**Unit Overview**

**Separation Lab: From Trash to Cash**

Target Grade Level(s): high school—9-12

Subject(s): chemistry, physical science, physics

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**Problem Statement**

The Weyerhaeuser sawmill in Raymond, Washington, has a large amount of material build-up in their lumberyard (slag pile). The ground in the lumberyard is covered with bark/woodchips from the stored logs, gravel from the roads leading into the yard (brought in by the logging truck tires), and dirt. The sawmill saw an opportunity to create new products to sell locally, if they could separate the materials. The woodchips could be sold to landscapers. The gravel could be reused on the sawmill roads. And the dirt could be sent to a local composting company to mix into their system. Weyerhaeuser purchased a large “separation machine,” and successfully put it into use in their lumberyard.

Students are shown slides of this scenario, and given the following goal:

How can you use physical and chemical properties of substances to separate a mixture and reclaim valuable materials for other uses?

Your goal is to separate the slag pile from the Raymond sawmill log yard into useful materials. The slag pile is equal parts (by mass) of salt, sand, poppy seeds (i.e. sawdust), and iron filings. As a mixture, the slag pile is worthless and will cost money to dispose of. The separated substances have the following values:

* salt = $10/gram
* iron = $15/gram
* sand = $2/gram
* poppy seeds = $5/gram

To succeed, you must have at least $50 of reclaimed substances.

You have 1 class period to plan and 2 class periods to accomplish this. You must be finished by end of class on Friday. Any unseparated materials will be thrown away.

**Unit Overview and Table of Contents**

This lab unit is intended for the first unit in chemistry class, when students are just becoming familiar with lab equipment, practice, and safety. In this unit, students will apply prior knowledge about material properties to separate substances. They will use correct vocabulary for lab equipment. They will create and execute lab procedures.

* Day 1
  + Matter discussion (brief)
  + Project Introduction
  + Prelab
* Day 2
  + Prelab checkoff
  + Lab planning—partners create experiment procedure
  + Planning checkoff
* Day 3
  + First lab procedure day
* Day 4
  + Second lab procedure day
  + DUE: separation lab packets
  + Poster introduction
* Day 5
  + Poster work day
* Day 6 (optional)
  + Poster work day

**Standards**

* HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.\*
* HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
* CCSS.ELA-Literacy.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
* CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**Soft Skills**

Communication

Students will create a written initial lab procedure, and will revise the procedure as they implement it.

Students will communicate the results of their experiment in a poster summary that is displayed to the public (other students at the school).

Students will practice accurate laboratory vocabulary throughout the unit.

Collaboration

Students will work in small teams to coordinate, design, and execute the lab procedure. Because the procedure requires multiple days, students may need to coordinate schedules and collaborate outside of class to successfully complete the unit.

Critical Thinking

Students must analyze the properties of the substances they are working with, and create separation procedures that minimize loss, in order to achieve the “payment” incentive of the lab.

Creativity

Students must design unique procedures for separating materials, with no restrictions, other than time and basic safety, on how they achieve the goal.

Students will design a creative poster to display their final results.

**Local and Personal Relevance**

This unit emphasizes the benefit of salvaging and reclaiming materials from industrial operations. The Weyerhaeuser story clearly illustrates the opportunity to take something that costs the company money to dispose of in a landfill and reclaim and recycle it for a break-even cost and opportunity for revenue.

This unit directly connects chemistry concepts about the properties of various substances and laboratory techniques with real-world uses.

The hands-on nature of this lab and the poster deliverable provide opportunities for students at all academic levels to successfully participate in the unit.

**Connections to career and educational pathways**

The Weyerhaeuser story directly connects this unit to real-world implementation. Students can see how chemistry understanding of materials is implemented in industrial operations.

The creative problem solving that students do in this unit, designing their own experimental procedures, connects to real-world careers in terms of problem solving challenges.

From this unit, some students show interest in the laboratory aspect of the experiment, using lab equipment and techniques. Other students show interest in the engineering aspect of the experiment, refining and optimizing the process. Still other students show interest in the communications elements, designing colorful, creative posters.

**Day 1: Project Introduction**

**Problem statement**

How can you use physical and chemical properties of substances to separate a mixture and reclaim valuable materials for other uses?

This lesson introduces the overall project. Students do a prelab to start thinking about the properties of substances.

**Learning objectives**

* Day 1
  + Matter discussion (brief)
  + Project Introduction
  + Prelab
* Students will be able to: describe & observe unique chemical and physical properties of salt, sand, iron, and poppy seeds that can be used to separate a mixture.

**Lesson standards**

* HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.\*
* HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
* CCSS.ELA-Literacy.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
* CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**Materials**

* Separation Lab Day 1 slides
* Separation Lab Mixture (equal parts by mass: poppy seeds, iron filings, sand, salt)
* Samples of Lab Mixture in closed container (Ziploc bag, clear film canister, petri dish)

**Lesson preparation**

* Prepare Separation Lab mixture at least one day before the unit. Mass equal parts of poppy seeds, iron filings, sand, salt. Students will receive 8 g/team, so a class of 32 students will need 128 g of mixture.
* Review Day 1 slides.

**Time required**

50 minutes, minimum

**Grouping of students for instruction**

Students should work individually, though they can discuss ideas together during the prelab.

**Instruction guidelines**

* Slide 3: Introduce how to do science, how to do chemistry, data/observations vs inferences.
* Slide 4: Discuss matter, particles, physical vs. chemical change.
  + Physical change = no change at the particle level
    - liquid H2O and gaseous H2O are both H2O
  + Chemical change = change at the particle level
    - electrolysis of water causes H2O to split into H2 & O2 particles
  + Physical and chemical change are NOT related to whether the change is reversible.
    - Many chemical changes can be reversed (H2 + I2 ↔ HI).
    - Many physical changes cannot be reversed (breaking an egg).
  + EXPANSION: add slides about types of substances & mixtures
* Slide 5: Introduce project
  + As you work through the next slides, focus on making the story real for students. The sawmill is a real place, with real costs for getting rid of materials. The people working at the sawmill are strongly motivated, both environmentally and economically. They want to reduce what they send to the landfill and they want to provide benefit to the sawmill, to keep it running and provide work for everyone.
* Slide 6: Weyerhaeuser sawmill in Raymond WA
* Slide 7: Sawmill operations
* Slide 8: Example of sawmill logyard
* Slide 9: Logyard operations. Note pile of debris in upper right quarter of picture
* Slide 10: Close up of debris from logyard
  + Debris collects at the bottom of the logyard and must be cleaned up, disposed of at landfill, which costs the sawmill money.
  + Actual debris includes rock (sand), sawdust (poppy seeds), and dirt. Separation mixture includes iron filings, which can be added to the story as “industrial debris from the machinery. Separation mixture also includes salt, which can be added to the story as “salt from occasional flooding by high tides on the river shown in Slide 6”
* Slide 11: If you use lab journals for labs, set up your lab page here. Partners are assigned on day 2.
* Side 12: Introduce prelab. Provide limited samples (1/table) of the separation mixture in closed containers for students to observe as they work on prelab.

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| Teacher | Student |
| Do Now: Imagine you buy some kool aid powder, open it, and see there is saw dust mixed in with the kool aid powder!  Describe how you could separate this weird mixture. | Students come into class and complete Do Now |
| Slide 3: Introduce how to do science, how to do chemistry, data/observations vs inferences. | Have partner A take 15s to describe an observation to partner B. Partner B needs to summarize inference to partner A (15s).    Record definitions in their notebook in vocabulary section or as lesson notes. |
| * Slide 4: Discuss matter, particles, physical vs. chemical change.   + Physical change = no change at the particle level     - liquid H2O and gaseous H2O are both H2O   + Chemical change = change at the particle level     - electrolysis of water causes H2O to split into H2 & O2 particles   + Physical and chemical change are NOT related to whether the change is reversible.     - Many chemical changes can be reversed (H2 + I2 HI).     - Many physical changes cannot be reversed (breaking an egg).   EXPANSION: add slides about types of substances & mixtures | Students should be writing their own vocabulary:  · Physical Properties  · Chemical Properties  · Physical Changes  · Chemical Changes    Have students turn to a shoulder partner and describe the difference between physical and chemical properties and then physical and chemical changes.    The students should take some quiet thinktime when asked about “are particles changed in the process?” Then ask for volunteers to express their ideas. |
| Suggestion: have students write three questions they have as they listen to the scenario set forth on the next slides. Even if they are not perfectly on topic, it can give insight into how to present this later. Maybe your students may need a video to help, or if you live where there is a sawmill, then the students may have personal stories.   * Slide 5: Introduce project   + As you work through the next slides, focus on making the story real for students. The sawmill is a real place, with real costs for getting rid of materials. The people working at the sawmill are strongly motivated, both environmentally and economically. They want to reduce what they send to the landfill and they want to provide benefit to the sawmill, to keep it running and providing work for everyone. * Slide 6: Weyerhaeuser sawmill in Raymond WA * Slide 7: Sawmill operations * Slide 8: Example of sawmill logyard * Slide 9: Logyard operations. Note pile of debris in upper right quarter of picture * Slide 10: Close up of debris from logyard   + Debris collects at bottom of logyard and must be cleaned up, disposed of at landfill, which costs the sawmill money.   + Actual debris includes rock (sand), sawdust (poppy seeds), and dirt. Separation mixture includes iron filings, which can be added to the story as “industrial debris from the machinery. Separation mixture also includes salt, which can be added to the story as “salt from occasional flooding by high tides on the river shown in Slide 6”     Take some time to hear 3-5 questions. You may or may not answer their questions right now. | The students should be listening and writing any questions down they may have. |
| * Slide 11: If you use lab journals for labs, set up your lab page here. Partners are assigned on day 2. * Side 12: Introduce prelab. Provide limited samples (1/table) of the separation mixture in closed containers for students to observe as they work on prelab | The students will be setting up their lab journals and completing the prelab. |

**Accommodations**

Accommodations can be done according to specific IEPs. The assignment includes a vocabulary list with pictures, which provides support for ELL students.

**Extensions**

Add discussion of properties of substances, types of substances (element, compound, heterogenous, homogenous), physical vs. chemical properties.

**Day 2: Lab Planning**

**Problem statement**

How can you use physical and chemical properties of substances to separate a mixture and reclaim valuable materials for other uses?

This lesson introduces laboratory equipment vocabulary and use. Students work with partners to create an experimental plan and have it approved.

**Learning objectives**

* Day 2
  + Prelab checkoff
  + Lab planning—partners create experiment procedure
  + Planning checkoff
* Students will be able to: write a step-by-step experimental plan to separate a mixture of poppy seeds, iron filings, sand, salt using lab equipment vocabulary.

**Lesson standards**

* HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.\*
* HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
* CCSS.ELA-Literacy.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
* CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**Materials**

* Separation Lab Day 2 slides
* Separation Lab: Procedure, Deliverable, Vocabulary sheets (class set, 1/partner group)
* Separation Lab Experiment Plan (1/partner group)
* Separation Lab Mixture (equal parts by mass: poppy seeds, iron filings, sand, salt), in 4g allotments, 1/partner group (in closed container—Ziploc bag, clear film canister, petri dish)
* Stamp

**Lesson preparation**

* Measure Separation Lab mixture into 8g allotments, in closeable containers. Ideally, a container is a small petri dish with a cover. Also usable: Ziploc snack bags, film canisters.
  + NOTE: large amounts of the mixture likes to self-separate based on density & particle size. Do your best to evenly mix before portioning out.
* Photocopy Separation Lab: Procedure, Deliverable, Vocabulary sheet as double-sided sheet. Each partner team needs one for reference. To conserve paper, make a class set on colored paper and put them inside plastic page protectors.
* Photocopy Separation Lab Experimental Plan, 1/partner team + a few extras for do-overs.
* Gather samples of lab equipment to show and describe to students.
* Review Day 2 slides.

**Time required**

50 minutes, minimum

**Grouping of students for instruction**

Students should be in partner groups of 2 or 3. Use your classroom method for partner assignment.

**Instruction guidelines**

* Slide16: Review students’ prelabs from day 1. Students should mention specific properties for each substance: salt, sand, sawdust, iron; and how that property might enable separation.
  + Prelab review can be done as class discussion, partner discussion.
* Slide 17: Lab & equipment review
  + Assign student partners
  + Hand out partner lab sheets. Have partners read front side.
  + Review problem statement.
    - Students will not “fail” the lab if they cannot provide 4 sample packets. They must describe what went wrong on their final poster.
    - Students will not “fail” if they do not achieve $50—it is one of multiple things being graded in the rubric.
  + Review procedure
    - 1 day for planning (today!)
    - 2 days for execution—no extra time!
  + Review deliverables
    - Poster
    - 4 packets with separated substances
    - Data (in journal and on poster)
  + Turn to vocabulary side of lab sheet.
    - Show examples of each piece of lab equipment and discuss use and best practices. Be brief—30 sec per item.
* Slide 18: Experiment planning
  + Hand out Experimental Plan to each team.
  + Team should work together to create separation plan, using correct vocabulary. They should do their best to write detailed steps, in procedural sequence.
  + Students should do their best to follow their procedural sequence in the lab, but they may amend it as they need to. If they amend their procedure, this should be captured in their lab data.
    - NOTE: magnets are not on the equipment list, but are allowed if students request them
    - NOTE: students may request a “sieve” or “strainer.” It is your call to allow, if you have equipment.
    - NOTE: students may request a balloon (for static electricity separating). It is your call to allow, if you have equipment.
    - NOTE: though Bunsen burners are on the equipment list, only hotplates are used for heating in this lab
  + When teams have clear plan, provide “stamp of approval.”
  + Push students to use accurate lab vocabulary.
  + Review plan for appropriate use of lab materials and whether plan is achievable within 2 days. Otherwise, plans do not need to be successful (based on your knowledge as teacher). This is inquiry-based activity.

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| **Teacher** | **Student** |
| Do Now!  The teacher will walk around the room and stamp notebooks/review prelab preparation   * Slide16: Review students’ prelabs from day 1. Students should mention specific properties for each substance: salt, sand, sawdust, iron; and how that property might enable separation.   + Prelab review can be done as class discussion, partner discussion. | The students prepare their lab notebooks-they should fix any issues the teacher points out to them during the stamp routine.    The students make adjustments based on the Prelab review. |
| * Slide 17: Lab & equipment review   + Assign student partners   + Hand out partner lab sheets. Have partners read front side.   + Group roles are recommended   + Review problem statement and scenario.     - Students will not “fail” the lab if they cannot provide 4 sample packets. They must describe what went wrong on their final poster.     - Students will not “fail” if they do not achieve $50—it is one of multiple things being graded in the rubric. | The students should be participating in the assigning of partners based on your own classroom method.    The assigned reader should read the directions and the front side of the lab sheet. |
| * + Review procedure     - 1 day for planning (today!)     - 2 days for execution—no extra time!   + Review deliverables     - Poster     - 4 packets with separated substances     - Data (in journal and on poster)   + Turn to vocabulary side of lab sheet.     - Show examples of each piece of lab equipment and discuss use and best practices. Be brief—30 sec per item. | The students should be paying attention-this is procedural information they need. They should be writing down an questions they need to ask so they can get it clarified after the teacher finishes with instruction. |
| * Slide 18: Experiment planning   + Hand out Experimental Plan to each team.   + Team should work together to create separation plan, using correct vocabulary. They should do their best to write detailed steps, in procedural sequence.     - NOTE FOR NEXT SESSION: Students should do their best to follow their procedural sequence in the lab, but they may amend it as they need to. If they amend their procedure, this should be captured in their lab data.     - NOTE: magnets are not on the equipment list, but are allowed if students request them     - NOTE: students may request a “sieve” or “strainer.” It is your call to allow, if you have equipment.     - NOTE: students may request a balloon (for static electricity separating). It is your call to allow, if you have equipment.     - NOTE: though Bunsen burners are on the equipment list, only hotplates are used for heating in this lab   + When teams have clear plan, provide “stamp of approval.”     - Push students to use accurate lab vocabulary.     - Review plan for appropriate use of lab materials and whether plan is achievable within 2 days. Otherwise, plans do not need to be successful (based on your knowledge as teacher). This is inquiry-based activity. | The students should already have group roles ready to go before they begin.    A reader should re-read the directions and make sure the team knows what they will be working towards.    The students need to discuss and agree on each step of the procedure and why it is important using correct vocabulary.    The students should use resources available to confirm properties of the individual materials to help them make their procedure.    The students need to get a stamp from the teacher once they have completed their procedure. |

**Accommodations**

Accommodations can be done according to specific IEPs. The assignment includes a vocabulary list with pictures, which provides support for ELL students.

**Extensions**

If time allows, students may handle lab equipment

**Day 3: Lab Procedure 1**

**Problem statement**

How can you use physical and chemical properties of substances to separate a mixture and reclaim valuable materials for other uses?

This lesson is the first lab day, where students implement their experimental plan.

**Learning objectives**

* Day 3
  + Begin experimental plan
  + Take notes on plan changes
  + Use lab equipment properly
  + Use time well
* Students will be able to: perform and adjust a complex multistep procedure to separate a mixture of poppy seeds, iron filings, sand, and salt.

**Lesson standards**

* HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.\*
* HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
* CCSS.ELA-Literacy.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
* CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**Materials**

* Separation Lab Day 3 slides
* Separation Lab: Procedure, Deliverable, Vocabulary sheets (class set, 1/partner group)
* Separation Lab Mixture (equal parts by mass: poppy seeds, iron filings, sand, salt), in 8 g allotments, 1/partner group (in closed container—Ziploc bag, clear film canister, petri dish)
* Lab equipment

**Lesson preparation**

* Lab should be ready for students to begin work.
  + NOTE: Give students smallest beakers & Erlenmeyers—50 mL if possible. Larger glassware will lead to them using too much water, taking too long to evaporate
  + NOTE: Do not make hotplates available on first lab day.
* Make sure there is location for students to set aside their materials to continue on second lab day.
* Review Day 3 slides.

**Time required**

50 minutes, minimum

**Grouping of students for instruction**

Students should continue in assigned partner group.

**Instruction guidelines**

* Slide 21: Review lab protocols with students. Review deliverable goals.
  + Students must record initial mass of substance before separation. They must record mass of each material after successful separation.
  + Students should create a “packet” from scratch paper to hold successful separation of each material.<https://www.gardensillustrated.com/plants/make-your-own-origami-seed-packet/>
  + Students should do their best to follow their experimental plan. They can change their plan as they need, and they should record these changes in their journal.
  + Students should use minimum amount of equipment needed at one time. You will run out of equipment otherwise.
* Dismiss students with approved plans to begin lab.
* Work with remaining students to get their plans approved.
* Slide 22: Clean-up
  + Start 10 minutes before end of class
  + Students should label what they are keeping until tomorrow
  + Clearly state which equipment they may keep until tomorrow

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| **Teacher** | **Student** |
| Do Now:  Suzy & Joe started their mixture separation by removing iron using the magnet. Now they have sand, salt, & poppy seeds still mixed together. Share what you think their next step should be to separate these! | The students prepare their lab notebooks-they should fix any issues the teacher points out to them during the stamp routine.    The students make adjustments based on the Prelab review. |
| * Slide 21: Review lab protocols with students. Review deliverable goals.   + Students must record initial mass of substance before separation. They must record mass of each material after successful separation.   + Students should create a “packet” from scratch paper to hold successful separation of each material.   + Students should do their best to follow their experimental plan. They can change their plan as they need, and they should record these changes in their journal.   + Students should use minimum amount of equipment needed at one time. You will run out of equipment otherwise.   + Dismiss students with approved plans to begin lab.   Work with remaining students to get their plans approved  Teacher should be monitoring the lab as the students work.  Questions teachers can ask:   * Explain the purpose of (material used). * What made you decide to use (process) to separate out (material)? * (if a material is not being used): How will you be using (material)? Do you need to use it right away? * Tell me why you are separating (item in mixture) first. | The students are following their procedure they wrote last class. If they have not been approved, the first thing the students need to do is get approval from the teacher before beginning.    Each step of the lab should be completed separately. The group should choose one person to pick up the materials necessary to complete the lab.    The students should always use good safety habits and appropriate safety procedures.    As the students follow their initial procedure, they need to make notes of any alterations or modifications they made during the experiment. |
| * Slide 22: Clean-up   + Start 10 minutes before end of class   + Students should label what they are keeping until tomorrow   + Clearly state which equipment they may keep until tomorrow | The students should follow instructions to clean up exactly as the teacher directs. The student should be sure their material is clearly labeled so it does not get mixed with other groups. |

**Accommodations**

Accommodations can be done according to specific IEPs. The hands-on, inquiry-based nature of this lab makes it appropriate for students with a variety of accommodation needs.

**Extensions**

Students will use all the time you have on this activity. If you are able to provide extra time at lunch or before/after school, you may do so. At the same time, pushing them to accomplish the task within assigned time is a good goal. They will not “fail” if they cannot successfully separate all substances.

**Day 4: Lab Procedure 2**

**Problem statement**

How can you use physical and chemical properties of substances to separate a mixture and reclaim valuable materials for other uses?

This lesson is the second lab day, where students complete their experimental plan and begin thinking about their poster deliverable

**Learning objectives**

* Day 4
  + Second lab procedure day
  + DUE: separation lab packets
  + Poster introduction
* Students will be able to: collect, measure, and analyze data from their experiment separating a mixture of sand, salt, iron filings, and poppy seeds.

**Lesson standards (NGSS, CCSS, CTE):**

* HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.\*
* HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
* CCSS.ELA-Literacy.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
* CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**Materials**

* Separation Lab Day 4 slides
* Materials continue from Day 3
* Scratch paper & tape for students to make packets

**Lesson preparation**

* Lab should be ready for students to begin work.
  + NOTE: Hotplates should be available today.
* Review Day 4 slides.

**Time required**

50 minutes

**Grouping of students for instruction**

Students should continue in assigned partner group.

**Instruction guidelines**

* Slide 25: Quickly review expectations for lab.
  + Inform students that they must start hotplate work as soon as possible to finish during class period.
  + Remind students they must complete separation during class period.
  + Remind students to mass final samples.
* Slide 26: Briefly review poster expectations
  + You may also introduce the poster expectations at end of class. It is good to introduce the expectations before Day 5, so students have overnight to start thinking about the poster.
  + Dismiss teams to lab
  + Students may be confused about the packets. Encourage them to just make small packets with scratch paper. [Packets are important only to demonstrate that 4 substances were separated.]
* Clean-up
  + Start at least 10 minutes before end
  + Make sure students have a space to save their final packets

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| **Teacher** | **Student** |
| Do Now: Direct students to prepare for the rest of the lab | Discuss with your group how to divide up the work. Have one member of the group get materials and everyone else get safety equipment (as needed) |
| Slide 25:   * Hotplates are available for evaporating water. * Teacher should be checking on groups and ask probing questions, and questions about any changes made from original procedure.     Teacher should direct students to clean up as soon as they finish with the lab.  In order to introduce the separation lab poster, the teacher should call for cleanup approximately 15 minutes before class ends. | Students should be focusing on finishing their procedure today. They should be managing their time wisely to finish today.  They need to make sure their recovered items are in their paper envelopes    The students should clean up their station as soon as they finish putting the last of their substances in their envelopes. |
| Slide 26:  Introduction of the poster during last 15-10 minutes of class.  Explain that they will need to complete a Lab reflection (individually, in notebook) and a Separation lab poster. (as a group)  Basic setup is on the slide:  Each team will create one poster  On the poster must include a paragraph describing the procedure, an evaluation of their procedure and any improvements that they should make.  The poster must include any data collected, organized appropriately, calculations made to figure out how much value their substances had.  They need to affix the envelopes onto the poster.    The design should be creative, colorful, and include drawings of the lab setup. | Students will need to just listen to this preview of what is expected for the poster. |

**Accommodations**

Accommodations can be done according to specific IEPs. The hands-on, inquiry-based nature of this lab makes it appropriate for students with a variety of accommodation needs.

**Extensions**

Students will use all the time you have on this activity. If you are able to provide extra time at lunch or before/after school, you may do so. At the same time, pushing them to accomplish the task within assigned time is a good goal. They will not “fail” if they cannot successfully separate all substances.

**Day 5: Poster Work Day**

**Problem statement**

How can you use physical and chemical properties of substances to separate a mixture and reclaim valuable materials for other uses?

This lesson is the first poster work day, where students reflect on their experiment, and communicate with the public about their work.

**Learning objectives**

* Day 5
  + Poster work day
* Students will be able to write and communicate a summary and analysis of the results of their mixture separation process on a poster.

**Lesson standards**

* HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.\*
* HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
* CCSS.ELA-Literacy.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
* CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**Materials**

* Separation Lab Day 5 slides
* Poster paper, art supplies
* Separation Lab Poster rubrics
* Student packets from Day 4

**Lesson preparation**

* Photocopy and slice the poster rubrics (one/student)
* Review Day 5 slides.

**Time required**

50 minutes

**Grouping of students for instruction**

Students should continue in assigned partner group.

**Instruction guidelines**

* Slide 29: Discuss actual procedure used at sawmill
  + Simpler process used than in lab, because of need for scale and efficiency
* Slide 30: Sawmill slag separated into 3 parts
  + Fines = dirt, small bits of wood (sawdust)
* Slide 31: Discuss poster expectations
  + Use rubric to help structure expectations
  + Answer student questions
* Work time
  + Students should work with partner(s) to create poster

|  |  |
| --- | --- |
| **Teacher** | **Student** |
| Do now:  Review and write a reflection individually:  What worked well? What can be improved?    Teacher should check and stamp response. | Students should record this in their lab notebook after their lab. |
| Show slides 29 & 30  Describe the process Weyerhaeuser uses to separate the pile of construction waste. | Students can listen and prepare questions. |
| Slide 31:  Describe the requirements needed to complete the poster.  The teacher should hand out the rubric to the students and review each criteria.  Ask one member of each group to summarize the requirements to their group.  The teacher should call on 2 students to summarize the assignment that did NOT do the original summarization. | Students should listen        one group member summarize the requirements to the rest of the group. |
| The teacher should walk around and check on the posters. | The students should begin working on their posters. |
| Give 5 minutes for cleanup. Allow time tomorrow for finishing up any last minute posters Request the rubric be attached to the back of their posters and be sure to have their names and period on the poster somewhere. | The students need to clean up their spaces and follow directions given by the teacher. |

**Accommodations**

Accommodations can be done according to specific IEPs. The creative requirement for the poster enables students with language and writing challenges to contribute equally to the deliverables.

**Extensions**

Students will use all the time you have on poster. If you are able to provide extra time at lunch or before/after school, you may do so.

If you are able to structure this unit so Day 5 falls on Friday, you can make the poster due on Monday, encouraging partners to work together over the weekend.

**Day 6: Poster Work Day (Optional)**

**Problem statement**

How can you use physical and chemical properties of substances to separate a mixture and reclaim valuable materials for other uses?

This lesson is the second poster work day, where students reflect on their experiment, and communicate with the public about their work.

**Learning objectives**

* Day 6
  + Finish Poster

**Lesson standards**

* HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.\*
* HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
* CCSS.ELA-Literacy.RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
* CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

**Materials**

* See Day 5

**Lesson preparation**

* See Day 5

**Time required**

50 minutes

**Grouping of students for instruction**

Students should continue in assigned partner group.

**Instruction guidelines**

* See Day 5
* Realistically, you will need this day for students to get poster done.

**Accommodations**

Accommodations can be done according to specific IEPs. The creative requirement for the poster enables students with language and writing challenges to contribute equally to the deliverable.

**Extensions**

Students who finish their poster early can help to hang finished posters on the classroom or hallway walls.

**Final Items**

**Assessment**

* Formative Assessment in the Lessons
  + Student prelab
  + Partner experimental plan
* Summative Assessment for the Unit
  + Final poster

**References/Resources**

* Separation Lab Slides (.ppt file)
* Separation Lab Worksheet (.pdf file)
  + Includes vocabulary sheet
* Separation Lab Poster Rubric (.pdf file)