The influence of vegetation on precipitation

7th Grade Science

Unit Summary:

This unit will develop an understanding of precipitation and interception. The role vegetation plays in total precipitation will be discovered after students are introduced to the scientific method, experimental design, data collection, and data analysis. Students will collect, analyze, synthesize, and draw conclusions from an experiment derived in the classroom. Prior to this lesson, students should have a good foundation in meteorology and understand what drives precipitation (e.g., lake effect, radiation, and seasons). Students should know the differences between cover types and the layers of a canopy. This unit is directly related to the broad water cycle unit and units regarding watershed science.

Next Generation Science Standards:

MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Learning Objectives:

1) Students will be able to list the steps of the scientific method, define each step, and express why it is important to the scientific method.

2) Students will be able to develop testable questions and create experiments to test their questions regarding local precipitation.

3) Students will be able to measure monthly precipitation collected in precipitation collectors with a graduated cylinder to the nearest milliliter.

4) Students will be able to accurately input monthly precipitation values into their experiment datasheets.

5) Students will be able to average monthly precipitation values.

6) Students will be able to extrapolate monthly precipitation values.

7) Students will be able to compare monthly precipitation values across different seasons.

8) Students will be able to compare precipitation values of an open field to a closed forest.

9) Students will be able to define interception and its role in total precipitation between the open field and the closed forest.

10) Students will be able to extrapolate monthly precipitation to a larger scale.

11) Students will be able to compare monthly precipitation values from one watershed to another.

Table of Lessons:

Lesson Title- Brief Description	Learning Objectives	NGSS Addressed (codes)	Materials
The Investigation Process: The students will revisit the steps to the scientific method. Their understanding of the power of the scientific method and use of the first four steps (1- Question, 2- Investigate, 3- Hypothesis, 4- Experimental Design) will be strengthened by a worksheet and group discussion.	1) Students will be able to accurately number the scientific method. 2) Students will be able to develop questions and create experiments regarding local precipitation.	**MS-ESS2-4** **MS-ESS3-2** **MS-ESS2-5**	• Scientific method worksheet.
Units, Significant Figures & Extrapolation: Students will continue to collect samples from the experiment they designed in lesson one while paying close attention to the units they are measuring. Additionally, the students will be introduced to the topic of significant figures and why they are important when reporting results. Not only will the students get a good grasp of these topics while they work through their data collection process, by discussing the real-world applications of extrapolation (e.g., how much rain fell in a rain gauge: how much rain fell on my crops) students will understand the power of converting units and expanding their collected values to the broader scale.	3) Students will be able to measure monthly precipitation. 4) Students will be able to accurately input monthly precipitation values into a table.	**MS-ESS2-4** **MS-ESS3-2**	• Precipitation collectors • graduated cylinders • Worksheet with monthly precipitation table.

Data analysis: This lesson continues to build on the unit's goal to further develop the students' understanding and experience with using the scientific method. This lesson should be introduced in a manner in which the student gets excited about using mathematics to prove trends in the data they collected. Students can be asked to define what evidence is, asked to restate their hypothesis, and then ask them how they can use the data they collected to prove their hypothesis correct or prove it was incorrect. This would again highlight the power of the scientific process; it can be a means to define reality and truth! The students should be comfortable with spreadsheet software. The students should be knowledgeable in some forms of basic mathematic computations (e.g., summing, averaging). The students should have experience in graphing data, bar graph and XY plot, as well as multiplication when they extrapolate their collected rainfall depths to total area rainfall.	5) Students will be able to average monthly precipitation values. 6) Students will be able to extrapolate monthly precipitation values.	**MS-ESS2-4** **MS-ESS3-2**	• Calculator • student worksheet with monthly precipitation table • spreadsheet software (e.g., Microsoft Excel), and worksheet.
Drawing conclusions: The students will further build upon their experience through this unit and finalize their learning by creating a "consultation letter" based upon their results from the Analysis lesson. This letter will be one page in length and support their management recommendation regarding their experiment in lesson one. This letter will give the students a real-world like experience in communicating via written word. This process will help develop the student's understanding of the water cycle and how it impacts our day to day life. Additionally, this task will assess each student's understanding of the entire unit as this is the "performance assessment" lesson.	7) Students will be able to compare monthly precipitation values. 8) Students will be able to compare the monthly precipitation values of an open field to a closed forest. 9) Students will be able to define interception. 10) Students will be able to extrapolate monthly precipitation to a larger scale. 11) Students will be able to compare monthly precipitation values from one watershed to another.	**MS-ESS2-4** **MS-ESS3-2**	• Analyzed data from lesson three • word processing software (e.g., Microsoft Word)

Safety Considerations:

The students will be going outside, therefore proper clothing for the weather (rain, high or low temperatures, and proper footwear) are necessary. The students will be carrying equipment that may be heavy to them.

Evaluation Plan:

Lessons 1-3 will give the teacher the opportunity to check-in with the students and understand their ability to follow the material being presented to them. During this time it is appropriate to exercise the formative assessment while the students are completing their worksheets and group work. This should be done by asking the students questions and allowing them to fix their own misconceptions rather than telling the student he/she is wrong. The summative assessment tool is the final lesson of the unit (lesson 4). This lesson is created to assess the student's overall understanding of the topic by asking them to draw conclusions from the steps the teacher has walked them through during lessons 1-3. The final letter of recommendation that the student submits from lesson four, is the summative assessment. How they support their recommendation, how they explain their graphs and figures, and how they link their findings to the water cycle will inform the teacher whether or not the student understands the material.

Resources (websites):

The scientific process:
http://undsci.berkeley.edu/teaching/us_alignment.php
http://www.education.com/reference/article/Ref_What_Scientific/

http://www.asa3.org/ASA/education/think/science.htm

Brief description of how this unit relates to your graduate research. (1 page):

The scientific process is at the core of any PhD student's research. By introducing Hancock middle schoolers to the scientific method they will better understand the process in which I am conducting my graduate research and the care in which researchers take when performing quality research. The students will develop a question, create hypotheses, generate and carry out an experiment, collect data, analyze their data, and draw conclusions. This is directly related to the process I'm undertaking through my graduate research.

While conducting my research it is imperative to understand units, calculate accurate equations, extrapolate data to a larger scale, and respect the power of statistics. The students will be introduced to basic mathematical solutions in order to develop their understanding of statistics and its place in science. The students will also be introduced to the significance of collecting accurate and precise measurements when conducting sound research. It is imperative to my research that I collect data with the highest standards possible in order to present relevant results to my peers and leaders of my field.

Students will understand a small, but significant aspect of the water cycle, precipitation. Which is not only related to my graduate work it is also is a large part their daily life. By collecting monthly

precipitation values the students will experience the process of measuring rainfall and understanding the input of fresh water into their local region. These processes will hopefully cause them to understand their fragile and valuable connection to this natural resource.

My graduate research deals with greenhouse gas emissions from depressional wetlands within the western Upper Peninsula of Michigan, USA. Greenhouse gases (specifically carbon dioxide and methane) emission rates from soil have been linked to the depth of the water table. Seasonal water table depths are dependent upon soil type & infiltration, vegetative cover type, climate, and weather (precipitation). This unit will develop the student's understanding of precipitation and vegetative cover and its role in total precipitation. By understanding these relationships students will better understand the factors influencing soil greenhouse gas emissions.