Lesson Title	Pure Substances and Mixtures
Length of Lesson	90 minutes
Created By	Christopher Ramos
Subject	Science
Grade Level	10-12 (Physical Science)
State Standards	Physical Science: 1b, c, d, g,
DOK Level	Three
DOK Application	Draw conclusions, investigate, compare, construct
National Standards	9-12: A (Inquiry); B (Physical Science)
Graduate Research Element	Identification skills necessary in determining effects of contaminants on plant health

Student Learning Goal: The goal is for students to understand the properties of heterogeneous and homogenous mixtures. The aim of the discussion will be for the student to be able to distinguish between homogeneous and heterogeneous mixtures (and type: suspension, colloid As well, this lesson will hark back to previous lessons on the **kinetic theory**.

Beginning with an animated demonstration of Brownian motion - the seemingly random motion of a particle (like dust) suspended in air or water - to capture student, the teacher will lead a discussion on types of mixtures (which are composed of pure substances).

The students will gain an intuitive grasp of the concepts of diffusion, Brownian motion, and homogeneous mixture by engaging in a group exercise (see guided practice). They will plot data into a series of matrices. To do so, they must work together.

As well, students examine various pure substances and mixtures to practice their identification skills.

National Science Education Standards of Content

9-12: Science as Inquiry: Understandings about Scientific Inquiry

*Scientists conduct investigations for a wide variety of reasons. For example, they may wish to discover new aspects of the natural world, explain recently observed phenomena, or test the conclusions of prior investigations or the predictions of current theories.

*Scientists rely on technology to enhance the gathering and manipulation of data. New techniques and tools provide new evidence to guide inquiry and new methods to gather data, thereby contributing to the advance of science. The accuracy and precision of the data, and therefore the quality of the exploration, depends on the technology used.

*Mathematics is essential in scientific inquiry. Mathematical tools and models guide and improve the posing of questions, gathering data, constructing explanations and communicating results.

9-12: Physical Science: Structure and Properties of Matter
*The physical properties of compounds reflect the nature of the interactions among its molecules. These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them.

Materials Needed (supplies, hand-outs, resources):
Mixing (guided practice):
a penny for each student, masking tape, crayons (yellow, blue, grey), stop watch

(INSPIRE_HO_Ramos_07-30-10_brownian-motion.doc)
(INSPIRE_HO_Ramos_07-30-10_mixing-exercise-layout.xls)

Mixtures and Pure Substance (independent):
Beakers, beaker heaters, ethanol, water, thermometers, periodic table, heat resistant gloves, flour, digital scale, olive oil

(INSPIRE_HO_Ramos_07-30-10_Substance-and-Mixture-Identification.doc)

Lesson Performance Task/Assessment:
The students will divide into groups and work on the "INSPIRE_HO_Ramos_07-30-10_Substance-and-Mixture-Identification.doc" worksheet in order to hone their identification skills and relate the knowledge yielded by the lecture to real world examples.

Lesson Relevance to Performance Task and Students:
The usage of engaging activities is meant to better solidify the knowledge from lecture into the students' minds.

Anticipatory Set/Capture Interest:
1. Students will be showed a java applet demonstrating an animation of Brownian motion. This is meant to connect back to the kinetic theory of gases.

http://galileo.phys.virginia.edu/classes/109N/more_stuff/Applets/brownian/brownian.html

Guided Practice:

As a class, students can perform an exercise that simultaneously demonstrates spontaneous mixing by random motion, diffusion, as well as Brownian motion. This exercise will help the student visualize the homogeneous mixtures as well as the random nature of gas particle movement.[1]

1) Each student will receive a penny and a crayon. Half of the class will receive a blue crayon (representing water) and the other half will receive a yellow crayon (representing ethanol). While one student receives a grey crayon (representing a mote of dust).

2) The crayons will be necessary for the students to fill out the tables in INSPIRE_HO_Ramos_07-30-10_mixing-exercise-layout.xls.

3) The students will stand in rows according to the exercise layout and they will use the previously taped marked guide to do so.

4) For about160 seconds, students will flip their coin and make the appropriate movement (the students need not be in sych).

a) If the student flips heads, they will turn to the right and take a step forward.

b) If the student flips tails, they will turn to the left and take a step forward.

c) If the space is occupied, they can choose to flip the coin again or wait until the space in front of them becomes available.

d) The student representing the mote of dust will not have their own coin. Instead, when a student representing a water or ethanol molecule wants to occupy the mote's space, they will NUDGE the mote into another space.

e) The teacher will ask everyone to stop after 5 seconds and record their current position in the appropriate table.

The teacher will ask everyone to stop after 5 more seconds have past and record their current position in the appropriate table.

The teacher will ask everyone to stop after 10 more seconds have past and record their current position in the appropriate table.

[1] http://www.physics.emory.edu/~weeks/squishy/Experiments.html

The teacher will ask everyone to stop after 20 more seconds have past and record their current position in the appropriate table.

The teacher will ask everyone to stop after 40 more seconds have past and record their current position in the appropriate table.

The teacher will ask everyone to stop after 80 more seconds have past and record their current position in the appropriate table.

5) Teacher will ask the students to share their six different positions with the class. Each student need only mark the color that student used in their respective table sheet.

Independent Practice:
See "INSPIRE_HO_Ramos_07-30-10_Substance-and-Mixture-Identification.doc" worksheet.

Remediation and/or Enrichment:
Remediation: Individual IEP; partner help throughout lesson; shorten parts of the assignment; focus on few samples.

Enrichment: Have students who finish early write a paragraph describing why they think it is important to be able to identify different kinds of mixtures (for instance, you wanted to drink a glass of water with bits of grit and dirt floating in it - a suspension).

Check(s) for Understanding:
1. Recap the differences between heterogeneous mixtures and homogenous mixtures (solutions, emulsions, suspensions).

Closure:
When all is done, take some time to poll the students: did they understand? Ask students who seem disinterested to explain the difference between heterogeneous and homogeneous mixtures. How are heterogeneous and homogeneous mixtures similar?

Teacher Notes:

Preparation:
Following the layout guide, the teacher must mark the floor of the classroom with masking tape and identify with tape the square number (eg: A1, B7, etc)

Reference Notes:
http://www.saskschools.ca/curr_content/science10/unita/redon12.html