

Precipitation Towers: Modeling Weather Data

Brandy A. Bermudez

Violet E. Millington

Math Connections in the STEM Classroom

### Introduction

Using the lesson, [Precipitation Towers](#) from the NASA Jet Propulsion Laboratory, students will stack cubes (Lego bricks or Unifix cubes) as a way to model precipitation data. Students will then compare the precipitation ranges and seasonal patterns for New Brunswick, New Jersey and Annapolis, Maryland. In order for the data to have meaning, students must understand the relationship between the data and the display of the stacked bricks/cubes. This is a single lesson, approximately 40-50 minutes, for kindergarten students.

### Engaging Context

Students will be able to model the natural phenomena of precipitation through the use of Lego/Unifix cubes. This activity will allow students to make sense of a real world scenario, identify important details, and model the situation to answer mathematical problems.

“Scientists study moisture, rain, snow, and other forms of precipitation in the atmosphere. They study how they interact and how they behave in bigger weather and climate systems. These observations are detailed enough to allow scientists to distinguish between rain, snow and other precipitation types, as well as observe the structure, intensity and dynamics of storms. These data are then fed into the weather forecast models that meteorologists use to issue weather warnings, which can improve the health and safety of people on the ground” (NASA-Goddard Space Flight Center).

### Measurable Objectives

- Students will be able to graph precipitation data using Lego or Unifix cubes.
- Students will be able to identify the precipitation ranges and seasonal patterns in Annapolis, Maryland and New Brunswick, New Jersey for 10 out of 12 months (83% accuracy).
- Students will be able to compare the precipitation ranges and seasonal patterns between Annapolis, Maryland and New Brunswick, New Jersey for 10 out of 12 months (83% accuracy).

### Standards

#### Common Core State Standards (CCSS)

- K.MD.A.2 -Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. *For example, directly compare the heights of two children and describe one child as taller/shorter.*

#### New Jersey State Learning Standards (NJSL)

- K.MD.A.2 - Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.

#### Next Generation Science Standards (NGSS)

- K-ESS2-1 : Analyzing and Interpreting Data
  - Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
    - Use observations (firsthand or from media) to describe patterns in

the natural world in order to answer scientific questions.

### Materials Used to Model Mathematics

- [GPM: Too Much, Too Little | Precipitation Education](#): Researchers need accurate and timely rainfall information to better understand and model where and when severe floods, frequent landslides and devastating droughts may occur.
- NASA's Global Precipitation Measurement (GPM) satellite's global rainfall data will help us to better prepare and respond to a wide range of nature.
- US Climate Data website for finding precipitation totals for different cities.
- Lego bricks/Unifix cubes

### Collection of Student Evidence

Prior to watching the video, [GPM: Too Much, Too Little | Precipitation Education](#), teachers will discuss the water cycle, using NASA's, [Water Cycle Map](#) and provide information about precipitation.

“Precipitation happens when any form of water – liquid or solid – falls from the atmosphere down to Earth’s surface. The amount of water that’s deposited from the sky to the ground is not the same throughout the world, a country, or even a city. Some places get rain or snow (or some other form of precipitation, such as hail or sleet) fairly consistently all year, while others may have strong seasonal patterns.” (NASA - Jet Propulsion Laboratory).

For this lesson, we have chosen to utilize the Three-Act Task developed by Dan Meyer. Three-Act Tasks are whole-group mathematics tasks that “provide engaging, thought-provoking contexts for mathematical enquiry” (*3-Act Tasks*).

The first of three acts is meant to present a problem to students through the use of a video, image, or some other situation. Students are encouraged to discuss what they see and what they wonder about the problem being presented. Students then generate “questions to answer and make estimates about the likely solution” (San Francisco Unified School District).

In the second act, a small amount of information is revealed. Students are then encouraged to revisit and revise their original question as needed. They then work towards a solution to their question. Students are encouraged to ask the teacher for any additional information they can offer to help them solve the problem.

For the third and final act, students share their thinking and solutions. The teacher then reveals the true solution and students again discuss. Once any additional questions have been discussed, the teacher then connects these acts to the core math lesson that is to be presented. The following is the three-act task we developed for this lesson.

### **Act 1**

Students will watch the [GPM: Too Much, Too Little | Precipitation Education](#) video clip. It is important to remind students that they are to be thinking about math as they look at the video. The teachers will encourage student thinking by asking the following questions:

- What do you notice?
- What do you wonder?
- What do you think comes next?

**Act 2**

As a whole group, students will identify the information needed to answer a math question about the real-world scenario of precipitation amounts in New Brunswick, New Jersey and Annapolis, Maryland. Here, students will identify the variables, so they have enough information to answer the problem. In determining the variables students are encouraged to give estimates that are too few, too many, and just right.

At this point, teachers will provide students with an example of how to tabulate and construct their towers vertically. Students will then pair up or work individually to work on the problem. They will use Lego bricks or Unifix cubes to measure the rainfall for their designated cities. The student recording sheets can be found [here](#).

Students will count out cubes to represent monthly precipitation totals and, using the template, place them on the appropriate square for each month.

First, students will calculate the range of their data by subtracting the lowest amount of precipitation from the highest amount. Students will then compare the precipitation ranges between New Brunswick and Annapolis. Next, they will look at the seasonal patterns by observing the heights of the stacked Lego bricks or Unifix cubes which signifies more/less/no precipitation for their particular city. After completing the activities and discussions students will draw bar graphs of their city's precipitation templates.

**Act 3**

For the final act, the solution will be revealed. Students will then regroup and share their solution strategies to justify their thinking. Students can discuss, draw a picture or be the teacher to show their understanding of the precipitation relationship

between the two cities. Listed below are two guiding questions:

What are the seasonal patterns of precipitation for each of the two cities?

What does the data tell us about the relationship between New Brunswick, NJ and Annapolis, MD ?

### **Student Survey**

A survey of student understanding will be collected at the end of the lesson.

The survey can be found in the link below:

- [Student Survey- Precipitation Towers](#)

### **Formative Assessment**

- Observe students as they count out Lego bricks/Unifix cubes and place them in the appropriate square for each month.
- Student participation in class discussion

### **Summative Assessment**

- Student's ability to compare rainfall between New Brunswick , New Jersey and Annapolis, Maryland.
- Students' drawings of bar graphs based on the data collected.
- Student survey of activity

### **Conclusion**

After viewing a Three-Act Task video clip on The Teaching Channel, we decided to use it. The Three-Act Task is more appropriate for kindergarteners to use when completing a modeling task. "Not every mathematics task can or should engage students in all five modeling actions" (Meyer, 2015). We also decided to modify the standards given by the NASA Jet Propulsion Lab to be early education friendly. Rather

than calculating averages, we are focusing on ranges which use subtraction as its basic mathematical skill.

Students are also engaged throughout the Three-Act Tasks by completing the precipitation towers, student survey with deep-thinking questions, and graphing data on a bar graph. The teacher is merely the facilitator of learning while the students use the data to help them think about what numbers mean and how they are used in real life.

### **Collaboration**

Teamwork made this assignment much easier. When Violet presented the idea of this lesson Brandy had already reviewed it and so the decision to use it was effortless. After discussing and deciding on the information that needed to be included in both the survey and the data collection sheet Brandy created the data collection sheet and Violet created the survey. Since we are both kindergarten teachers we are familiar with the standards and the ebb and flow of a kindergarten class, so planning went smoothly. Brandy and Violet decided to give an overview of a three-act task (definition, creator) and then adapted the JPL-NASA activity to be more specific to the three-act task format. Although the requirement was a proposal we wanted to create an actual lesson plan to make sure the activity would be able to work with the three-act task format.

### References

3-Act Tasks. (n.d.). Retrieved June 8, 2020, from <http://www.iseemaths.com/3-act-tasks/>

NASA - Goddard Space Flight Center (n.d.). Retrieved from Waterfalls-The Science

NASA Goddard (n.d.). Too Much Too Little [video file]. Retrieved from  
<https://gpm.nasa.gov/education>

NASA Goddard (n.d.). Water Cycle [Image]. Retrieved from  
<https://gpm.nasa.gov/education>

NASA - Jet Propulsion Laboratory - California Institute of Technology (n.d.) *Precipitation*

*Towers: Modeling Weather Data*. Retrieved from

<https://www.jpl.nasa.gov/edu/teach>

Meyer, D. (2015). *MISSING THE PROMISE OF Mathematical Modeling*. *Mathematics Teacher*, 108(8), 578–583.

San Francisco Unified School District. 3 Act Tasks. (n.d.). Retrieved June 13, 2020, from <http://www.sfusdmath.org/3-act-tasks.html>

The Teaching Channel. *Three-Act Tasks: Modeling Addition* [video file]. Retrieved from <https://learn.teachingchannel.com/video/kindergarten-math-addition-nsf>

US Climate Data. (n.d.). Weather averages Annapolis, Maryland. Retrieved June 11, 2020, from <https://www.usclimatedata.com>

US Climate Data. (n.d.). Weather averages New Brunswick, New Jersey. Retrieved June 11, 2020, from <https://www.usclimatedata.com>