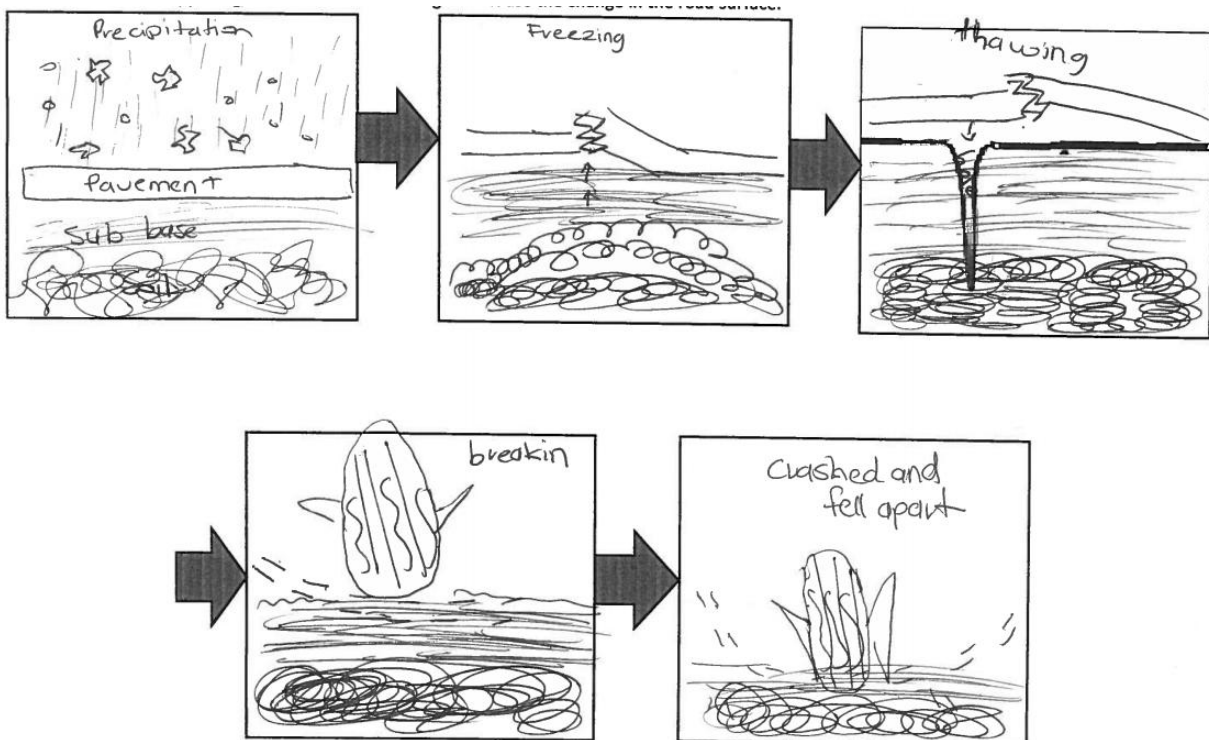


LESSON 2: PHYSICAL WEATHERING



WEATHERING, EROSION & DEPOSITION MODULE

Lesson 2 – PHYSICAL WEATHERING

ACKNOWLEDGEMENTS

ICE Leadership Team

- Alan R. Berkowitz, Head of Education, Cary Institute
- Joshua Gabrielse, Director of Science, City Schools
- Kevin Garner, Coordinator of Science, City Schools
- Kia Boose, Secondary Science Specialist, City Schools
- Vonceil Anderson, Curriculum Writer, City Schools
- Jonathon Grooms, Assistant Professor of Curriculum and Pedagogy, George Washington University
- Kevin Fleming, Graduate Research Assistant, George Washington University
- Mary Ellen Wolfinger, Doctoral Student, George Washington University
- Bess Caplan, Ecology Education Program Leader, Baltimore Ecosystem Study
- Tanaira Cullens, Education Assistant, Baltimore Ecosystem Study
- Chelsea McClure, Education Assistant, Baltimore Ecosystem Study
- Martin Schmidt, Upper School Science, McDonogh School

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.

ICE Partners



Cary Institute
of Ecosystem Studies

BALTIMORE CITY
PUBLIC SCHOOLS

THE GEORGE
WASHINGTON
UNIVERSITY
WASHINGTON, DC



This material is based upon work supported by the National Science Foundation under Grant #DRL-1721163. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



WEATHERING, EROSION & DEPOSITION MODULE

Lesson 2 – PHYSICAL WEATHERING

Lesson 2: Physical Weathering

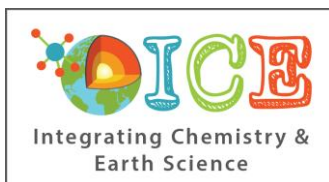
Driving Question: *How does freezing water break down mountains?*

Summary: Students will experiment with factors that lead to the weathering process of ice-wedging and develop a cause and effect understanding of how it contributes to the formation of potholes in our streets. By the end of the lesson sequences, students will "storyboard" the process of pothole formation which will demonstrate their understanding of the concept. They will also complete the rock tumbler activity that models weathering of natural and urban materials. **Teachers notes:** This topic includes a three day lesson set.

Activity Description:


Day 1:

- **Opening Activity:** Students will, once again, identify the agent of change in images. This time the images will be ones that they took of the areas that they live in and submitted to their teacher. This is to show that agents of weathering, erosion, and deposition also effect more urban environments.
 - Using a teacher-created PowerPoint of students' photos, have students identify the cause of change in each image.
 - **Teacher Note:** You may use the *Baltimore Weathering and Deposition Photos Powerpoint* resource if students did not find useable images.
 - Have the class vote for the most powerful or influential "super-agent" of destruction or weathering.
- **Focus on the Cracks:** To begin their direct study of weathering, using ice-wedging, students will examine the power of freezing water and how much it increases in size as it freezes.
 - Students complete the expansion activity from *Brr...It's Cold in Here* (see Lesson 1).
 - Students observe, record and analyze the change in volume of the frozen water.
 - Allow the ice to melt as students analyze their data.
 - Once it has melted, students will record one last set of observations on the volume.
 - **Teacher Notes:** Save the discussion questions/data for after the mini lesson.
- **Frost/Ice Wedging Mini Lesson:** The teacher will facilitate a discussion on the process and mechanism of ice wedging in conjunction with the development of potholes in roads.
 - Show students a picture of a street pothole as a specific example of urban weathering.
 - Have student share their experiences with potholes.
 - When do they form?
 - Where do they form?
 - What is the worst you have ever seen/experienced?
 - Have students explain what they think causes potholes.



WEATHERING, EROSION & DEPOSITION MODULE

Lesson 2 – PHYSICAL WEATHERING

- Show video: [Weathering and Erosion - Freeze Thaw Weathering \(Lammas Science 1:20\)](#)
 - Please note that the speed of the process in the video is greatly exaggerated.
-  **Questioning prompts:**
 - What property of water causes the pattern we observed in the syringe?
 - How can a small change in the volume of water have a big effect on the condition of a street or sidewalk?
- **Set-up Rock Tumbler Model of Weathering of Urban Building Materials – Part 1:** Pause the lesson on Ice Wedging to set up the Rock Tumbler activity. The teacher, along with the students, will be setting up the rock tumbler modeling demonstration as students complete Part 1 of the activity.
 - The teacher will let the students know that we need to allow the ice to finish melting in the syringes, so we are using this time to set up the activity for tomorrow's lesson.
 - Students complete Part 1 of the *Physical Weathering of Urban Building Materials: River Rock Simulation*.
 - **Teacher Note:**
 - Materials for student use:
 - Balances
 - Rocks (some of each rock types)
 - Materials for teacher use:
 - Rock tumbler
 - Water
 - Grit
 - In terms of materials and logistics, your rock tumbler is designed to support 2 tumbling barrels. Depending on your class load, you will need to use 1 barrel per 2-3 classes.
 - Example:
 - Use the first barrel for your first two periods. Demonstrate the setup for both periods and start it tumbling after the second period. Then use the second barrel for the rest of your classes, and start it tumbling at the end of your last class.
 - Next morning, open the first barrel for your first class and save liquid for your second class to see. Have both classes analyze rock data using balances, et cetera.
 - Repeat the process with the second barrel for the rest of your classes.
 - Consult video for tips on how to set up the Tumbler: *River Rock Simulation*.
 - **Logistics suggestion:** As students will need to rotate through the different rock stations, it might be a good idea to have this set up parallel to the pothole storyboarding activity. As students are working on their storyboards, have small groups “step out” of the activity to complete their



WEATHERING, EROSION & DEPOSITION MODULE

Lesson 2 – PHYSICAL WEATHERING

measurements and observations. Then at the end of the period(s) set up the tumbler and set it turning after the appropriate period(s).

Homework: Students will complete Part 2 of the *Physical Weathering of Urban Building Materials: River Rock Simulation activity*.

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.

- Modify classwork, assessments, homework (true/false, reduced responses)
- Clarify or provide directions in the students' native language
- Pair students that share a home language
- 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.

- As this is a three-day lesson set, post an agenda that covers the activities for the three days.

This day's activities could easily be set up as learning stations.

Lesson Summary:

Students should have an idea of the following: Water expands when it freezes. When this expansion happens within the space of a crack in rock or pavement causes the crack to widen. When the water thaws it shrinks to its original volume. When more water fills the cracks and freezes once again the crack will widen further. This process is known as ice or frost wedging and is a component of the formation of potholes in our streets. Students should be asking about what other types of forces cause pot holes? Does water do anything else to the road?

Day II:

Driving Question: *How does moving water break down mountains?*

- **Opening Activity:** Engage students' prior knowledge and experience by viewing images of damage done by water weathering and erosion.
 - Review pictures of weathering caused by running water in Baltimore and dramatic ones around the world (potholes, canyons, etc.).
 - *Water Weathering PowerPoint*
- **Expansion Activity Discussion Questions:** Return to the Expansion activity from Lesson 8. Have the students check the volume of the melted syringes and record the data. Students will then use their



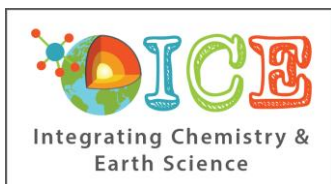
WEATHERING, EROSION & DEPOSITION MODULE

Lesson 2 – PHYSICAL WEATHERING

observations, calculations and the information from the mini lesson to complete the discussion questions in the expansion activity to wrap up this portion of the lesson.

- Have students complete the discussion questions at the end of *Brr...It's Cold in Here* (see Lesson 1).
- **Discussion prompt:** Is the evidence presented today sufficient to conclude that water causes potholes? Why or why not?
- **Rock Tumbler Model of Weathering of Urban Building Materials – Part 2:** Today you will open the rock tumbler so that the students can see the effects of water weathering on rocks. As you do this, be sure to save your “discard water” for your other classes to see. A key point that you will want to emphasize is that this is not directly “dissolving”. The weathering here is due to repeated impacts of the rocks chipping off small particles thus smoothing the rocks.
 - With your class:
 - Review hypotheses predictions
 - Remove rocks and collect data
 - Materials needed:
 - paper towels
 - balances
 - strainer
 - basin/beakers
 - rinse water
 - Analyze and interpret the results
 - Complete pre/post storyboard diagrams showing the changes that took place in the rock tumbler.
 - *Physical Weathering of Urban Building Materials: River Rock Simulation*
 - **Teacher Note:**
 - In terms of materials and logistics, your rock tumbler is designed to support 2 tumbling barrels. It is suggested that, depending on your class load, you use 1 barrel for 2-3 classes.
 - Example:
 - Refer to the example from the previous lesson.
 - Consult the video for tips on how to set up the tumbler: *River Rock Simulation*.
 - **Clean Up:** *Do not* pour the sediment-laden liquid down the drain. It will cause significant clogging. Ask the assistant principal in charge of science where to dump the barrel contents outside.

Homework: Students will complete the video worksheet *Pothole Homework* to prepare for tomorrow's activity.



WEATHERING, EROSION & DEPOSITION MODULE

Lesson 2 – PHYSICAL WEATHERING

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.

- Graphic organizers
- Reduce the writing load (sentence frames and sentence starters)
- Reduced vocabulary load

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.

- As this is a three-day lesson set, post an agenda that covers the activities for the three days.
- This day's activities could be set up as learning stations.

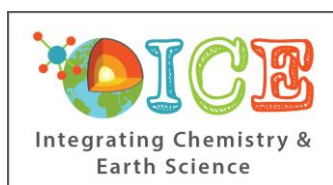
Lesson Summary:

Students should have an idea of the following: River water facilitates weathering of rocks by carrying abrasive particles and rolling stones against each other. When this happens, small pieces break off the larger stones shrinking, smoothing, and rounding them. The sediment is carried off by the flowing water. Different types of rock weather at different rates based on their composition and hardness. Students should be considering how these two processes work together to create potholes in the streets of Baltimore, and if other factors contribute to their formation.

Day III:

Driving Question: *How does water break down other rock materials?*

- **Opening Activity:** Engage the students in a discussion on potholes in Baltimore by discussing the information from the videos that were assigned as homework.
 - Students will share their thoughts on the homework assignment.
- **Pothole Story Board:** Students are asked to summarize what they have learned about ice wedging and its effects on physical surfaces, such as roads, in the formation of potholes. They will storyboard the sequence of events, with full explanations of processes and mechanisms, in this activity.
 - Ask students to explain how ice-wedging and other physical weathering processes apply to pothole formation.
 - Include effects of salt on road causing ice to melt.
 - After the discussion ask students to summarize what they learned about the formation of potholes by creating/drawing a storyboard/comic strip that illustrates and explains the steps of pothole formation using the *Pothole Storyline*.
 - **Teacher Note:** Encourage students to put in as much detail as possible and include both processes and mechanisms for each step/action.



WEATHERING, EROSION & DEPOSITION MODULE

Lesson 2 – PHYSICAL WEATHERING

- **Scaffold Versions of Activity Sheet:** *Pothole Storyline with Mechanisms, Pothole storyline with mechanisms and word bank*
 - Have students do a Gallery Walk using sticky notes to give feedback to their peers regarding their storyboards. Have students focus their feedback on the level of detail and the presence of identified and explained process and mechanisms.
 - Students return to their storyboard and edit/update their model based on the feedback they received from their peers.

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 visuals
- Sentence frames and sentence starters
- Monitor responses

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.

- As this is a three-day lesson set, post an agenda that covers the activities for the three days.

Utilize the scaffold resources provided for the Pothole storyboard activity.

Lesson Summary:

Students should have an idea of the following: Physical weathering breaks objects into smaller pieces but does not change the identity of the object. Water is a major component of Physical weathering due to its ability to expand when it freezes and through flowing water aiding in abrasion. These two processes are a significant component in the formation of potholes in city streets as well as the natural landscape. Questions they should be considering, at this point, include how can weathering change the composition of the rocks?

