Lesson Title	Stoichiometry
Length of Lesson	1 day (90 minutes)
Created By	Hannah Box
Subject	Chemistry
Grade Level	10th
State Standards	9-12: 1c,1d, 3d,4b,5c
DOK Level	DOK 2/DOK 3
DOK Application	Graph, compare, collect and display, modify, make observations/investigate, draw conclusions
National Standards	Science as Inquiry A: Physical Science B
Graduate Research Element	Stoichiometry is important because reaction conditions are often optimal with specific stoichiometric amounts and will not proceed unless this requirement is met. As a graduate student in chemistry, I use stoichiometry to make calculations every day.

Student Learning Goal:

Students will construct a small plastic rocket. This bulb is filled with water, and then most of the water is displaced - first with hydrogen and then oxygen. Electrodes are inserted into the device. A spark causes the mixture to ignite and launch the rocket. Students are challenged to find the mixture and then use it to launch a rocket across the room using proper stoichiometry.

State Standards: Chemistry:

1c. Demonstrate the use of scientific inquiry and methods to formulate, conduct, and evaluate laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)

1d. Organize data to construct graphs (e.g., plotting points, labeling x-and y-axis, creating appropriate titles and legends for circle, bar, and line graphs), draw conclusions, and make inferences. (DOK 3)

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

4b. Use the ideal gas laws to explain the relationships between volume, temperature, pressure, and quantity in moles. (DOK 2)

5c. Analyze a reduction/oxidation reaction (REDOX) to assign oxidation numbers (states) to reaction species and identify the species oxidized and reduced, the oxidizing agent, and reducing agent. (DOK 2)

National Standards:

Science as Inquiry: A:

- IDENTIFY QUESTIONS AND CONCEPTS THAT GUIDE SCIENTIFIC INVESTIGATIONS. Students should formulate a testable hypothesis and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment. They should demonstrate appropriate procedures, a knowledge base, and conceptual understandings of scientific investigations.

Physical Science: B:

- CHEMICAL REACTIONS. Catalysts, such as metal surfaces, accelerate chemical reactions. Chemical reactions in living systems are catalyzed by protein molecules called enzymes.
- CHEMICAL REACTIONS. Solids, liquids, and gases differ in the distances and angles between molecules or atoms and therefore the energy that binds them together. In solids the structure is nearly rigid; in liquids molecules or atoms move around each other but do not move apart; and in gases molecules or atoms move almost independently of each other and are mostly far apart.
- CHEMICAL REACTIONS. A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecule, 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):

For each group of 3-4 students, you will need: mossy Zn, 1.0 M HCl, freshly opened 3% H_2O_2, a catalyst for the H_2O_2 (1.0 mL of yeast water), 1 petri dish half, 2 vials with pop off lids (H_2 and O_2 generators), incremented pipet bulb, piezoelectric sparking mechanism (modified Charcoal Lighter), Electric tape, film canister cap, hot glue gun, 10 cm of 24 AWG speaker hook-up wire (double solid, not stranded: Radio Shack #278-1509), and wire strippers

Lesson Performance Task/Assessment:

Students will collect data in an attempt to find the combination of Hydrogen and oxygen that makes the loudest pop and will launch the farthest distance when a spark is applied.

Lesson Relevance to Performance Task and Students:

The students will use their knowledge of stoichiometry to guide them throughout the experiment and come to the conclusion that the balanced chemical equation will provide them with the answer to this inquiry.

Anticipatory Set/Capture Interest:

Discuss with the students how this reaction is used in the main engines of the space shuttle. http://www.nasa.gov/returntoflight/system/system_SSME.html

Guided Practice:

Students should have already covered stoichiometry so that the entire time may be dedicated to performing the lab.

Independent Practice:

The teacher will demonstrate to the students how the set up will work and the students will work through the worksheet and experiment in groups of 2-3.

Remediation and/or Enrichment:

Remediation: Individual IEP. Have the students perform only do part one of the experiment. Create larger groups of students.

Enrichment: Have students repeat these experiments with other reactive gases and make a comparison.

Check(s) for Understanding:

What types of reactions were used to produce the hydrogen and oxygen gas?

Would your results change if the bulb was calibrated wrong? Explain.

Each group will be expected to shoot their pipet bulbs successfully at least once.

Each student will complete the questions on their worksheet.

Closure:

Students will discover that the perfect combination of gases to make the loudest pop and the launch the farthest distance is that of the balanced chemical equation.

Possible Alternate Subject Integrations:

Teacher Notes:

Lesson modified from:
http://chemmovies.unl.edu/chemistry/beckerdemos/bd000.html