the table of sea turtle data creates a non-linear relationship. *(2.1)* * Based on the tables and visual graphs, students explain which relationships are linear and which one is non-linear. *(2.2)* * Students learn how to calculate rates of change. *(2.3, 2.4)* | * Facilitate reading and discussion on the basics of linear and non-linear relationships and the corresponding data. *(2.1, 2.2)* * Facilitate class discussions on the different rates of change of the predators and crab mating events. *(2.4)* |
| ***Elaborate***  How does the lesson allow students to extend their conceptual understanding of the three dimensions through opportunities to apply knowledge, skills, and abilities in new experiences? | * Students combine their data, analyze data to look for patterns, and graph data to see the visual representations. *(1.3,3.2)* * Using evidence from their simulation, students will write a recommendation letter. *(4.1)* | * Facilitate class discussion on importance of visualizing data in different ways (tables vs. graphs). *(1.3,3.2)* * Discuss the use of visual data and how viewing all the tables and graphs combined provides multiple representations of rates of change. *(1.3,3.2)* * Letter is scaffolded for students but remind them to include evidence from their data. *(4.1)* |
| ***Evaluate***  How does the lesson—through both formative assessments embedded throughout the lesson and a summative assessment that might coincide with the elaborate phase—make visible students’ thinking and their ability to use practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions? | **Formative:**  Ongoing questioning and discussion. *(all sections)*  *Crab mating event and predator event data. (1.3, 3.1)*  Graphs for data trials. (*1.4, 3.1)*  **Summative:**  Recommendation letter sheet. *(4.1)* | |

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|  | **1.1** | **1.2** | **1.3** | **1.4** | **2.1** | **2.2** | **2.3** | **2.4** | **3.1** | **3.2** | **4.1** |
| **Engage** |  |  |  |  |  |  |  |  |  |  |  |
| **Explore** |  |  |  |  |  |  |  |  |  |  |  |
| **Explain** |  |  |  |  |  |  |  |  |  |  |  |
| **Elaborate** |  |  |  |  |  |  |  |  |  |  |  |
| **Evaluate** |  |  |  |  |  |  |  |  |  |  |  |

**Section 1 – Aquarium Friend or Foe *(110 minutes)***

*The focus of Section 1 is to provide students with a background of the Crab Aquarium Challenge, allow them to collect data through a simulation, and finally to graph their data. Students learn how simulations, or models are used to represent real-life situations and will collect and analyze data in tables and graphs to make recommendations. Additionally, through the Predator/Prey Video, students are presented information about predators and prey and the characteristics of the organisms that will be considered for the aquarium. Students are placed in groups of three and each student will choose a different predator to study. Each team is given a container of red, green, yellow and blue color counters which represent predator or mating events. Each group, having different pheromone percentages, will report their data to the class and all will record it on their data sheet. Students are asked to identify any data trends and then they create coordinate graphs of their data, including a discussion of independent and dependent variables.*

***Preparation***

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| **Materials** | **Student Pages** |
| * Trays * Container with color counters * Aquarium Display Challenge video * Predator/Prey video * Blue Crab/Sea Turtle video | * Mating and Predator Sort Sheet * Mating and Predator Investigation Sheet for Data Trial 1 * Results Graph for Data Trial 1 |
| **Prep the Day Before:**  Review the section and challenge. Review videos. | |

***Planning***

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| **GSE** | ***MGSE7.RP.1*** *Compare unit rates associated with Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.*  ***MGSE7.RP.2*** *Recognize and represent proportional relationships between quantities.*  ***MGSE7.RP.2a*** *Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.*  ***MGSE7.RP.2b*** *Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.* | | |
| **CCSS** | ***CCSS.MATH.CONTENT.7.RP.A.1:*** *Compare unit rates associated with Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.*  ***CCSS.MATH.CONTENT.7.RP.A.2:*** *Recognize and represent proportional relationships between quantities.*  ***CCSS.MATH.CONTENT.7.RP.A.2.A:*** *Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.*  ***CCSS.MATH.CONTENT.7.RP.A.2.B:*** *Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.* | | |
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| **Key Terms and Concepts** | | **Essential Questions** | **Assessment and Grading Opportunities** |
| * Predator * Prey * Model * Food web * Data trends * Data table * Coordinate pair * Independent variable * Dependent variable * Cartesian coordinate graph | | * How do you use proportional relationships to solve real-world problems? * How are models used to solve problems? * How are graphs used to visually represent real world data? | * Discussion Questions: **Participation** * Procedure and data collection: **Formative** * Interpret data and graphs: **Formative** |

**Section 2 – Analyze Mating and Predator Events *(50 minutes)***

*In this section, students will learn how to analyze the differences in data values as well as calculate rate of change. Through the text in* ***Part 2.1,*** *students are given step by step instructions on how to analyze the difference in the data values. Then they are introduced to rate of change where they understand it as a ratio of the difference of the dependent to the independent variables. Additionally, in* ***Part 2.2****, students will understand that a constant rate of change is represented by a linear relationship and that a rate of change that is NOT constant is a non-linear relationship. Students will look at all the graphs in their group to determine which one is non-linear. While reading through the text and working through this section, students will learn that graphs make it easier to understand trends in data and relationships between variables. The text in* ***Part 2.3*** *introduces students to liner relationships with different rates of change and provides step-by -step instructions to determine the rate of change for any two coordinate pairs.* ***Part 2.4*** *students understand that the visual representation or graphs make the data easier to understand and communicate.*

***Preparation***

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| **Materials** | **Student Pages** |
| * N/A | * Mating and Predator Investigation Sheet for Data Trial 1 * Results Graph for Data Trial 1 |
| **Prep the Day Before:**   * Review the section. * Review class discussion questions and possible answers. | |

***Planning***

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| **Key Terms and Concepts** | | **Essential Questions** | **Assessment and Grading Opportunities** |
| * Data table * Consistent * Rate of change * Independent variable * Dependent variable * Cartesian coordinate graph | | * How do we calculate rates of change? * What does the graph of a consistent rate of change look like? * How do I identify the independent and independent variables? | * Discussion Questions: **Participation** * Finding rate of change:  **Formative** |

**Section 3 – Aquarium Habitat #2 *(70 minutes)***

*In section 3, students will conduct another simulation for a new aquarium which contains a different amount of water. The pump in this new tank circulates the water differently as well. Students will perform the simulation again with new data collected from Dr. Weissburg’s lab. In* ***Part 3.1****, students will collect and share the data just like they did for trial 1, recording their new data on* ***Mating and Predator Investigation Sheet for Data Trial 2****. Again, the new data will be shared with the whole class and all can then analyze and graph the data. Students will graph all the predators this time. In* ***Part 3.2****, students will calculate the rates of change for Habitat 2. Students should notice that the crab mating events and the red drum and sea turtle predator events all have the same rate of change with the croaker having a different rate of change.*

***Preparation***

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| **Materials** | **Student Pages** |
| * Trays * Container with color counters for Trial 2 | * Mating and Predator Sort Sheet * Mating and Predator Investigation Sheet for Data Trial 2 * Results Graph for Data Trial 2 |
| **Prep the Day Before**:  • Review the section.  • Review class discussion questions and possible answers. | |

***Planning***

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| **GSE** | ***MGSE7.RP.1*** *Compare unit rates associated with Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.*  ***MGSE7.RP.2*** *Recognize and represent proportional relationships between quantities.*  ***MGSE7.RP.2a*** *Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.*  ***MGSE7.RP.2b*** *Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.* | | |
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| **Key Terms and Concepts** | | **Essential Questions** | **Assessment and Grading Opportunities** |
| * Data table * Rate of change | | * How do visual representations of data help identify trends? | * Discussion Questions: **Participation** * Data tables and graphs 2: **Formative** |

**Section 4 – Answer the Challenge *(30 minutes)***

*The challenge concludes in Part 4.1 with a thorough analysis of the data through the visual representations of the mating and predator events where students should be able to see which predators are attracted to the crab pheromone the most. Using the* ***Recommendation Letter sheet****, each student will independently use their information to write a recommendation letter. This letter will recommend which predators to put in the tank with the blue crab based on their analysis of all their data. Students will provide evidence to support their decisions in their letter while speaking to their new understanding of data visualization through both tables and graphs.*

***Preparation***

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| **Materials** | **Student Pages** |
| * N/A | * Recommendation Letter sheet |
| **Prep the Day Before:**  • Review the section.  • Review class discussion questions and possible answers. | |

***Planning***

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| **CCSS/GSE** | ***CCSS.MATH.CONTENT.7.RP.A.1/MGSE7.RP.1*** *Compare unit rates associated with Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.*  ***CCSS.MATH.CONTENT.7.RP.A.2/MGSE7.RP.2*** *Recognize and represent proportional relationships between quantities.*  ***CCSS.MATH.CONTENT.7.RP.A.2.A/MGSE7.RP.2a*** *Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.*  ***CCSS.MATH.CONTENT.7.RP.A.2.B/MGSE7.RP.2b*** *Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.* | | |
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| **Key Terms and Concepts** | | **Essential Questions** | **Assessment and Grading Opportunities** |
| * Rate of change | | * How can we communicate mathematical and scientific data? * How do tables and graphs of data assist when making decisions? | * Class Discussion Question: **Participation** * Recommendation letter: **Summative** |