Lesson Title	ALERT: Chemical Reactions EVERYWHERE
Length of Lesson	Up to two (50 minute) class periods
Created By	Calista Guthrie
Subject	General Science
Grade Level	8th grade
State Standards	8th: 1a, 1b, 1c, 1d, 1e (Inquiry); 2a, 2b (Physical Science); 3h (Life Science)
DOK Level	1, 2, 3
DOK Application	Repeat, Arrange, Label, Define, Recall, Identify Patterns, Construct, Cause/Effect, Observe, Compare, Hypothesize
National Standards	5-8: A (Inquiry); B (Physical Science); C (Life Science); D (Earth & Space Science)
Graduate Research Element	In anoxic conditions, sulfate-reducing bacteria may degrade organic matter, thereby producing sulfide, which is toxic for grasses.

Student Learning Goal:

MS 8th Grade:

1. Inquiry: (a) (b) Distinguish between qualitative and quantitative observations and make inferences based on observations. (c) Summarize data to show the cause and effect relationship between qualitative and quantitative observations. (d) Analyze evidence that is used to form explanations and draw conclusions. (e) Develop a logical argument defending conclusions of an experimental method.

2. Physical Science: (a) Identify patterns found in chemical symbols, formulas, reactions, and equations that apply to the law of conservation of mass. (b) Predict the properties and interactions of given elements using the periodic table.

3. Life Science: 3(h) Describe how an organism gets energy from oxidizing its food and releasing some of its energy as heat.

National Science Education Standards of Content 5-8:

A: Inquiry: Use appropriate tools and techniques to gather, analyze, and interpret data. Develop descriptions, explanations, predictions, and models using evidence. Think critically and logically to make the relationships between evidence and explanations. Communicate scientific procedures and explanations. Understanding about scientific inquiry.

B: Physical Science: Properties and changes of properties in matter. Transfer of energy.

C: Life Science: For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. Lack of resources limit the growth of populations in specific niches in the ecosystem.

D: Earth and Space Science: Soil consists of weathered rocks and decomposed organic material from dead plants and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.

Materials Needed (supplies, hand-outs, resources):
For demonstration: Baking soda, calcium chloride, phenol red, water, tray to contain mess, zip lock bag, spoons, 2 tubes, 2 sets of gloves, 2 pairs of goggles, matches.
For activity: assorted colors of LEGOs, Student worksheets (INSPIRE_Day1WorkSheet_Guthrie_07.13.12.doc, INSPIRE_Day2WorkSheet_Guthrie_07.13.12.doc)

Lesson Performance Task/Assessment:
Students will observe the reaction that occurs when phenol red is added to the baking soda/ calcium chloride mixture. Using LEGOs, students will build a model of the reaction. After modeling the reaction that they can see, they will discuss that chemical reactions are not just in a lab; they are everywhere, even when we cannot see them. Ask students to list some examples of a chemical reactions. Even when we breathe, a chemical reaction occurs! What do we breathe in? Out? What happens when you blow hot air onto glass? It fogs up. Why? Because you exhale carbon dioxide AND water vapor! We need oxygen to respire - do all organisms use oxygen for respiration? Next, students will model respiration and photosynthesis using LEGOs. Students will discuss how the equations differ and why they are important. For example, photosynthesis produces organic matter; this is how plants grow and sustain themselves. Respiration is the reverse of photosynthesis. The students will then be shown the reaction for sulfate reduction and asked to identify differences and similarities with the reaction for respiration. The point should be brought up that breakdown of organics through different metabolic processes, like sulfate reduction, releases different by-products to the environment that can affect the things that live there. For example, sulfide (a product of sulfate reduction) is toxic to many plants. Organic matter is still involved (CH_2O), but instead of reacting with oxygen, it reacts with sulfate. This point is brought out to show students that organisms are diverse, and resources can control what organisms can survive in an environment.

Lesson Relevance to Performance Task and Students:
Students will be introduced to chemical formulas and equations (reactants, products, balancing). They will then apply what they learn from the demonstration reaction to model photosynthesis and respiration. They will discuss that if no oxygen is available for

respiration there are other mechanisms for respiration such as sulfate reduction. Sulfate reduction is a dominant process in organic rich environments where oxygen is limited.

Anticipatory Set/Capture Interest:
Demonstration of a reaction:

> In a zip-lock bag add 1 spoonful of baking soda and 2 spoonfuls of calcium chloride. Put phenol red in a tube and hold the tube upright inside the bag. Seal the bag and empty the tube. When the bag is getting full, open it to release pressure. When the bag is opened, light a match inside (see video in Teacher Notes).

Students will form hypotheses about what is causing the reaction that they observe.

Guided Practice:
In the first class period students will be guided in a class discussion introducing chemical reactions. The demonstration reaction and model will be done together as a class. Inform students what color LEGOs represent what elements. For example color keys and LEGO compounds, see LEGO Atoms and Molecules: Chemical Reactions (see Teacher Notes). Students will use the worksheet INSPIRE_Day1WorkSheet_Guthrie_07.13.12.doc to familiarize students with terminology as the LEGOs help them to demonstrate the terminology.

Independent Practice:
In the second class period, students will build models of reactions for photosynthesis and respiration using LEGOs. Inform students of the color representing each LEGO element. For example color keys and LEGO compounds, see LEGO Atoms and Molecules: Photosynthesis (see Teacher Notes). Students will follow instructions and answer questions using the worksheet provided (INSPIRE_Day2Worksheet_Guthrie_07.13.12).

Remediation and/or Enrichment:
Remediation – Have students practice writing formulas using the color-coded elements provided for the demonstration. The formulas do not have to occur in nature, just let them practice and build the model.

Enrichment- Instead of doing a demonstration, place students in pairs and have each group do the experiment. To expand on the experiment, view the Wet Lab Video (see Teacher Notes). If working in the lab is too challenging, have students model another reaction (either one you provide or one they look up for homework). Students should provide the key for what elements are represented by different colors, as well as the balanced chemical equation.

**See INSPIRE_Remediation-Enrichment_Guthrie_07.13.12.doc for worksheet ideas.

Check(s) for Understanding:
Satisfactory completion of worksheets in addition to class discussion during closure. On day 2 students should employ the terminology they learned in day 1. Students should recognize that respiration is not just a term used when WE breathe. It is how living cells "breathe". They should understand how to write chemical formulas and be able to identify reactants and products in a chemical equation.

Closure:
For closure, the class will discuss the results from the demonstration. The discussion could be led with a series of questions.

Example questions to get started:
Question 1: Why do plants photosynthesize?
Question 2: Why do chemical reactions have to be balanced?

Possible Alternate Subject Integrations:
Math

Teacher Notes

Guidance for Reactions
INSPIRE_Guidance_Guthrie_07.13.12.doc

LEGO Atoms and Molecules: Chemical Reactions
http://mindandhand.mit.edu/educators/curriculum-packages/lego-chemistry.shtml

LEGO Atoms and Molecules: Photosynthesis
http://mindandhand.mit.edu/educators/curriculum-packages/photosynthesis.shtml

Wet Lab Video
http://techtv.mit.edu/videos/14780-lego-atoms-and-molecules-chemical-reactions-part-1-wet-lab