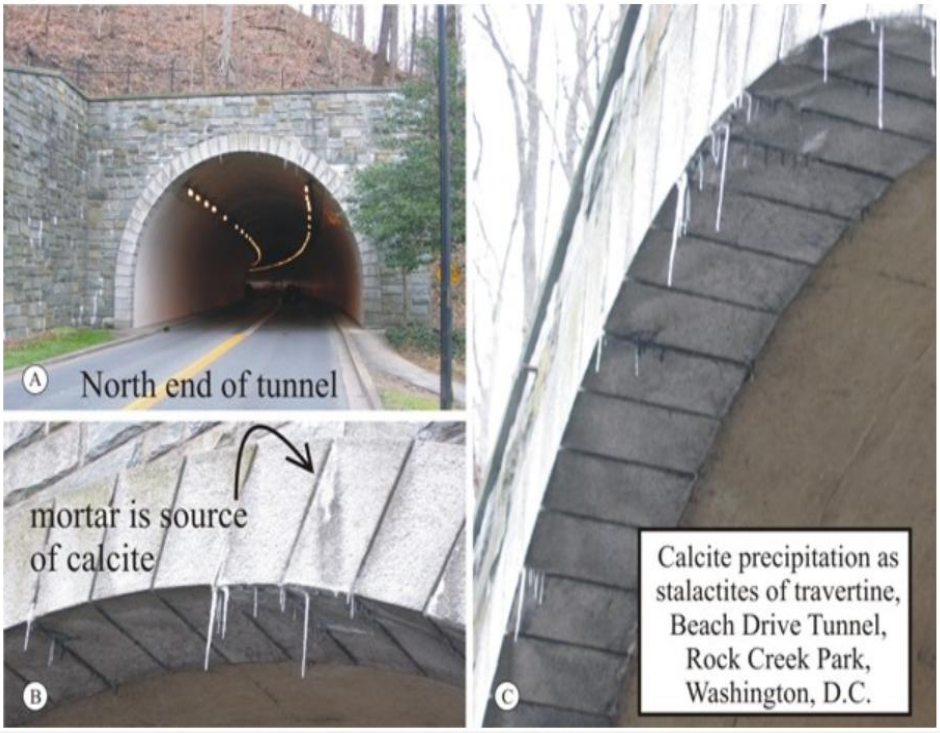
Integrating Chemistry & Earth Science

WEATHERING, EROSION & DEPOSITION MODULE

LESSON 7:

CHEMICAL DEPOSTION

An example of chemical weathering, a natural geologic process, operating on an artificial structure. **Reprecipiation of calcite**, north end of Beach Drive Tunnel, near the National Zoo. Calcite is dissolved out of the mortar by rain, carried a short distance, then redeposited drop by drop into stalactites. A more complete description appears below.



THE GEORGE WASHINGTON UNIVERSITY WASHINGTON, DC

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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.

ICE Partners

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Lesson 7: Chemical Deposition

Driving Question: *What happens to dissolved materials?*

Summary: Students will **simulate the process of limestone formation** in a chemical deposition lab activity by blowing through limewater.

Activity Description:

- **Opening Activity What is Limestone?** Engage student's prior knowledge (6th and 8th grade instruction) of sedimentary rock types and limestone with this activity.
    - Have students search the internet for information on how limestone is formed.
    - Ask students to write one paragraph summarizing the process of limestone formation.
        - Possible modification**:** Allow students to write a bulleted list.
    - Ask students to share what they have found with the class**.**
- **Limestone Formation and Dissolution Lab Activity:** Students will investigate the formation of limestone by observing chemical deposition from lime water.
    - To begin, review chemical weathering that may have taken place in the rock tumbler.
    - Students will complete the Chemical Deposition and Limestone Laboratory activity.
        - **Teacher Note**:
            - Material Preparation:
                - Clear Cups
                - Straws
                - Lime water (Saturated solution)
                - Timer
                - Goggles
        - There are detailed teacher notes for the activity at the beginning of the Chemical Deposition - Limestone Formation and Dissolution Lab document and the *Chemical Deposition Lab Video*. The video goes through the mechanics of the activity and other considerations for the students.
- **Chemical Deposition Forming Rocks in the Baltimore Region:** With the teacher's guidance, students will expand their focus to the regional level and learn about mineral depositions in the Baltimore region.
    - Teacher and students review PowerPoint *Example of Rock & Mineral Deposition* showing interesting examples of chemical deposition at work in the region.

Homework: Complete lab write-up.

Sources of Evidence of Three-Dimensional Student Learning: Students will write a well-constructed report for the laboratory investigation.

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.

- Link concepts to students' background experiences
- Make explicit links between past learning and new concepts
- Active listening guides
- Reduced vocabulary load
- Clarify or provide directions in the native language

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.

Lesson Summary: Students should have an idea of the following: Chemicals dissolved in water can for solids. Animals can facilitate chemical deposition by creating shells. Chemical deposition is also the chemical process known as precipitation. Ions in solution can react to form solid materials. The deposited materials form sedimentary rocks such as limestone.

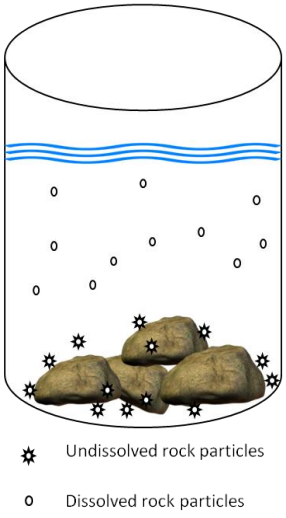
Chemical Deposition – Limestone Formation and Dissolution Lab

Teacher Overview:

In this activity, you will consider what happens to the material that is dissolved in water – in streams and rivers, bays and oceans, even groundwater - from chemical weathering. You will conduct an experiment to study the conditions under which calcium carbonate precipitates or is deposited out of solution in water.

Part 1 – Review of chemical weathering / class discussion

- Recall the physical weathering activity with the rock tumbler.
- Project the mass loss for each rock type on the board
- Discussion Questions
  - Which material lost the most mass? Which lost the least mass?
  - Where did the mass from these materials end up?
    - In the water in the tumbler
  - How did those materials get into the water in the barrel?
  - Now that these materials are in the water, what do you think will happen to the materials?
    - The heavier materials settle out along the bottom of the barrel
    - Materials that have dissolved into the water column remain in the water column. Some may precipitate out. How?



  - Can you think of an aquatic organism that draws elements from the water column for life? What about terrestrial organisms?
    - Fresh water snails are precipitating out the calcium to make their bodies. If there is a stream without enough calcium, those streams won't have shell forming organisms in them.
    - Salt water oysters make their shells came from calcium that came from the mountains. The calcium was dissolved from the mountains, got into streams and then the Bay where it was precipitated out into calcite by the oysters.
    - There would be no life on the planet without weathering. All elements would be locked up in rocks and not available for life.
    - Where do YOU get the calcium for your body – bones, etc?
  - Recall the materials in Baltimore that weather the most. What minerals are in marble? Background materials on Marble.

Part 2 - The Limewater Experiment / Student lab activity – Student sheet below

Background

- In some instances, weathered materials can form new rocks. These are called sedimentary rocks.
- In some cases, sedimentary rocks can form through a chemical process. For instances, when CO2 reacts with calcium in the water column, Limestone may be formed by direct precipitation of calcium carbonate. Gas + Liquid = Solid.
- In this experiment, we are going to simulate this process. Gas + Liquid = Solid
- Limewater has a high concentration of calcium.
- Carbon dioxide passed into limewater gives a milky solution, due to precipitation of an insoluble suspension of calcium carbonate:
    - $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$
    - If excess CO_2 is added, the following reaction takes place:

$CaCO_3(s) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$

    - The milkiness disappears since calcium bicarbonate is water-soluble

Objectives

- Observe chemical deposition in an aqueous system

Materials

- Limewater-$Ca(OH)_2$
- Straws
- Goggles
- Gloves
- Clear plastic cups/beakers
- Timer/stopwatch.
- pH paper (optional)

Sequence

- Decant limewater into a clear plastic cup or beaker (approximately 1-2cm depth)
- Gently blow through straw into limewater until limewater becomes cloudy
- Let settle on counter for a period of time
- Record observations and discuss
- Continue to blow into limewater through straw until limewater becomes clear
- Record observations and discuss

Observations Blowing Part I

Time	Description of Limewater	Notes

0:00		
1:00		
2:00		
3:00		
4:00		

Observations after Settling

_____

_____

Observations Blowing Part II

Time	Description of Limewater	Notes
0:00		
1:00		
2:00		
3:00		
4:00		

Discussion Questions

1) What gas are you blowing out?
2) What is the chemical reaction causing the precipitate to form?
3) What is the chemical formula of the precipitate?
4) What happens to the precipitate when you continue to blow through the straw?
5) In unit 4, you learned about Ocean Acidification. How does this activity connect to that phenomena?
6) How might chemical deposition help cement the pebbles, sand or silt to turn them into rock (sedimentary rock formation)?
7) What are some other examples of chemical deposition to form rocks?

Chemical Deposition – Limestone Formation and Dissolution

Background

- In some instances, weathered materials can form new rocks. These are called sedimentary rocks.
- In some cases, sedimentary rocks can form through a chemical process. For instances, when carbon dioxide reacts with calcium in the water column, Limestone may be formed by direct precipitation of calcium carbonate. Gas + Liquid = Solid.
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Procedures

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2. Gently blow through straw into limewater until limewater becomes cloudy
3. Let settle on counter for a period of time
4. Record observations and discuss
5. Continue to blow into limewater through straw until limewater becomes clear
6. Record observations and discuss

Observations Blowing Part I

Time (min)	Description of Limewater	Notes
0:00		
1:00		
2:00		
3:00		
4:00		

Observations after Settling

_____

_____

Observations Blowing Part II

Time (min)	Description of Limewater	Notes
0:00		
1:00		
2:00		
3:00		
4:00		

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Discussion Questions

8) What compound are you exhaling through the lime water?
9) What is the chemical reaction is causing the precipitate to form?
10) What is the chemical formula of the precipitate?
11) What happens to the precipitate when you continue to blow through the straw?
12) In unit 4, you learned about Ocean Acidification. How does this activity connect to that phenomena?
13) How might chemical deposition help cement the pebbles, sand or silt to turn them into rock (sedimentary rock formation)?
14) What are some other examples of chemical deposition to form rocks?