



Lesson Title	Acids and Bases in the Environment (Acid Rain)
Length of Lesson	45 minutes
Created By	Cheryl McLaurin
Subject	Chemistry
Grade Level	10-12
State Standards	3.c., 3.d., 5.a
DOK Level	1, 2, &3
DOK Application	Cause/effect, Compare, Predict, Calculate, Investigate
National Standards	B: Physical Science
Graduate Research Element	Erosion processes

Student Learning Goal:

Students will discover the chemical process behind acid rain formation. They will also be exposed to the acid-base reactions that rain and acid rain has on some geologic features. The difference between acidified habitats and naturally-occurring acidic environments will be covered.

State Standards:

3.c. Classify chemical reactions by type

- Single displacement, double displacement, synthesis (combination), decomposition, disproportionation, combustion, or precipitation.
 - Products (given reactants) or reactants (given products) for each reaction type.
- Students will identify that a double displacement reaction occurs and what the products will be.*

3.d. Use stoichiometry to calculate the amount of reactants consumed and products formed.

- Difference between chemical reactions and chemical equations.
 - Formulas and calculations of the molecular (molar) masses
 - Empirical formula given the percent composition of elements
 - Molecular formula given the empirical formula and molar mass
- Students will be asked to calculate how much calcium carbonate it would take to neutralize a 1" rainfall event over the city of Starkville.*

5. a. Analyze and explain acid/base reactions.

- Properties of acids and bases, including how they affect indicators and the relative pH of the solution
- Formation of acidic and basic solutions
- Definition of pH in terms of the hydronium ion concentration and the hydroxide ion concentration
- The pH or pOH from the hydrogen ion or hydroxide ion concentrations of solution



- How a buffer works and examples of buffer solutions
Students will learn how acid rain forms and its effect on the environment.

National Standards:

B. Physical Science: Chemical Reactions

- Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies.
- A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms. In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to form new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gases in the atmosphere, burning and processing of fossil fuels, the formation of polymers, and explosions.

Materials Needed (supplies, hand-outs, resources):

Powerpoint, chalk or limestone, acid and basic soil samples, environmental test kit

Lesson Performance Task/Assessment:

Students will be asked to explain why certain acid-base reactions occur during demo.

Lesson Relevance to Performance Task and Students:

Recall and application of the lecture.

Anticipatory Set/Capture Interest:

Pictures of damage from acid rain will be shown and students will be asked to explain what has occurred.

Guided Practice:

Students will hear a presentation on the chemical processes of acid rain, the causes behind it, and how it affects the environment. Students will be shown the difference between naturally-occurring acidic environments and damage from acid introduced to an environment.

Independent Practice:

Students will be asked to balance and calculate how much calcium carbonate it takes to neutralize nitric acid. If acid and basic soil samples can be obtained, students can perform a soil pH test (ex. LaMotte Environmental test kit) and be asked to predict the outcome when nitric acid is dropped on soils of differing pH's.



Remediation and/or Enrichment:

IEP's will be supported. Other acidic equations can be reviewed to give students more practice and expose them to other reactions possible.

Check(s) for Understanding:

- How does acid rain differ chemically from regular rain?
- How does acid rain affect you?
- Are all acidic situations negative?

Closure:

Students will be shown a demo of the effect of acid on rocks, soil, and plants.

Possible Alternate Subject Integrations:

Earth Science, Biology

Teacher Notes:

- Nitric or sulfuric acid can be used for demo.
- Look up the typical rain and soil pH for your area to describe the effect of acid rain on your area.
- Kits for acid rain demos are available.