ICE
Integrating Chemistry & Earth Science

WEATHERING, EROSION & DEPOSITION MODULE

LESSON 6:

LANDFORMS AND PHYSICAL DEPOSITION

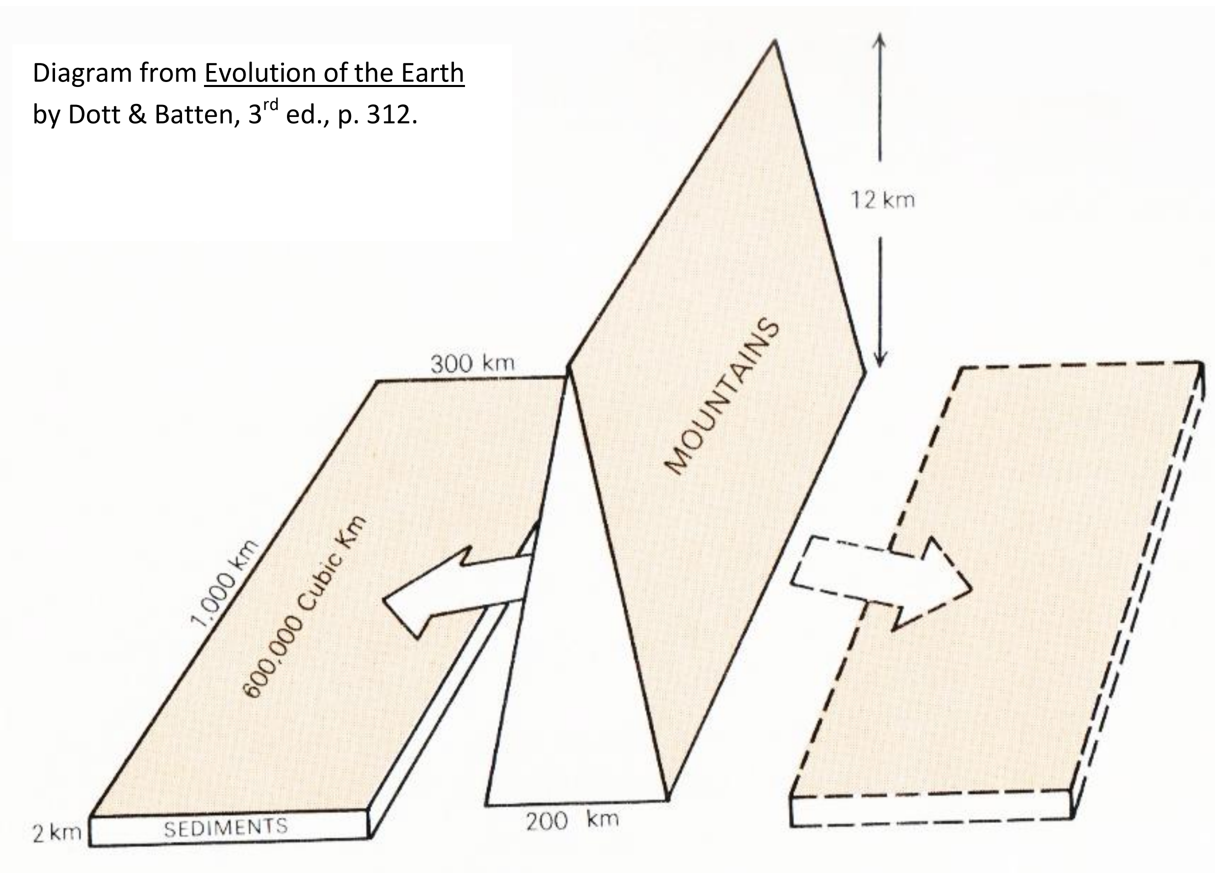

Diagram from Evolution of the Earth by Dott & Batten, 3rd ed., p. 312.

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The following lesson and associated materials are part of the Integrating Chemistry and Earth science (ICE) Urban Heat Island Module. The Module brings together important concepts from Earth science and chemistry to help students build an understanding of why urban areas have higher temperatures both during the day and at night, than their rural counterparts.

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Lesson 6: Landforms and Physical Deposition

Driving Question: *Where does the moving material go?*

Summary: Students will examine the **changes in matter within a simulated stream** to develop an understanding of the process of settling. Students will **analyze data and observations collected during class investigations** and apply their understanding to the natural world through student created models

Activity Description:

- **Opening Activity- Erosion and Deposition Investigation:** Students investigate the settling rate/order of sediments in water by shaking containers with various sizes of rock, sand, and silt.
    - Have students do the Suspension/Settling activity.
    - Students experiment with a mixture of silt, sand, and gravel to explore and observe the relationships between:
        - Water velocity (force of motion) and ability to carry particles in suspension
        - Particle size and settling rates
        - **Teacher Note:** If possible, save the jars from your final class of the day and let them set overnight. Allow students to examine the effects of longer-term settling at the beginning of class tomorrow.
    - **Questioning prompt:**
        - How are the particles moving?
        - How do the different sized particles settle differently? Why?
        - How does shaking the jar at different speeds effect the moving particles?
- **River Sediments Model:** Based on their observations, students will predict the order of sedimentation and create a pictorial model of sediments at a river outlet.
    - Hand out River Sediments Model Sheet and have them illustrate, based on their observational data, where they believe each sediment particle will drop out of the flowing water and end up on the diagram.
        - **Teacher Note:** At this point do not have them complete their explanation. That will be completed after the next activity.
- **Deposition Simulation:** After making their model, students will further test the motion of sediments using the Race of Deposition simulation. Then they will edit their models based on their new data.
    - In groups of 4, have students investigate deposition patterns in flowing water by completing the Race of Deposition activity.
        - In this activity, students will simulate where a river will drop sediments (heavy, light) as if flows downstream or into a lake or ocean.
        - **Teacher Note:**
            - Materials:
                - large marbles
                - steel balls

      - rubber balls
      - ping pong balls
      - straws
      - folded paper
    - Set-up notes are at the end of the activity packet.
  - After completing the data analysis for this activity, students return to their River Sediments Model Sheet and make any modifications/edits.
    - The edits/modifications should be in a second color.
  - Once students have edited their diagram, they should explain their final model the class.
- **How Tall were Baltimore's Mountains?** The teacher, or a student, will lead a class discussion on how scientists could reverse-engineer the size of ancient mountains from the volume of deposited materials left from weathering, erosion, and deposition.
  - **Key Questions:**
    - Where are Baltimore's mountains now?
    - How can we estimate the height of the mountains that once stood where Baltimore is today?
  - Using the *Height of Baltimore's Mountains PowerPoint*, the class discusses how scientists might determine the height and volume of Baltimore's mountains based on the estimates of the volume of coastal plain sediments and assumptions of mountain shape and density.

Homework: Complete the deposition CER found at the end of the Race of Deposition activity.

Sources of Evidence of Three-Dimensional Student Learning: Students will apply the data they collected and analyzed, regarding components of sedimentation, to a model that they create, critique, and update based on newly acquired information.

EL Support:

Purposefully choose one or more of the following options based upon student needs or formative assessment data to have students process and engage with content.

- Reduced vocabulary load
- Provide written notes
- Provide visuals
- Monitor responses
- Allow verbal and non-verbal responses (gestures)

Differentiated Instruction:

Purposefully choose one or more of the following options based upon student needs or formative assessment data to have students process and engage with content.

- Assign lab groups based on differing ability levels/mixed readiness groups with targeted roles.

For students who need support with writing their CER, provide *CER Graphic Organizer.* Students can also color code their writing, having a different color for each component in the Claim Evidence Reasoning format.

Lesson Summary:

Students should have an idea of the following: Moving water carries sediments. It takes more energy to move large particles than small particles. Large particles, such as rocks, fall out of the flowing water fastest while smaller particles take longer to fall out and thus travel farther in the stream. At the mouth of a river the large rocks will collect first and the finer sediment moves further away from the opening and settles into the deeper waters. Students should be asking questions like what about the dissolved/chemically weathered material? Where is it going?

Suspension/Settling Activity

Overview:

Similar to the rock tumbler, which simulates the effects of moving water and 'grit' materials, we can use water in a jar to simulate the study the processes of suspension and settling. In this activity, you will place a mixture of materials that differ in their physical-chemical properties in a jar. In Part 1, you will move the jar at different rates, simulating different flow rates or mechanical forces in the water and observe which materials go into suspension and which stay settled. In Part 2, you can agitate the mixture completely and study the rate at which different materials settle, and what patterns they form when deposited at the bottom of the jar. In this activity you can answer these questions:

1. What is the relationship between the movement rate of water and its ability to pick or bring into suspension different materials?
2. How do different materials settle once the water they are suspended in stops moving?
3. What patterns are formed as materials are deposited from a suspension when water stops moving?

A. Gather these materials (working in groups of 3-4)

- A jar with a lid
- The following materials
  - Silt
  - Sand (or fine sand)
  - Gravel (or coarse sand)
- ¼ c measuring cup (tbd)
- Water
- Stop watch (can be on cell phone)
- Smooth surface to work on
- Ruler and tape to mark distance to move jars on table

B. Part 1 - Studying suspension vs. velocity:

1. Mix equal volumes (1/4 c) of the three materials (dry) in the bottom of the jar.
2. Carefully, slowly fill the jar with water trying to minimize disturbance of the material. Put a lid on the jar.
3. Mark the table with two pieces of tape 50 cm apart. This is the distance you will move your jar smoothly for the study.
4. Assign these roles to members of your group
   a. Agitator – this person will carefully move the jar back and forth between the tape to the beat of the Time Keeper.
   b. Time Keeper – this person will tap the table with the beat or frequency for each trial as shown in the table
   c. Data Recorders – the people will observe the jar carefully and make a judgement at during the last movement of the jar for each trail how much of each material is in suspension, using a scale:
      i. 0 = none
      ii. X – some

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iii. XX – a lot

5. Once everything is set, with the Time Keeper ready with the stopwatch, the Agitator ready with the jar and the Data Recorders ready with the data table, the Time Keeper sets the beat, the Agitator gets that beat and then moves the jar to that beat for 5 repetitions back and forth. Then the Data Records record their observations during the last repetition.
6. How could you graph these data?
7. What patterns do you observe?

Suspension Study Data Table

Rate (repetitions per 5 seconds)	Silt	Sand	Gravel	Other Observations
	Amount settled 0 = none, X = some, XX = a lot			
2				
4				
6				
8				
10				

C. Part 2 - Studying settling

1. Mix the jar thoroughly then stopping and start the stop watch immediately.
2. Note the time it takes for each type of material to settle. NOTE – you may need to leave it the jar set up overnight to actually get the time for some of the material to settle.
3. What patterns do you observe?

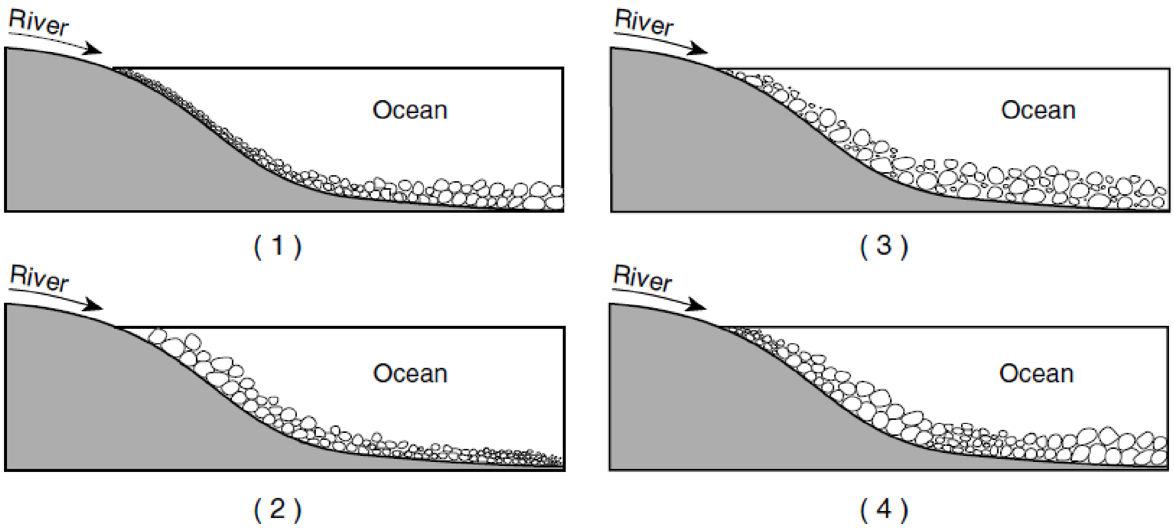
Settling Study Data Table

Material	Time to Settle	Other Observations
Silt		
Sand		
Gravel		

Video Link: https://www.youtube.com/watch?v=ZC6EaVYdiVo

D. In the world:

Examine the four diagrams below, each show the point where a river meets the ocean. If the river is carrying sediments of a variety of different sizes [large rocks to fine sediment] which diagram below show the most likely deposition pattern? (what will drop out first? Second? Etc) CER format

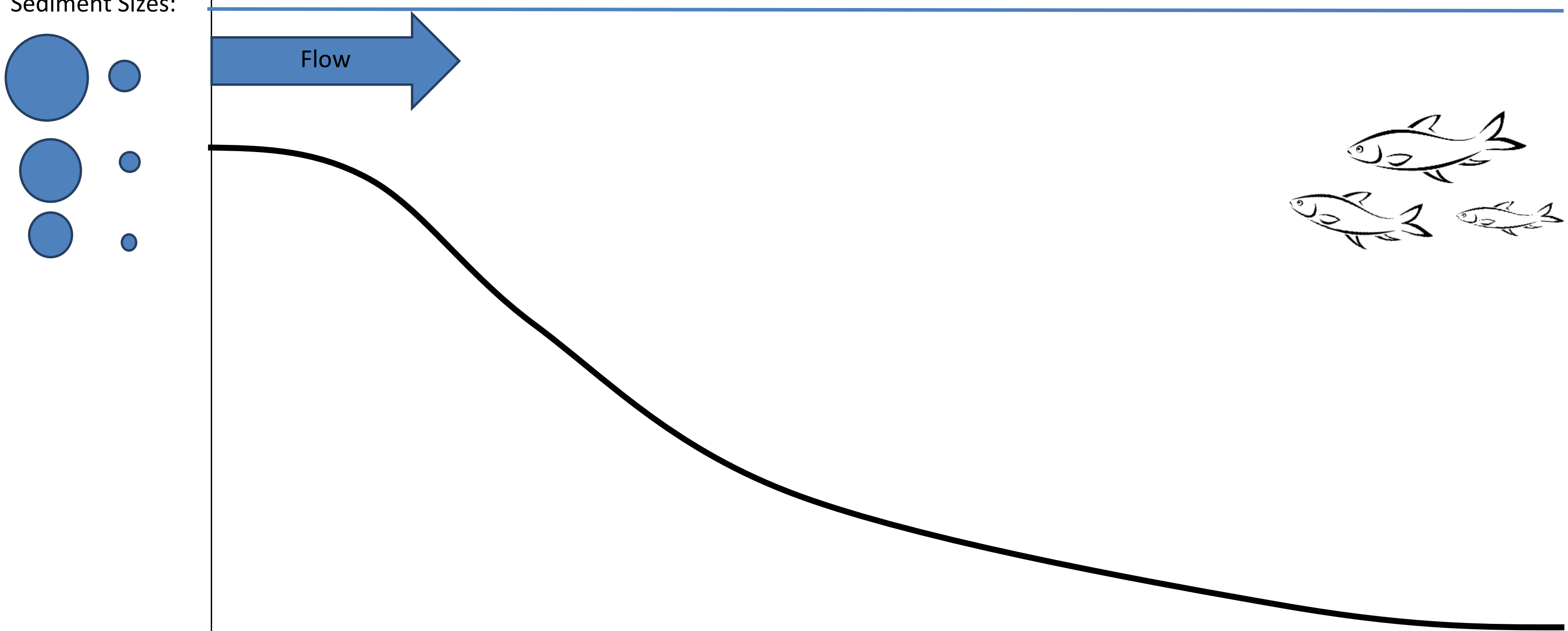


Your Claim is your diagram choice. Give multiple pieces of evidence that supports your reasoning in your response.

River Sediments Model

On the diagram below, draw the sediments in the location that you believe they will be dropped by the water, as it leaves the mouth of the river. You will work on this twice—use the color key below to indicate each attempt.

Sediment Sizes:



Key

☐ 1st Model

☐ Edit/2nd Model

Explain your placement of the sediments:

The Race of Deposition

After a nation-wide search, 4 competitors have made it to the finals of the Race of Deposition being held right here in Baltimore, MD. After observing the competitors (materials) predict your winner in the beginning of the race

Materials Per group:

- Accordion folded papers for race lanes
- Ruler
- Straws
- 1 inch diameter:
  - Ping pong
  - Bouncy ball
  - Steel ball bearing
  - Marble

Instructions:

- Set up "race track" with the accordion folded papers, three papers per material being raced.
- Place your "competitors" behind the start line
- Students receive one straw per competitor
- Count down 3,2,1 START
- Students have 5 seconds to "Race" their competitor (blow through the straw)
- Student must stay behind start line!
- At the end of the race, students will use the ruler to determine the distance traveled of each material (cm)

and then participate in the competition!

Prediction: Looking at the materials on your desk. Which competitor do you believe will make it closest to the finish line? Why?

Data table:

Competitor (Material)	Weight of Competitor (material)	Distance travelled (cm)

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Create a horizontal bar graph of the results (data):

Explain: Why did the competitor (material) that received first place travel the furthest distance?

Model Analysis: This activity was modeling the movement of rocks/particles in a stream environment. What do the materials from the race represent in the stream environment?

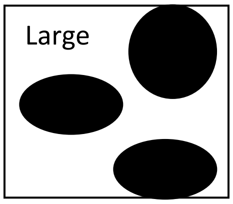
Stream Environment	Material from Race
Rocks	
Flowing Water	

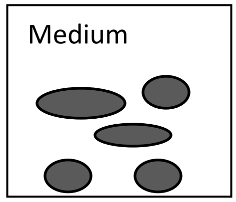
Discussion Question: If we ran the race with marbles of different sizes (small, medium, large), what do you believe the results would be? And why?

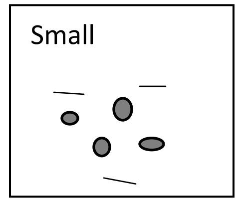
Deposition CER Homework:

Now that we have observed how a materials weight affects the distance traveled. Use your knowledge of deposition and particle movement to place the rock sizes pictures below into the stream image. Where do you think the large, medium and small particle deposition would be located in a flowing stream?

Rocks/Particles:

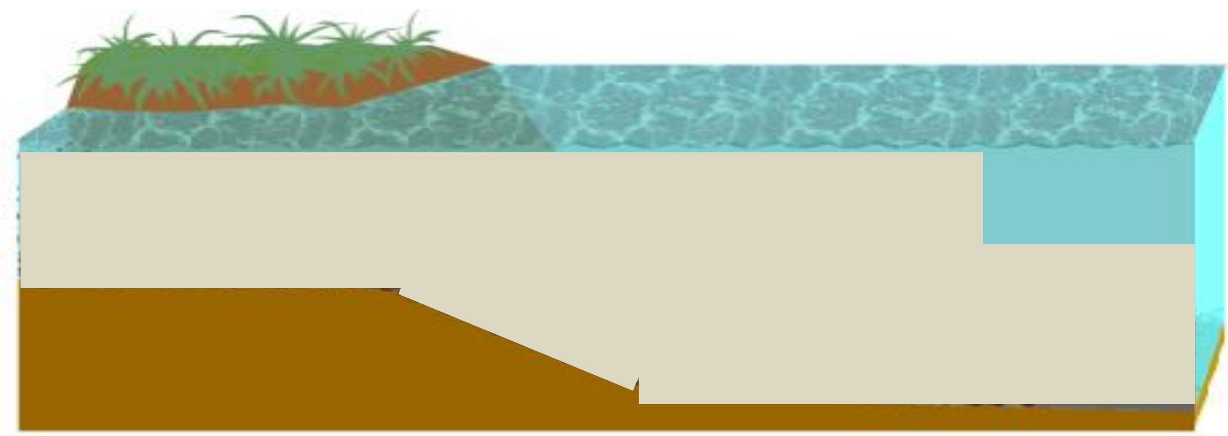






Why did you place the deposition in that location in the stream? Use CER format to answer.

Claim:



Evidence:

Reasoning:

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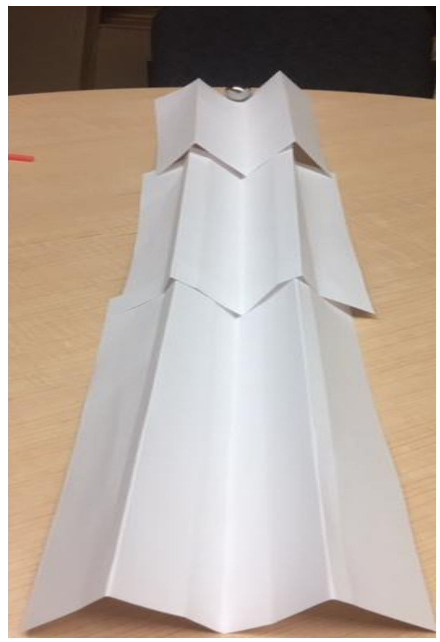
Virtual model to view how deposition occurs in a stream environment:
www.classzone.com/books/earth_science/terc/content/investigations/es0602/es0602page02_popup4.cfm

Teacher Notes:

Set-up:

- Each student will receive 3 pieces of paper to fold accordion style and lay in front of each other to create a "race lane" for their material.



Possible Extension:

- Students can weigh the individual materials (ping pong, steel ball, bouncy ball, marble) before the race and graph distance vs mass for analysis purposes.