

STEM-IT 2012

Land and Water STC Kit

Challenge: *Save Gaveo City from Flash Flooding*

STEM-It Project Team Members:

Jillian Finkbeiner

Kristie Gonzales

Dr. Frannie Skomurski

*STEM-IT: a Math Science Partnership Grant from the Office of Superintendent of Public Instruction managed by ESD 123 and facilitated by Georgia Boatman, Regional Science Coordinator, ESD 123 and Peggy Willcuts, STEM Education Consultant, Pacific Northwest National Laboratory.



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Dear Educator,

Welcome to the Science, Technology, Engineering, and Mathematics (STEM) Challenge for the STC Land and Water Kit. It is our hope that your students will be enthusiastic to learn about the interaction between land and water. This STEM Challenge is designed to encourage students to solve a real-world engineering problem. Students will be able to use the knowledge they have gained in order to design a dam to save a mock community called Gaveo City, from flash floods. The challenge is interactive, meaningful and easy to implement into the kit.

As you begin the STEM Challenge, all materials and information needed in order to complete the challenge are provided. To further entice our students into the Challenge, five letters are addressed to your students from Dr. Frannie Skomurski, an environmental geologist from Pacific Northwest National Laboratory. Each letter will have background information for you, and a letter to be read aloud to your students. In order for this challenge to be successful, students will need to complete all of Dr. Frannie's questions and challenges. Here is an outline of the letters and when they should be read to your students:

Letter #1 – Introductory Letter: prior to Lesson 1

Letter #2 – After Lesson 4

Letter #3 – After Lesson 7 (Shake-tube challenge)

Letter #4 – After Lesson 11

Letter #5 – Final letter, before Lesson 12

As you embark on the Land and Water STEM Challenge with your class, we wish you the best of luck! Remember, science is most impactful and life-changing when combined with technology, engineering and mathematics.

Best Regards,

Jillian Finkbeiner

Kristie Gonzalez

Dr. Frannie Skomurski

STEM-IT Grant 2012*

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Letter 1: Collect data for Dr. Frannie to research the Gaveo River’s behavior on land

Dear Teacher,

Welcome to the STEM Land and Water Challenge! We are excited to guide you through the design challenge. The purpose of Lesson 1 is to begin conversations with your students about the interaction of land and water. See what they know and what they want to know. Also, have students observe the aerial photographs of different water-eroded landscapes. You can choose when it is best to read the following letter from Dr. Frannie, to your students.

Dear Students,

My name is Frannie and I am a geologist who sits on the Gaveo City Council. Over the years, the people in this community have been experiencing flash floods when it rains heavily which causes damage to local property, including houses, farms, and paths along the river. I understand that you are going to be studying the interactions between land and water in your classroom. I am writing because I need your help in developing a plan to protect Gaveo City from flash floods.

In order to do so, we must conduct a series of investigations to understand how land and water interact. For that, it is important that you make careful observations for each experiment and keep detailed and carefully labeled sketches. It is also very important to carefully record your data by taking accurate and clear notes and working as a team! This information will help us decide the best course of action for Gaveo City in the future. I will be checking in with you from time to time as we conduct this investigation. Thank you in advance for your help and I look forward to your ideas and recommendations.

Sincerely,

Frannie, Geologist*
Gaveo City Council

***Career Information:**

A geologist is a scientist who studies the interaction of rocks and minerals with land and water in order to solve problems. Geologists can also study fossils, volcanoes, earthquakes, the environment, water resources, energy and mineral resources, and many other topics related to the Earth. Colleges and universities, private industry, and government agencies hire geologists at different levels of educational training, from Bachelors to Masters to Doctoral degrees.



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Dear Teacher,

The purpose of Lesson 4 is to introduce students to the interaction of land and water, by adding flowing water to the stream table. Students will observe the interaction, collect run-off and describe their stream channel through a scientific drawing. Students will also measure the length and width of their stream channel and record this data. The following letter will connect well with Lesson 5 in which students will explore different components and properties of the soils in the stream table. After Lesson 4 is conducted, read Dr. Frannie’s letter and allow the science teams to discuss and draw conclusions from their lab.

Dear Students,

Greetings again from the Gaveo City Council. This is Frannie the geologist checking back in. I heard that you have recently observed the different components that make up soil and that you are now conducting experiments on the effects of running water on land. I am curious to know about the results from your experiments. In your science teams, can you please discuss and answer these questions for me?

- What did you observe about the soil components?
- How did the running water from the stream source change the land?

I understand that you also collected water or “run-off” from your stream tables in graduated cylinders. I am curious if the water looked the same on the first day that you collected it compared to a day later? Was there any material at the bottom of your collection tube on Day 1? If so, what did it look like? How about on Day 2?

In geology, we say that water is “eroding” the land if it carries sediment (small pieces of rocks and minerals) with it. Do you think your stream is “eroding” the land surface? What evidence do you have to support your claim?

Please report back to me with answers to these questions. As time goes on it will be very important to document how water changes the land surface that you are studying. Please be sure to keep good notes and keep up the detailed observations! And as always, work together as a team. I will be checking in with you again in the near future. Thank you for your help.

Sincerely,

Frannie, Geologist
Gaveo City Council



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Letter #3 –After Lesson 7 with “shake tube” challenge

Dear Teacher,

In Lessons 5 and 6, students explored the different soil components and how some sediments hold onto more water than other sediments. The purpose of Lesson 7 is to observe the speed of run-off and evidence of erosion and deposition in the stream table. Students will be able to track these changes by placing in flags and using marine sand. The wrap up activity is to sketch the aerial view of their stream table. The following letter allows students to combine their knowledge of soil components and properties, with the interaction of water. Students will need to focus on the soils and how water interacts with each. At the end of the letter, Dr. Frannie has a separate design challenge for students to try. The needed materials (which are not provided by the kit) are enough water bottles for each team. Using the extra soil provided in the kit, students can create a “shake tube” to observe the interaction of soil and water over time (days/weeks). We encourage you to create “shake tubes” with your students; it is an inexpensive, hands-on way to observe the different soil components over time.

Dear Students,

I hope that you are all having fun examining the effects of water on our local area. I recently analyzed soil samples from the Gaveo City area and found the following components:

Clay	Humus	Gravel	Sand
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Look closely at your stream tables and where all the different types of soil components are mixed together. As you examine your stream tables, my questions for you as a class are:

1. Which soil components are deposited first? Why do you think this happens?
2. How does the speed of the water affect the amount of soil that is eroded and deposited by water?

Now that you understand the movement of water and soil, I have an extra experiment challenge for you! As a table team, use a water bottle and place 60 mL of each soil component into the bottle. Then fill up our bottle and start to shake! After shaking for a good minute, let the bottle rest on your desk and watch the interaction of the water and soil.

1. What is the order in which the soil components fell? Sketch out your shake tube in your science notebook.
2. Predict how long you think it might take for all of the soil components to settle at the bottom, and the water to become clear again.

As you continue to investigate please make sure you keep accurate notes of what you observe. Remember it is important to keep detailed and accurate drawings to help with your understanding. And as always, make sure you work as a team!

Thank you,



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Frannie, Geologist
Gaveo City Council

Letter #4 – After Lesson 11

Dear Teacher,

In Lesson 11, students learn how nature, such as landforms can affect the way water travels over land. They also observe how natural land features, hills and rocks, affect the direction in which water flows. This investigation will be beneficial to their STEM-IT challenge after Lesson 12. If students used rocks in this lab, have students keep them, so they can potentially use them in their STEM-IT challenge.

In Lesson 12, students will need to design and test a dam to save Gaveo City in their stream tables. Dr. Frannie's letter will challenge students to begin their design process for their STEM-IT project.

Dear Students,

I was wondering if you could help me answer some questions I was thinking about. What effect does a large amount of rapidly flowing water have on the amount of soil that is eroded? How do hills and rocks affect the direction and flow of water? To help with answering these questions please make sure to closely observe what is happening in your stream tables.

Taking what you know, I need your help in coming up with a plan for building a dam to protect the City of Gaveo from flash flooding. When you have finished your design, your teacher will be sending me your detailed diagrams of your plans. To help you get started, answer these following questions in your science notebook, using your previous investigations and assignments from me:

1. Where would you place a dam and why?
2. What materials will you use and why?
3. Where is the safest place for people to live once the dam is built and why?

As you develop and test the design of your dam, please make sure you keep accurate notes of what you observe. Please fill out the cost sheet, as we are not a wealthy city and need to build a cost effective dam. Also, make sure you keep very detailed and accurate drawings to help with your understanding. When trials and notes are finished, your teacher will send your data to our City Council for review. As we review we will be looking at your design, trial notes and cost sheet. As always, make sure you work as a team. I look forward to seeing your engineering plans and test results!

Thank you,

Frannie, Geologist
Gaveo City Council



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Materials List and Costs

<u>Materials</u>	Cost	Quantity	Total Cost
Craft sticks	\$15 each		
Toothpicks	\$10 each		
Small Boulders	\$20 each		
Large Boulders	\$30 each		
Straws	\$10 each		
Sticks/Twigs	\$10 each		
<u>Soil Components</u>			
½ Cup Sand	\$25		
½ Cup Humus	\$30		
½ Cup Clay	\$35		
½ Cup Gravel	\$40		
Total Cost: _____			



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Letter #5 –after Lesson 12

Dear Teachers,

This final letter wraps up the STEM-IT Challenge! Thank you for participating in this special engineering and scientific challenge. We hope your students enjoyed the challenges and discussions throughout the unit!

Dear Student Experts,

Thank you for building and testing many different and innovative dam designs to help protect the Gaveo City from flash flooding. In the end, the City Council has taken the best results from each of your ideas and costs into consideration. For example, placing the dam upstream from the city is very important for holding back the water that flows during a flash flood event. Also, using a piping system or natural land features like rocks or hills can help in controlling the flow of water during a flash flood. We are also considering releasing some extra dam water from time to time to help maintain good soil for farming and habitats for animals along the river. The dam also gives the residents of Gaveo City another source of electricity called “**hydroelectric power**”.

We invite you all to visit our city sometime and I sincerely thank you for sharing the detailed findings of your investigations and your final recommendations. You would all make fine geologists or engineers someday! Until then, study hard, keep taking good notes, and remember that working well as a team is important.

Sincerely,

Frannie, Geologist
Gaveo City Council



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