Lesson Title	Properties of Gases
Length of Lesson	90 minutes
Created By	David Wilson
Subject	Chemistry / Physical Science
Grade Level	9-12th Grade
State Standards	2a, 4(a,b,c) / 4d
DOK Level	1, (3,2,2) / 2
DOK Application	Classify, (analyze, use) / utilize
National Standards	9-12: B: Physical Science
Graduate Research Element	A study of the properties of gases is a fundamental area of chemistry. These properties dictate the function of many of the analytical instruments (AA, GC, ICP, SCF-LC, etc.) necessary for studying chemistry.

Student Learning Goal:

State Standards: (Chemistry)

2) Demonstrate an understanding of the atomic model of matter by explaining atomic structure and chemical bonding.

a. Describe and classify matter based on physical and chemical properties and interactions between molecules or atoms. (DOK 1)

4) Analyze the relationship between microscopic and macroscopic models of matter.

a. Analyze the nature and behavior of gaseous, liquid, and solid substances using the kinetic molecular theory. (DOK 3)

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

c. Use the gas laws of Boyles, Charles, Gay-Lussac, and Dalton to solve problems based on the laws. (DOK 2)

State Standards: (Physical Science)

4) Develop an understanding of the atom.

d. Utilize the periodic table to predict and explain patterns and draw conclusions about the structure, properties, and organization of matter. (DOK 2)

National Science Standards: (9-12)

B: Physical Science: Structure and Properties of Matter.

- 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.

Materials Needed (supplies, hand-outs, resources):
{**WARNING**: Please read the MSDS of any chemical before using it.}
[Quantities of the following supplies listed are per each group.]
DEMO 1 – Balloon in a Bottle

- 1 balloon
- 1 bottle (glass or plastic)

DEMO 2 – Can Crusher

- 1 aluminum can
- water
- hotplate
- pie pan

DEMO 3 – 2 Magic Jars

- 2 mason jars (with lids)
- 5"x5" window screening
- water

DEMO 4 – HCl and NH_3

- 2, 50 mL beakers
- 30 mL ammonia (NH_3)
- 30 mL concentrated hydrochloric acid (HCl)
- Parafilm

DEMO 5 – Explosive Reaction #1

- 8 grams ammonium nitrate (finely, freshly ground)
- 8 grams zinc powder
- 1 gram ammonium chloride
- ceramic tile
- glass petri dish

DEMO 6 – Explosive Reaction #2

- 5 grams iodine
- 50 mL concentrated ammonia
- filter paper

DEMO 7 – Cartesian Diver (quantities per each student)

- 1, 20 oz plastic bottle of water
- 1 plastic transfer pipette
- 1 hex nut (sized so that it fits very snuggly onto the pipette stem)
- OPTIONAL:
    - Hot glue and hot glue gun
    - Food coloring

{See the Teachers Notes at the end of the lesson plan for directions.}

Lesson Performance Task/Assessment:

1) Students will describe and explain the demonstrations shown them in terms of force of pressure, air pressure, and temperature.

2) Students will relate the demonstrations to the properties of gases and gas laws, which they have learned previously.

Lesson Relevance to Performance Task and Students:
The students have learned to interpret descriptions of the properties of gases. They have learned also to perform calculations associated with the gas laws. In this lesson they will observe the practical implications of the descriptions of the properties of gases with they have learned.

Anticipatory Set/Capture Interest:
The students will be reminded of the gas properties that they have learned thus far, and the first demonstration will effectively motivate the students in the lesson. Each demonstration is rather dramatic.

Guided Practice:
As a class, each demonstration will be discussed without my giving the students a concrete explanation of the properties. The students' thinking will be probed and guided with each demonstration.

Independent Practice:
Students will create their own Cartesian diver after being shown a completed one. They will have to construct it on their own. {See the Teachers Notes at the end of the lesson plan for directions.}

Remediation and/or Enrichment:
Remediation: Individual IEP.
Enrichment: The students will relate the Cartesian diver to the concept of buoyancy and the construction of submarines.

Check(s) for Understanding:
Class discussions and students' written explanations will be used to evaluate students' understanding.

Closure:
Students will explain each demonstration orally as a class.

Possible Alternate Subject Integrations:
This lesson is purely physical science.

Teacher Notes:
Instructions:

1) Balloon in a bottle
    a. http://youtu.be/Rcnv0gGYup8 - - First demo in this video.

   b. Extension: Tell the volunteer you'll pay them $50 if they can blow it up. They won't be able to. Ask them if they'll pay you $50 if you can blow it up. If they say yes, squeeze the bottle until the balloon pops out and inflates.
2) Can Crusher
   a. http://youtu.be/Rcnv0gGYup8 - - Third demo in this video at 1:20 min.
3) 2 Magic Jars
   a. http://www.wonderhowto.com/how-to-do-floating-water-trick-162796/
4) HCl and NH_3
   a. http://youtu.be/qdQ62Z5Io1g - - First demo on this video.
5) Explosive Reaction #1
   a. WATCH THESE BEFORE DOING THE REACTION!
      i. http://youtu.be/XFR1VeDOKs8
      ii. http://youtu.be/E5iBZdEIg8Y
      iii. The reactions are more violent than they appear in the video.
6) Explosive Reaction #2
   a. WATCH THESE BEFORE DOING THE REACTION!
      i. http://youtu.be/L436Rx42jXg
         1. Notes: No filtration is necessary. Just spoon out the solid after the reaction, and spread it on filter paper to let it dry undisturbed.
         2. As long as it is wet it is not explosive. When it dries, it is explosive.
      ii. Classic Video: http://youtu.be/2KlAf936E90
7) Cartesian Diver
   a. Detailed Reference with videos: http://dwb4.unl.edu/chemistry/beckerdemos/BD031.html
   b. Alternative Method with straws: http://youtu.be/BiI7DhFgoNQ