The Mighty River

** Created by Kyle N. Hoffman, Geology, Linn-Mar High School, Marion Iowa. 2009*

Objectives:

- Students will be to identify land formations caused by moving water (rivers, streams, floods)
- Students will demonstrate knowledge of how different rock types erode
- Students will show an ability to create real life scenarios using data collected

Standards:

Science as Inquiry

1. Identifies questions and concepts that guide scientific investigations
2. Designs and conducts scientific investigations
3. Uses technology and mathematics to improve investigations and communications
4. Formulates and revises scientific explanations and models using logic and evidence
5. Recognizes and analyzes alternative explanations and models
6. Communicates and defends a scientific argument

Earth and Space

1. Understands and applies knowledge of energy in the earth system
2. Understands and applies knowledge of Geochemical cycles

Essential Questions:

1. How does flooding of Indian Creek affect the Linn-Mar campus?
2. How important are the rock types for containing erosion from river systems?
3. How does the placement of the rock type, and the size and shape of the river system affect the erosion rates?

Engage:

Students will be shown different photographs of the 1993 Upper Mississippi River and 2008 Cedar River floods. They will also be given different sets of data from both floods. Students will analyze both sets of photographs and data. They will need to write their observations in their composition notebook. They will then need to formulate several questions to discuss with the class, along with noting several key observations that they made.

As the discussion is going on, if needed, start to guide their discussion to what effect these floods had on the landscape surrounding these areas. The ultimate goal is to discuss these effects that floods can play in our landscape formations.

Explore/Elaborate:

This will be connecting their knowledge of rock types, placement of the rock, and the size and shape of the river system with land formation and will be focusing on river systems and flooding.

Materials:

- measuring tape
- stacks
- compass
- graph paper
- field journal
- composition notebook
- GPS

- With their field journals and comp. books, the students will be going down to Indian Creek (on campus) to create a profile running from the new road (west bank) to the football stadium (east bank). They will start at the walking bridge (down stream) and head north to the first large meander (upstream).
    - Using GPS equipment, have the students plot each point of reference they take for the profile.
    - Later, they will input this data into MyWorld to create a virtual map of their profile.
- They will also be taking the velocity rate of the stream at each section that is profiled.
- Class will be put into groups of 4 and will be given a certain section of this quadrant to measure. They will need to graph their section as they measure it out.
    - There will be an in class discussion on how to create their profile.
- Back in class, the students will put all their sections together to create a whole profile of the quadrant. This will be put on the board for all the class to see and use when needed.
- Using their notes from previous units, each group will need to recreate the profile, but will need to add in geologic features. Meaning, the rock layers found and the different types of landscapes and land formations found within the quadrant.
- Now, using the data from the opening discussion about recent floods in the Midwest, students will need to calculate the velocity that Indian Creek was flowing during the 2008 flood. They will also need to calculate the erosion rate that occurred during this time. This could be difficult due to the fact that they will need to calculate the erosion rate for each rock layer that was exposed during the flood. Each rock type will have a different erosion rate.
    - They will need to keep in mind the placement of the rock, along with the size and shape of the river system.
- They will now create a scenario for Indian Creek for the next 50 years. Their scenario will need to include:
    - At the velocity and erosion rates calculated earlier, what will have to occur at Indian Creek for a major landslide to occur on the west bank to put the new road into danger?
    - Include all possible events that could occur. Remember this will be a prediction, so there is no right answer. But their scenarios will need to realistic. Such as, would a 500 year flood occur multiple times in 50 years?
    - They need to keep in mind about the new bridge built just downstream and the new football stadium being built just upstream. Along with the new road and its runoff. Would any of these affect the velocity of Indian Creek and speeding up the erosion rate?

    - This scenario needs to be set up in a year by year format. We will use the computer lab a day or two to help predict future weather forecast (Farmers' Almanac). They could look at weather patterns over the past 50 years to determine future patterns that may occur.
- They will then need to develop a plan to help control the flooding (like they are now for downtown Cedar Rapids).
- Next, change the rock layers to different types of rocks. Along with changing the landscape of the river system, such as removing or adding bluffs. Recreate a summarized scenario. How different would the results be? Is there a type of rock that would be better to withstand erosion over another? Does it matter if the river is full of bluffs or is surrounded by low laying land?
- They will be presenting their scenario to the class when all done.
- There will be a class discussion after the presentations to allow any unanswered questions to be talked about and hopefully answered. Some questions to bring to the class would be the importance of the rock types and the landscape near river streams and how they help determine erosion rates.

Extension:

- Extend the scenario to include the Cedar River.
- Extend the scenario to finish 100 years from present, not 50 years.

Evaluation:

Your grade will be based off of your individual work and group work.

Individual:

	5	3	2	1
Participation during the profiling portion.	You were busy the entire time. You did your part. You worked well with your group.	You were busy, but only helped a little bit. Worked well with other group members.	You were not busy and helped only a little bit. Worked well with other group members.	You did not help your group and did not work well with your group either.
Participation during the profiling portion in the classroom.	You did your share of the workload and your part was well done and thorough.	You did your share of the workload and your part was well done but not thorough.	You did your share of the workload but your part was not well done and not thorough.	You did not do your share of the workload but your part was not well done and not thorough.
Participation during the scenario portion. (x2)	You shared your ideas and listened to others. You did your part well and thoroughly.	You did not have any ideas to share. You did your part well and thoroughly.	You did not have any ideas to share. You did not do your part well or thoroughly.	You did not do your part.
Participation during the control plan. (x2)	You shared your ideas and listened to others. You did your part well and thoroughly.	You did not have any ideas to share. You did your part well and thoroughly.	You did not have any ideas to share. You did not do your part well or thoroughly.	You did not do your part.
Participation during Presentation	Spoke loud and clearly. You understood what you were talking about. Had eye contact with the class and did not read off notes.	Spoke loud and clearly. You understood what you were talking about. Had limited eye contact with the class and did not read off notes.	Spoke loud and clearly. You had some misunderstandings in what you were talking about. Had limited eye contact with the class and read off notes.	Hard to hear. You had a lot of misunderstandings in what you were talking about. Had no eye contact with the class and read off notes.

Group:

	5	3	2	1
Indian Creek Profile	Was thoroughly and neatly done. All requirements were met.	Was thoroughly and neatly done. 1-2 requirements were not met.	Was not thorough or neatly done. 1-2 requirements were not met.	Was not thorough or neatly done. Over 3 of the requirements were not met.
Indian Creek Scenario	Was well thought out and very detailed. It was realistic. All requirements were met.	Was well thought out and very detailed. It was realistic. 1-2 requirements were not met.	Was not well thought out or very detailed. It was somewhat realistic. 1-2 requirements were not met.	Was not well thought out or very detailed. It was not realistic. Over 3 requirements were not met.
Indian Creek Control Plan	Was well thought out and very detailed. It was realistic. All requirements were met.	Was well thought out and very detailed. It was realistic. 1-2 requirements were not met.	Was not well thought out or very detailed. It was somewhat realistic. 1-2 requirements were not met.	Was not well thought out or very detailed. It was not realistic. Over 3 requirements were not met.
Presentation	All requirements were met. Well presented. Generated deep thinking questions and solutions.	All requirements were met. Well presented. Did not generate deep thinking questions and solutions.	1-2 requirements were not met. Well presented. Did not generate deep thinking questions and solutions.	Over 3 requirements were not met. Not well presented. Did not generate deep thinking questions and solutions.

Grading Break Down:

Individual:	35 pts.
Group:	20 pts.
Total:	55 pts.

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Purpose:

Within the past 20 years, the Midwest has experienced many devastating floods; including the 1993 flood of the Upper Mississippi River and the 2008 flood of the Cedar River. There have also been many smaller scale floods, such as our own Indian Creek, in 2003, 2007 and 2008. We will be looking into how these floods, and floods in general, affect the landscape that surrounds river systems.

Explore/Elaborate:

Step 1:

Materials:

- measuring tape
- stacks
- compass
- graph paper
- field journal
- composition notebook
- GPS

You will be put into groups of 4. Your group, along with rest of the class, will be venturing down to Indian Creek, to create a profile.

- The quadrant you will be surveying will be from the walking bridge (south) to the first meander (north) and from the new road (west) to the football stadium (east). There will be 8 sections profiled, 1 section per group.
- There will be a quick review in class about profiling before we go down to Indian Creek.
- As you are profiling, make sure that someone is plotting the stacks in terms of distance from starting point (middle of the creek) and elevation. Your profile will run east to west (football stadium to the new road).
    - You should plot a stack every 5 meters.
- Using the GPS equipment, plot each stack.
- You will also need to take the velocity of Indian Creek for all stacks plotted in the creek.

Step 2:

Back in the classroom, each group's profile will need to be added together to create a complete profile of the quadrant.

- This will be put on the board, when completed, for all groups to use as a reference.

Step 3:

In the computer lab, you will need input your plot point data into MyWorld. This will create a virtual map for you to print.

Back in the classroom, you will compile a complete profile of the quadrant. You will need to compare the two profiles, looking for any irregularities that may have occurred. Explain in your composition notebook why these irregularities occurred.

Step 4:
Your group will now make a complete profile also. This time, you will need to add all the rock layers and land formations found within the quadrant.

- Use your notebook and field journal to complete this step, look back at your rock units for help.

Step 5:
Using the data from the earlier data we discussed in class, calculate/list the following:

- Velocity rate of Indian Creek during the 2008 flood
- Velocity rate of Indian Creek during your profiling time
- Erosion rate of each rock layer exposed during the 2008 flood
- Erosion rate of all rock layers as if they were exposed during the 2008 flood

Step 6:
You will now need to formulate a scenario using your profile and data from past floods we used earlier.
Your scenario needs to include:

- At the velocity and erosion rates calculated earlier, what will have to occur at Indian Creek for a major landslide to occur on the west bank to put the new road into danger?
- Include all possible events that could occur. Remember this will be a prediction, so there is no right answer. But your scenarios will need to realistic. Such as, would a 500 year flood occur multiple times in 50 years?
- Keep in mind:
    - The new bridge built just downstream and the new football stadium being built just upstream
    - The shape of the rivers and how that affects flooding
    - The new road and its runoff
    - Would any of these affect the velocity of Indian Creek and speeding up the erosion rate?
- This scenario needs to be set up in a year by year format. We will use the computer lab a day or two to help predict future weather forecast (Farmers' Almanac).
    - You could look at weather patterns over the past 50 years to determine future patterns that may occur.

Step 7:
Create a control plan to help erosion from occurring on the west bank and help protect the new road.

Step 8:
Now you will need to change the rock layers and landscape features found around Indian Creek. Change these to several different types of rock.

- Recreate your scenario to match the new rock layers and landscape features
    - Only summarize the new scenarios
- Keep these questions in mind when recreating your scenario:
    - How different would the results be?
    - Is there a type of rock that would be better to withstand erosion over another?

- Are there landscape features that would better control flooding and erosion rates?

Step 9:
Prepare a presentation for the class. After presentations we will have discussion time to clarify any questions left.

Extension:

- Extend the scenario to include the Cedar River.
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Evaluation:

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