**Lesson Title:** The Crow and the Pitcher

**Unit Title:** Linear Relationships

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**Subject, Grade Level, and Date:** Math, 8th Grade, 10/15 1:00-2:00

**Placement of Lesson in Sequence and Lesson Rationale**

This is the 2nd activity for the unit. In the first activity the students will have practiced solving equations for the functions.

**Central Focus and Purpose**

In this lesson students will be learning about the linear relationship between two quantities and then analyzing the results on a graph. In this activity students will be placing marbles into cylinder that is filled with water to see how many marbles it needs for the water can rise.

**CCSS.MATH Content and Practice Standards**

[CCSS.MATH.CONTENT.8.F.B.4](http://www.corestandards.org/Math/Content/8/F/B/4/)

Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x, y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

[CCSS.MATH.CONTENT.8.F.B.5](http://www.corestandards.org/Math/Content/8/F/B/5/)

Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

#### [CCSS.MATH.PRACTICE.MP4](http://www.corestandards.org/Math/Practice/MP4/) Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

**Prior Content Knowledge and Pre-Assessment**

All students are at grade level and can write a linear equation when given a table or graph and can graph a line when give an equation.

**Learning Target(s) and Plan for Clarifying Intending Learning**

* I will be able to work together in a group to collect and record data in a real-life linear function scenario.
* I will be able to work together in a group to determine multiple representations of data including graphs, tables of values, equations, sketches, and written explanations.
* I will be able to work together in a group to recognize slope as rate of change, and y-intercept as the value at time = zero.
* I will be able to work together in a group to determine the equation of a line from data, a table of values, or a graph.
* I will be able to work together in a group to determine the amount of marbles it takes to reach 100Ml.

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| **Strategy for using assessments to guide student learning** | |
| The students will at the end of their trials the students will create an equation based off of their results. Then the students will share their ideas with the class through an oral report.In the end, the teacher will lead a class discussion to review what was learned and revisit misconceptions. | |
| **Success Criteria** (criteria for interpreting student success of the learning target) | **Plan for providing feedback and students’ monitoring of their own learning** |
| The group’s post must display how many marbles the crow needed to add to drink the water,refer to Table of Values,indicate and explain what key points of the graph represent, such as the *y*-intercept, slope, and labels; explain how you determined the equation of the line? explain how your sketch relates to the equation of the line. | The teacher will use the students to facilitate interaction relative to the learning targets. The teacher will give each group written feedback using the rubric as a guide. |

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| **Academic Language Demands** | | |
| **Language Function** | **Vocabulary & Symbols** | **Secondary Language Demand** |
| * Students will **examine** the change in water level as marbles are added to the cylinder * Students will **construct** an equation that represents the data gathered * Students will **explain** the equations that are created * Students will **predict** how many marbles it will take to reach 100mL * Students will **determine** the independent and dependent variables * Students will **identify** domain and range | * Slope * Equation * Graph * Domain * Range * Independent variable * Dependent variable * Function | **Mathematical Precision:**   * Students will label their graph correctly   **Syntax:**   * Students will need to correctly set up an equation that aligns with their data. * Students will need to correctly fill out the table with their data.   **Discourse:**  Teacher to Students:   * Asks questions * Guides class discussions   Student to Student:   * Work together to conduct experiment * Work together to complete the worksheet * Work together to create the poster that represents their data   Student to Teacher:   * Answering questions |

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| **Language Support** (instructional and assessment strategies) | | |
| **Language Instruction** | **Guided Practice** | **Independent Practice** |
| * A word wall with the vocabulary words needed throughout this lesson will be available to the students |  | * Pictures that help represent the meaning of each vocabulary word are provided to assist students in understanding and using the vocabulary. |

**Differentiation, Cultural Responsiveness, and Accommodation for Individual Differences**

In addition to the fable being read to them in class, students will have the option of watching a video of the fable as well to help build understanding. There is a student in my class who is both hard of hearing and partially blind. To accommodate her, she is provided with an earpiece that is connected to a microphone that I use so that she has a better time hearing me. Also, this device records each class so that she has the opportunity to reference it later. She is also given a computer that enhances the lettering of worksheets that she receives in order to make it more visible for her. This student is also given a para-educator to assist her. I differentiate my instruction for this student by providing an extended amount of time to complete each task. I have given her the questions that I will be asking in the lesson ahead of time so that she has time to work on them. That way, she is able to prepare for what will happen in class which will enable her to participate more. I have also given her a partner to work with who I know is patient with her. There are also a few ELL students in my class who I offer a video version of the fable to help ensure understanding. I also provide photos to help describe the definitions of the key vocabulary words.

**Materials – Instructional and Technological Needs** (attach worksheets used)

* Cylinder
* Water
* 10 marbles
* Pencil
* Worksheet
* Poster Paper
* Markers

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| **Instructional Plan** | | |
| **Pacing** | **Teacher Activities** | **Student Activities** |
| 1 minute | Organize students into groups of 3-4 people. | Students get in their arranged groups. |
| 5 minutes | Ask students what they know about Aesop’s fables. Read the fable “The Crow and the Pitcher”. | Students discuss what they know with the class what they know about Aesop’s fables. Students listen to “The Crow and the Pitcher” being read to them. |
| 3  minutes | Post the requirements on the board. Hand out The Crow and Pitcher Rubric so students can refer to the expectations of the activity as they go along. | Students read the rubric to know what is expected of them. |
| 3 minutes | Tell the students that they will conduct an experiment, collect and record data, and use that data to help them predict the number of pebbles it will take to bring the water to drinking level for the crow. | Students listen to directions. |
| 3 minutes | Give each group a graduated cylinder, a container of water, and a bag of marbles (about 10 marbles per group). Distribute the Crow and Pitcher Activity Sheet to students | Students receive given materials. |
| 2 minutes | Instruct students to do the following:   * Fill the cylinder with water to a level of 80 mL. * Add marbles, one at a time, to the cylinder. * Record the results on the table of values.   Inform the students to read the water level by looking at it directly from the side, not slightly above or below. If they notice a curve to the profile of the top of the water, the correct reading is indicated by the bottom of the curve. | Students listen to directions |
| 10 minutes | Teachers monitors student experiments | Students conduct the experiment.   * Fill the cylinder with water to a level of 80 mL. * Add marbles, one at a time, to the cylinder. * Record the results on the table of values. |
| 2 minutes | When all groups have completed the table (and added 6 marbles, one at a time), post the Crow and Pitcher Table of Values document camera and discuss findings. | Students discuss the results of their experiment. |
| 7 minutes | Instruct students to complete the activity sheet | Students work on completing the activity sheet. |
| 3  minutes | Foster a class discussion where students discuss any surprising discoveries. For example: The water will only rise to a certain level before the height of the marbles will exceed the height of the water. | Students discuss any surprising discoveries after completing their activity sheet. |
| 3 minutes | Instruct each group to create a poster including the following components:   * A table of values from their activity sheet. * A graph. * An equation. * A picture that relates the equation to the physical model. * A written explanation. | Students listen to instructions about how to create their poster. |
| 15  minutes | Teacher monitors students as they create their posters. | Students work together in their groups to create their posters. |
| 3  minutes | Lead the conclusion discussion about how results could have been different with different factors involved such as marble size and how that affects the data. | Students discuss how results would be different if the marbles used were larger or if they were “shooter” marbles. Students will explain their responses, describing the changes to the table of values as well as the slope of the graph. |

The Crow and The Pitcher

Lesson received from: <http://illuminations.nctm.org/lesson.aspx?id=3667>

**Rubric**

Rubric for assessment of assignments – **Representing and Explaining Your Formula**

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| CATEGORY | 4: EXPERT | 3: PRACTITIONER | 2: APPRENTICE | 1: NOVICE | SCORE |
| Diagrams and  Sketches | Diagrams and/or sketches are clear  and greatly add to the reader's  understanding. A clear explanation  relates the picture to the equation. | Diagrams and/or sketches are clear and easy to  understand. An  explanation of the patterns in the problem is given. | Diagrams and/or sketches are  somewhat difficult to understand or  limited in nature.  Explanation is poor or missing. | Diagrams and/or sketches are  difficult to  understand or are not used. |  |
| Table of Values | Table of values is correct, complete,  and organized and  includes all values requested in the  problem. Table is labeled properly. | Table of values is correct, and  organized and  includes most values requested in the  problem. Table is labeled properly. | Table of values is included but is  incomplete and/or incorrect. | Table of values is incorrect or difficult to understand, or is missing. |  |
| Graph | Graph is correct, complete, neat, and  organized. Graph is labeled and  numbered properly.  Correct decisions are made regarding  scale | Graph is correct, complete, neat, and  organized. There are minor problems  with labeling, numbering, or scale, | Graph has some minor errors, and /or is not labeled or numbered properly. | Graph has major mistakes in values or labeling or numbering or scale. |  |
| Equation | Equation is correct, and there is a thorough  explanation making connections  between the parts of the equation and the elements in the problem. | Equation is correct, but is not correctly or thoroughly explained. | Parts of the equation are  incorrect or not properly explained. | The equation is completely  incorrect or missing. |  |
| Written Explanation | Explanation is detailed and clear  and greatly adds to the reader’s  understanding of the problem. It answers all questions posed in the problem. | Explanation is clear and answers all of  the questions posed in the problem. | Explanation is somewhat difficult to understand, but includes critical components. | Explanation is difficult to  understand and is missing several  components or was not included. |  |
| Neatness and  Organization | The work is presented in a neat, clear, organized  fashion that is easy to read and eyecatching. | The work is presented in a neat and organized fashion that is usually easy to read. | The work is presented in an  organized fashion  but may be difficult to read at times. | The work appears sloppy and  unorganized.  Conclusions are not clear to the reader. |  |

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**The Crow and the Pitcher** NAME\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In this activity, you will simulate the story of “The Crow and the Pitcher” using a graduated cylinder and marbles.

Fill your graduated cylinder with 80 mL of water. You will be adding marbles until the water reaches a level of at least 100 mL—the level at which the crow can reach the water.

**1.** Before you begin the activity, make a prediction:

I believe that I will need to add \_\_\_\_\_\_\_\_ marbles in order to raise the water level to 100 mL.

**2.** Add the marbles one at a time and record the effect that each additional marble has on the water level. Complete the table.

|  |  |
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| NUMBER OF MARBLES (*x*) | WATER LEVEL (ML)  (*y*) |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |

**3.** What is the water level with no marbles added? Where will this point be located on a graph made from the data in the table?

**4.** Find the rate of change. What values are changing in the experiment? Which value change is dependent and which is independent?

**5.** How many marbles must be added to reach a level of 100 mL? How did you determine this?

**6.** How would you determine how many marbles are needed to reach any given level of water in the cylinder?

**7.** Continue adding marbles to the cylinder. Did anything unexpected occur? Describe your observations.

**8.** What are the limitations or restrictions on the number of marbles and on the level of the water?

**9.** Use your answers to Question 8 to identify the possible domain and range for the relationship between the number of marbles and the water level.

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