Biodiesel

Using Titration to Determine Molarity

The *Biodiesel* laboratory activity is an activity developed by Learning Undefeated to immerse students in the essential duties of chemical technicians in the fuel industry.

In these *Biodiesel* laboratory activities, students will explore specific properties of substances by performing and observing chemical reactions through manipulation of conditions such as volume and concentration. These activities allow students to gain critical laboratory experience in identifying properties of potential energy sources that are favorable for our environment. Their observations will allow them to analyze their collected data so that they may calculate unknown variables to determine precision of their investigation.

**LEARNING OBJECTIVES**

**Students will know:**

* Molarity
* Acids and base titrations
* pH scale
* pH indicators
* Equivalence points within acid base reactions

**Students will understand:**

* How titration is used to determine molar concentrations
* The balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.
* Matter is not lost through chemical reactions

**Students will be able to:**

* Search for natural pH indicating substances
* Determine if substances are acidic or basic
* Use conversion equations to find unknown variables, including unknown concentrations of solutions in Molar, percent composition and percent error within their solutions.
* Neutralize acids and bases through titration experiments
* Practice precise measuring

**UNIT PLAN**

**Pre-Laboratory Engagement (30 minutes)**

1. Students will be introduced to the pH scale and biodiesel as they watch the Kahn Academy’s Introduction to pH [video](https://www.khanacademy.org/science/high-school-biology/hs-biology-foundations/hs-ph-acids-and-bases/v/introduction-to-ph) (5:21), read a [short article on pH by Newsela](https://drive.google.com/open?id=1R6cNGHGYoJr9tLIHim1IDn_B_Zg90Hc2), and watch the University of Idaho’s [Biodiesel Education video](https://www.youtube.com/watch?v=zj6fDDQrl3w) (5:39).
   1. Students will answer corresponding questions on their [pre-laboratory handout.](https://drive.google.com/open?id=1qsAiRvVq_wUq_o7vKC4xPq3kCfrcOAGa_tCbcvrwW7Q)
   2. [Student Pre-Laboratory Handout KEY](https://drive.google.com/open?id=1pZQ4b2ufX99GCGxJE21xGjkfgDrCG3ClDdxwfYbp0Os)
2. Students will create an edible indicator from red cabbage and use it to determine acidity or alkalinity of substances at home.
3. [Edible pH Indicator Student Handout](https://drive.google.com/open?id=1WrH1aC1CHsGhjGOq5ddG6nHoLNnGBVyOiBP7nUePWac)
4. [Edible pH Indicator Student Handout KEY](https://drive.google.com/open?id=1MQp9wE6uMcooaH5kw3sjgMexNzY3YWbVJtK4mRBOw5U)

**Laboratory Activity (30-40 minutes)**

1. Students watch the introductory lab video [“Biodiesel Part One”](https://vimeo.com/415189127) (4:42)
   1. Students will answer the first three questions on page one of the [student worksheet](https://drive.google.com/open?id=1ajvuRW3uZ7fl-jylpQ2Qx3zcmNKwGcTcpu_qQzNj4jg)
2. Students will watch the lab video “[Biodiesel Part Two](https://vimeo.com/415196941)” (4:37)
   1. Students will answer quick check questions and fill in data for [Part II and III of the lab handout](https://drive.google.com/open?id=1ajvuRW3uZ7fl-jylpQ2Qx3zcmNKwGcTcpu_qQzNj4jg)
3. After the video, students will complete [part IV and V of the lab activity worksheet](https://drive.google.com/open?id=1ajvuRW3uZ7fl-jylpQ2Qx3zcmNKwGcTcpu_qQzNj4jg) on their own.
   1. Students view the [worksheet walk throug](https://vimeo.com/415227309)h (23:21) to help them answer the questions and learn the material.
   2. Video can be supplied before or after student work is submitted
      1. [Lab activity Worksheet KEY](https://drive.google.com/open?id=1vtX5ccngBirlAc_aSOy6Vb-vPNvvI2mjm9TQroYa8Xk)

**Post-Laboratory Extension (30-45 minutes)**

1. Students will conduct a titration of vinegar with baking soda to determine the percent composition of acetic acid in vinegar and compare to commercial standards.
2. [At Home Titration Student Procedure and Worksheet](https://drive.google.com/open?id=1xIvh58RYofZs5tfuSIKac527AsVa8NhUq-0K4LV8Ses)
   1. [At Home Titration Student Procedure and Worksheet KEY](https://drive.google.com/open?id=1ddxO2_sPFA0WnACsZym1nz3Oli_t2gjQj7Le0l5qDlE)

**STANDARDS ALIGNMENT**

**NGSS CONNECTIONS**

**HS-PS1-5** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

**HS-PS1-6** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

**HS-PS1-7** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

**TEKS CONNECTIONS**

**CHEM2.F**: collect data and make measurements with accuracy and precision;

**CHEM2.G**: express and manipulate chemical quantities using scientific conventions and mathematical procedures, including dimensional analysis, scientific notation, and significant figures;

**CHEM8.A**: define and use the concept of a mole;

**CHEM8.C**: calculate percent composition of compounds;

**CHEM8.F**: differentiate among double replacement reactions, including acid-base reactions and precipitation reactions, and oxidation-reduction reactions such as synthesis, decomposition, single replacement, and combustion reactions;

**CHEM10.C**: calculate the concentration of solutions in units of molarity;

**CHEM10.E**: distinguish among types of solutions such as electrolytes and nonelectrolytes; unsaturated, saturated, and supersaturated solutions; and strong and weak acids and bases;

**CHEM10.H**: define pH and calculate the pH of a solution using the hydrogen ion concentration.

**LOUISIANA STANDARDS FOR SCIENCE CONNECTIONS**

**HS-PS1-5:** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

**HS-PS1-6:** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

**HS-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.