Title:	Density Towers		
Author:	Jim Magee Brookland High School Brookland		
Course: **Grade:**	Environmental Science, Earth Science, Language Arts 11 – 12		**Duration:** Two 45-minute class periods
Objective: Demonstrate an understanding of density and internal layering of the earth; explain how this layering can help petroleum geologists explore for oil and natural gas.			
Summary of Lesson: Materials of the earth separate out by density and form distinct layers.			
Arkansas Standards:			
CLASS	**GRADE**	**SLE**	**STANDARD**
Environmental Science	**9-12**	**EVS-PS3-2**	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
Earth Science	**9-12**	**ES-ESS3-1**	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
Language Arts	**9-12**	**W.9-10.1.C** **W.11-12.1.C**	Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, reasons and evidence, and claim(s) and counterclaims; include commentary for support.
		W.9-10.1.E **W.11-12.1E**	Provide an appropriate concluding statement or section that supports the argument presented.
		W.9-10.2 **W.11-11.2**	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Teacher Excellence and Support System (TESS):
Domain 1b: Teacher Knowledge of students. (Learning types)
Domain 1d: Demonstrating knowledge of resources. (Use what is available)
Domain 2b: Establishing a culture for learning.
Domain 3c: Engaging students in learning. (Get them involved)

Instructional Strategies and Practices:
Marzano: Nonlinguistic representations.

Bloom's Level: Highest Level Only
Analyzing density of materials to determine layering.

Materials and Resources:

- Student Handout Density Towers Lab Report (one per student)
- Per lab group
  - 6 small plastic cups per group (at least 6-ounce capacity)
  - ¼ cup vegetable oil
  - ¼ cup isopropyl alcohol
  - ¼ cup water
  - ¼ cup dish soap
  - ¼ cup dark corn syrup (Karo)
  - ¼ cup motor oil
  - 1 drinking water bottle (at least 700ml size)
  - 100ml beaker
  - balance or digital scale
  - Food coloring (Choose colors that will be different than those already showing in the other liquid samples)
  - Computer/iPad/chrome book with internet access

Suggested Resources:
http://www.wikihow.com/Calculate-Mass
https://www.scientificamerican.com/article/stacking-liquids/
https://www.stevespanglerscience.com/lab/experiments/density-tower-magic-with-science/

(These websites may change over time. If a website is no longer available, use key phrase "density towers" and "how to calculate mass" to find more current resources.)

Formative Assessment:
Quiz questions over calculating density and formation of Earth's layers. Student questioning during activity, Lab report

Notes to Teacher:
Great use of very basic measurement and calculating skills and works as a good refresher on measurement skills. Very visual and colorful.

Student Activity:

1. Distribute **Student Handout Density Towers Lab Report**.

2. Working in lab groups, students will:

   a. Obtain samples of all 6 liquids in small plastic cup.

   b. Find the mass of the empty beaker as a reference standard. (See web site as a refresher on how to calculate mass. http://www.wikihow.com/Calculate-Mass) (Also see https://socratic.org/questions/an-empty-250-ml-beaker-has-a-mass-of-60-g-when-100-ml-of-oil-is-added-to-the-bea for background and mass of beaker.

(These websites may change over time. If a website is no longer available, use key phrase "how to calculate mass" to find more current resources.)

   c. Find the mass of a 100ml sample of each liquid using the empty beaker (wash beaker between each sample).

   d. Calculate density for each sample using D=M/V, and record values in a data table. Should be as follows
      - Water: 1.0 g/ml^3
      - Karo Syrup: 1.3 g/ml^3
      - Alcohol: 0.79 g/ml^3
      - Vegetable oil: 0.92 g/ml^3
      - Motor oil: 0.87 g/ml^3
      - Dish soap: 1.06 g/ml^3

   e. Add food coloring to the water and alcohol. Choose colors that will be different than those already showing in the other liquid samples.

   f. Carefully, and very slowly, pour each liquid sample into the water bottle, beginning with the highest density sample first.

3. When all the ingredients have been added to the bottle, all the liquids will be distinguishable from each other. Have students draw a chart to show the order of the liquid.

4. Students will identify the scientific principle that is illustrated in this experiment.

5. In a similar manner, different densities of materials in the Earth will separate out into layers. Oil and petroleum formations, or rather the separation of these materials from the other substances in the earth (rock, minerals, water), occur in the same way. Within the earth there will be open areas, or areas of sandstone (acts like a spongy reservoir for petroleum). The petroleum will rise up and try to move through the less dense layers of rock. When it encounters impervious layers, or those that it can't readily move through, such as shale, it stops and will build or gather. Shale and other more dense rocks, which the oil cannot move upwards through, will actually act like a cap or lid to the petroleum deposits.

6. Students use lab computers to look up the densities of the 6 most common minerals in the earth's crust and list them in the order that they should typically "layer" within the earth.

7. Students will describe how this layering can help petroleum geologists explore for oil and natural gas deposits. Provide the following websites for background information:

   Exploration
   http://www.api.org/story/index.html
   http://www.conocophillips.com/what-we-do/exploring-for-energy/Pages/default.aspx
   http://en.wikipedia.org/wiki/Hydrocarbon_exploration

(These websites may change over time. If a web site is no longer available, use key words and phrases to locate current resources.)

Student Handouts: Printable copies of the handouts are available at: https://arkansasenergyrocks.com/educators/lesson-plans-9-12/. Go to the lesson plan title; student handouts accompany each lesson plan.

Student Handout
Density Towers
Lab Report

Name _____ Date: _____

_____ Class Period_____

_____

_____

Materials:

- ¼ cup vegetable oil
- ¼ cup isopropyl alcohol
- ¼ cup water
- ¼ cup dish soap
- ¼ cup dark corn syrup (Karo)
- ¼ cup motor oil
- 1 drinking water bottle (at least 700ml size)
- 100ml beaker
- balance or digital scale
- Food coloring (Choose colors that will be different than those already showing in the other liquid samples)

1. Gather equipment and obtain samples of all 6 liquids in small plastic cups.

2. Find the mass of the empty beaker as a reference standard.

3. Find the mass of a 100ml sample of each liquid using the empty beaker (wash beaker between each sample).

4. Calculate density for each sample using D=M/V, and record values in a date table.
    - Water:
    - Karo Syrup:
    - Alcohol:
    - Vegetable oil:
    - Motor oil:
    - Dish soap:

5. Add food coloring to the water and alcohol. Choose colors that will be different than those already showing in the other liquid samples.

6. Carefully, and very slowly, pour each liquid sample into the water bottle, beginning with the highest density sample first.

7. Describe what happened to the liquids. In the space below, draw a chart to show the order of the liquid. Label each liquid.

8. What scientific principle is illustrated in this experiment?

9. Use lab computers to look up the densities of the 6 most common minerals in the earth's crust and list them in the order that they should typically "layer" within the earth.

10. Using the following websites and other classroom resources, describe how this layering can help petroleum geologists explore for oil and natural gas deposits.

    Exploration
    https://www.api.org/oil-and-natural-gas/wells-to-consumer/exploration-and-production
    http://www.conocophillips.com/what-we-do/exploring-for-energy/Pages/default.aspx
    http://en.wikipedia.org/wiki/Hydrocarbon_exploration

(These websites may change over time. If a website is no longer available, use key words and phrases to locate current resources.)