Accidental Discoveries

Unit Summary

Accident or serendipity? The Essential Question: *How can we benefit from our accidents?* is explored by asking students to reflect on a time in their life when a mistake or accident reaped positive benefits; students analyze what skills and processes they used in their situation. To connect this understanding to the unit, students role-play scientists/inventors who have been hired to find a marketable use for a new substance that was created accidentally in a lab. Students research the question: *How have scientists used their accidents or mistakes to make our world a better place?* Students find answers to the question, *In what ways can science methods help you accomplish a goal?* by finding a marketable purpose for the new substance. Students must use their knowledge of properties of matter and experimentation processes to prove that their idea will work and eventually persuade people to buy their product. As a culminating project, students create labels for their products that synthesize all their learning for the purpose of marketing their product for consumers.

At a Glance

Grade Level: 6-8
Subject: Physical Science
Topics: Properties of Matter, Science as a Human Endeavor, Scientific Inquiry Process
Higher-Order Thinking Skills: Analyze and Synthesize Information, Classify Information
Key Learnings: Mass, Volume, Density, Measurement, Physical and Chemical Properties of Matter, Experimental Design **Time Needed:** Three weeks (90 minutes every other day or 45 minutes every day)

Curriculum-Framing Questions

- **Essential Question**
  How can we benefit from our accidents?
- **Unit Questions**
  How have scientists in the past used their accidents or mistakes to make our world a better place?
  In what ways can science methods help you accomplish a goal?
- **Content Questions**
  What investigations are necessary to derive physical and chemical properties of a substance?
  What are the relationships among mass, volume, and density?
  How do you set up a scientific experiment?

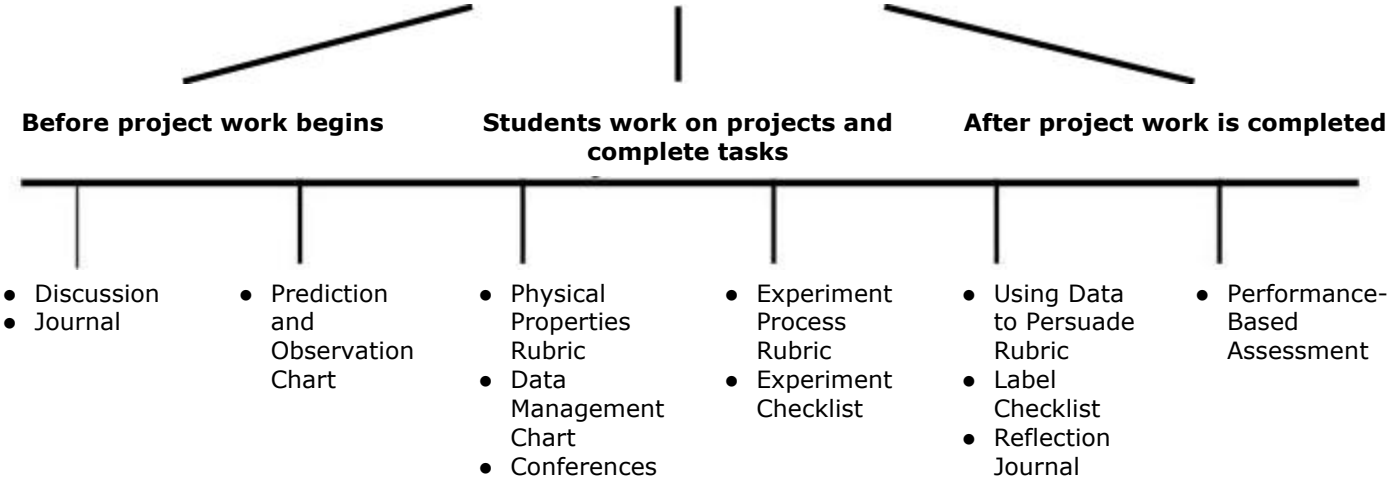
Things You Need

Instructional Procedures
Standards
Student Samples

Assessment Timeline

This timeline shows in chronological order the different types of formal and informal assessments that occur during the unit. The table below explains how each assessment is used and who uses it for what purpose.

Assessment Timeline



Assessment	Process and Purpose of Assessment
Prior Knowledge Journal	Students use their journal entry to reflect on how they react when making a mistake or accident. The teacher uses the information the students share to facilitate a class discussion and adjust instruction based on students' experiences.
Physical Properties Rubric	Students use the rubric to guide their thinking process during the slime lab and as a basis for peer feedback when assessing other members in their group. The teacher uses the rubric to assess organization and thinking skills and to adjust instruction on processing a lab and identifying and measuring physical properties. The rubric is adapted to match the adjustments made to the lab activity for different levels of learners: Slime Lab, Adapted Lab One, Adapted Lab Two, or Adapted Lab Three.
Data Management Chart	The data management chart helps students construct meaningful interpretations from cumulative data and apply those interpretations in the final label project. The teacher uses the data table to highlight measurements that are outside the parameters of acceptable accuracy and discusses with the class. It provides a quick glance at how the class is doing as a whole and reveals to the teacher where students may need more instruction.
Experiment Process Rubric	Students use the rubric before, during, and after their experiments to monitor the quality of the experiments so they may be useful to the final project. The rubric is also used for students to assess other group member's experiments and provide feedback that can be applied to the second round of experiments and ultimately the final project. The teacher uses the rubric to assess the relevancy of the experiment as compared to the group planning sheet, as a basis for questions in the second round of group conferences, and as a final assessment for the second round of experiments.
Experiment Checklist	Students use this to monitor their progress when constructing their experiment and to give other team member's feedback.
Conference Questions	The teacher conferences with each group to provide feedback on investigation plans and ideas before their experiment to make sure interpretations of the task are correct; and after their experiment to validate or redirect. Students use the conference sheet for reflection, to ask specific questions, and to clarify procedures.
Using Data to Persuade Rubric	Groups use the rubric to guide their process in developing their final product label and later to assess each other's individual label. The teacher uses the rubric to assess each student individually on their label and also the group's overall product idea.
Label Checklist	Students use this to monitor their progress when designing their label and to give other team member's feedback.
Reflection Journal	The reflection allows students the chance to generalize how science processes and skills helped them in completing the tasks in the unit. The teacher assesses whether students were able to

	synthesize their learning and observes common errors and strengths of the unit so adjustments can be made if needed.
Performance-Based Assessment	A final assessment is used to assess student's ability to transfer new learning to a new situation. The performance task allows the teacher one more opportunity to observe student's ability to measure and derive properties of matter on an individual basis.

Credits

Theresa Maves participated in the Intel® Teach Program, which resulted in this idea for an assessment plan. A team of teachers expanded the plan into the example you see here.

Note: *The hyperlinked support documents are not part of the PDF. They can be downloaded and printed individually.*

Instructional Procedures

Prior to the Unit
Students complete a series of labs in which they learn how to observe and quantify physical properties of substances and observe chemical properties and changes.

Introduction
Post the Essential Question: *How can we benefit from our accidents or mistakes*?Share with students an example of when you have made a mistake or accident that turned out to have positive outcomes. Share the circumstances and skills you used that turned it into a good thing. After sharing, have students reflect on a time in their lives when a mistake or accident turned out to have positive outcomes. Ask students to analyze the skills and processes they used in their situation.

Have students find three situations in which a scientist used a mistake or accident to make our world a better place. (Alternative: print and photocopy examples from the Internet and distribute different examples to partners to discuss and later share with the class.)
The following are resources:

- www.pbs.org/wgbh/nova/cancer/discoveries.html*

Conduct a class discussion about the meaning of serendipity. Discuss how serendipity relates to accidents and mistakes and to the situations the students researched. Ask students to write a journal response to the Unit Question, *How have scientists in the past used their accidents or mistakes to make our world a better place?* Help students synthesize the research and establish generalizations that are based on the research they conducted.

Slime Lab
Present the following scenario to students:

> Scientists in a nearby lab created a slimy substance by accident when trying to invent a new kind of glue. Some of their glue samples spilled in a sink that had just been cleaned and contained borax residue. The accidental combination of the glue, borax, and water formed a new substance in the sink that might serve a purpose. As an accomplished inventor and scientist, you have been hired by Maves Inventive Science Products Incorporated (MISPI) to find an inventive use for the substance. Your idea needs to have the potential to make our world a better place and provide a profit for MISPI.

Discuss with students the investigations necessary to derive physical and chemical properties of a substance. Assign partners to investigate all the physical properties of the individual substances that created the new material in the scenario. Each partner set receives 50 ml of borax, 50 ml of white glue, and 100 ml of water (the ingredients in the new substance). According to the student's need, hand out either the **Slime Lab**, **Adapted Lab One, Adapted Lab Two**, or **Adapted Lab Three**. Hand out and review the **Physical Properties Rubric** to help guide students during the investigation.

Have students recreate the accident in the scenario following the instructions for making slime.

Analyzing the Data
Compile measurable data from student's labs (temperature, mass, volume, and density) and hand out a data management chart of the class data for students to analyze. Use the data chart and students' analysis to facilitate a class discussion on the interpretations that students make. Emphasize any thinking contributed by the students that explains relationships among mass, volume, and density.

Show students how conclusions from data can be represented through graphs. Instruct students to create two graphs based on their own conclusions, using the data from the class chart.

Have students exchange lab write-ups to conduct a peer review using the **Physical Properties Rubric**. Assess the student's work as well from a teacher perspective using the same rubric. Provide further instruction if necessary.

Divide students into groups of four to create product management teams. Instruct each team to brainstorm at least 50 different ideas based on the physical and chemical properties observed from the lab conducted before. Tell teams they

must come to consensus on the two best marketable ideas from their list.

Explain that each team needs to design two experiments for each of the two ideas selected for a total of four experiments. Instruct each team member to pick one of the four experiments to do at home individually and be ready to share their results with their group next class. Ask the question, *How do you set up a scientific experiment?* After listening to student's responses, present a mini lesson on setting up an experiment if necessary. Pass out the **Experiment Process Rubric** along with the **Experiment Checklist** and instruct students to consult this rubric and checklist before, during, and after the experiment process so they may understand the criteria for a successful experiment.

Sharing Results from Experiments
Have students assess each other's experiment write-ups using the **Experiment Checklist**.

During the time students are assessing each other's experiments, conference with each team using the **Conference Questions**. Use the **Experiment Process Rubric** as a basis for assessing their experiments informally and to discuss how ideas and experiments can be improved. Remind students to save this experiment work so it can be used as a comparison to their final experiment later.

Tell students you are role-playing as a representative from the company and you have been directed to read their brainstorm lists and pick the one idea in which they will do their final experiments. This may or may not be the one they picked as part of their final two. Pick a different idea for each team so each project will be different per class.

Once the final idea has been selected, each team must design two new experiments (or if it is an idea they had already selected as their final two previously, then they can modify those experiments and make them more sophisticated).

Give teams time to design and modify their final two experiments. Explain that two people from each team will conduct one of the experiments and the other two team members will conduct the second experiment. Each partner set will complete their experiments individually to see if they can validate each other's data.

Using Data to Persuade
Allow teams time to share their final experiment results, checking to see if their data and conclusions match their corresponding partner's data. Have teams repeat the peer review process they used with their first experiments again using the **Experiment Checklist**, noting what areas have improved between the first and the second experiment.

Conference again with each team. During the conference, have students share their assessments and reflections on how they have improved. Assess their second experiment formally using the **Experiment Process Rubric**.

During the conference, also give feedback on their product idea and whether or not the experiment data from each partner set has proven their idea will work for the intended purpose. Use the information gleaned from the conferences to adjust instruction.

Deliver a mini-lesson on effective slogans and logos. Show examples of well-known product labels and have students distinguish between different types of information that are given on labels for products (technical, scientific, directions, advertising, warnings, etc.). Give teams time to brainstorm a logo and slogan for their product idea. Explain that even though each person creates a unique label, everyone on the team must use the same slogan and logo design.

Collect labels from commercial products and have teams assess the labels with the **Using Data to Persuade Rubric**. Remind students to consult the rubric and **Label Checklist** often when creating labels.

Presentations
Give students time to present individual labels in their teams and instruct students to assess each other's labels using the **Label Checklist**. Assess each label formally with **Using Data to Persuade Rubric**.

Have each student write a reflection journal entry on the Unit Question, *In what ways can science methods and procedures help you accomplish a goal?* Encourage students to think about the scientists (and the products they discovered) from their research in the beginning and compare the process they have gone through in the past weeks. Have them also write about the team process and the benefits and disadvantages of working in a team.

Optional: As a final assessment on the basic properties of matter specifically, have students take a **Performance-Based Assessment** to determine if they can transfer their learning to a new situation. Adjust future instruction according to the results.

Assessing Projects: Accidental Discoveries
Content Standards and Objectives

Targeted Content Standards and Benchmarks

Idaho State Science Standards

Observe and classify the structure and properties of matter

- Experiment with properties of matter and accurately measure physical properties (or investigate the relationship among mass, volume, and density)
    - Measurement
        - Predict/estimate measurements in volume, temperature, mass, and length to make sense of a scientific problem
        - Distinguish what type of measurements and tools are most useful to use in a scientific investigation
        - Use precise measurements in volume, temperature, mass, and length to derive data and form conclusions from an investigation

National Science Standards

Science as a Human Endeavor:

- Science requires different abilities, depending on such factors as the field of study and type of inquiry. Science is very much a human endeavor, and the work of science relies on basic human qualities, such as *reasoning, insight, energy, skill, and creativity*--as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and *openness to new ideas*.

Scientific Inquiry:

- Different kinds of questions suggest different kinds of scientific investigations. Some investigations *involve observing and describing objects*, organisms, or events; some involve collecting specimens; *some involve experiments*; some involve seeking more information; *some involve discovery of new objects and phenomena*; and some involve making models.
- Mathematics is important in all aspects of scientific inquiry.
- Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

Student Objectives

Students will be able to:

- Research and discuss famous past mistakes or accidents of scientists that have changed our world
- Accurately measure for volume and mass of various objects and calculate density –or--Quantify matter precisely
- Select and use different tools for measurement appropriate for the task
- Use data to make logical conclusions about matter
- Use knowledge of observable properties to predict measurements of mass, volume, density, and temperature for various substances
- Use scientific vocabulary to describe matter
- Design and implement unique experiments using the scientific method
- Represent data through graphs and charts or other visual aids
- Synthesize scientific information to persuade others to buy a product

Assessing Projects: Accidental Discoveries
Student Samples

Student Work Samples

1. **Experimental Processes:** Samples of student work from the first experiment and second experiment with scored rubrics showing improvement.

First Experiment	View as Microsoft Word* | View as PDF
First Experiment Rubric	View as Microsoft Word* | View as PDF
Second Experiment	View as Microsoft Word* | View as PDF
Second Experiment Rubric	View as Microsoft Word* | View as PDF

2. **Using Data to Persuade:** Three different levels of student work with scored rubrics.

Label 2	View as Microsoft Word* | View as PDF
Label 2 Rubric	View as Microsoft Word* | View as PDF
Label 3	View as Microsoft Word* | View as PDF
Label 3 Rubric	View as Microsoft Word* | View as PDF
Label 4	View as Microsoft Word* | View as PDF
Label 4 Rubric	View as Microsoft Word* | View as PDF

Assessing Projects: Accidental Discoveries
Adapted Lab One

Slime Lab Level 1 Adaptation

This lab is the same as the original except provides scaffolding for students with mild learning challenges. The same main learning objectives are addressed with this assessment, only there is more organization and prompts are provided. Scoring guide and rubric stay the same except organization sections are not applicable.

INITIAL

.	**Physical Properties**	**Predicted Chemical Properties**	**Measurements of mass, volume, and density label numbers**
White Powder (Borax)	.	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Density Show formula set up . .
Glue	.	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Density Show formula set up . .
Water	.	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Density Show formula set up . .

DURING

.	**Physical Properties**	**Predicted Chemical Properties**	**Measurements of mass, volume, and density label numbers**

Glue and Water	.	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: Density: Show formula set up . . Temperature: .
Borax and Water	.	.	Mass of container+substance _____ Subtract container _____ Final mass: _____ Volume: _____ Density: Show formula set up . . Temperature .
Prediction Statement for glue/water + borax/water:			
Water Tank Test: Explain your conclusion for this test			
Glue/Water + Borax/Water	.	.	Mass of container+substance _____ Subtract container _____ Final mass: _____ Volume: _____ Density: Show formula set up . . Temperature: .

AFTER

Answer in complete sentences.

13.	Relationships among mass, volume, and density: .

14.	Observations about heat energy of the substance: .
15.	Five statements about the data in the chart: Is all the data congruent (all the same)? Look for data among groups that stands out and explain why you think that particular data is different from the rest of the groups. 1. 2. 3. 4. 5.
16.	How does the chart help you analyze the data: .
17.	Create two different graphs or charts using spreadsheet software. Explain your interpretation of each one: . Graph or chart 1 interpretation: Graph or chart 2 interpretation:
18.	Using your own data, analyze the difference between the mass, volume, density, and temperature before, during, and after. How did they change or not change? .
19.	Explain the physical and chemical changes that took place in this lab. .
20.	Compare the temperature changes that occurred during the lab. .
21.	Observe teacher demonstrations on chemical properties. Were your predictions correct? .
22.	Which predictions were correct and which ones were not? .

CONCEPT BOX

Optional for this level but definitely needed for level 2. **Warning:** Chemical and physical properties are mixed together.	
Viscosity	Density of water is 1g/ml
Toxic	Color
Combustible	Solid, liquid, gas
Flammable	Mixture
Amorphous solid	Solution
Polymer	Heterogeneous
Mass divided by volume = density	Homogenous
Endothermic	Conductor
Exothermic	Insulator
Texture	Tensile strength
Mass	Ductile
Volume	Malleable
Density	Flexibility
Temperature	Porous
Liter (l)	Transparent
Milliliter (ml)	Translucent
Gram (g)	Opaque
Smell	Biodegradable
Absorb	Prefix—"non"
Physical properties	Physical change
Chemical properties	Chemical change

Assessing Projects: Accidental Discoveries
Adapted Lab Two

Slime Lab Level 2 Adaptation

This lab is adapted for students with learning challenges that are moderate; concepts have been reduced and some tasks eliminated. Most major learning objectives are still addressed but major scaffolding is provided. Scoring guide should be modified to reflect adaptations. Rubric stays the same except organization section is not applicable.

INITIAL

1. Observe the substances on the lab tray. Write down as many physical properties of each substance that you can observe and/or measure.
2. Predict chemical properties of each substance.

.	**Physical Properties**	**Predicted Chemical Properties**	**Measurements of mass, volume, and density label numbers**
White Powder (Borax)	.	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Mass/volume=density _____g / _____ml = _____g/ml . .
Glue	.	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Mass/volume=density _____g / _____ml = _____g/ml . .
Water	.	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Mass/volume= density

			_____g / _____ml = _____g/ml . .

DURING

3. Mix the 50 ml of water with the 50 ml of glue in cup **a**. **Stir until mixed**.
4. Mix the 1 ml of borax (white powder) with the 50 ml of water in cup **b**. **Stir until dissolved**.
5. Predict what will happen if you mix the two mixed substances (cup "a" and cup "b").
6. Slowly pour the borax/water **in the glue/water** stirring vigorously.
7. Take new substance out of the cup and massage in your hands.
8. Play with the new substance, observing properties and behavior.
9. List new physical properties, including mass, volume, and density.
10. Predict chemical properties (teacher will confirm predictions later as a class demonstration--these can not be tested at this point).
11. Give data of all properties that have been measured to teaching assistant or teacher to record in class spreadsheet.

Prediction Statement for glue/water + borax/water when mixed together: . .			
12. Squeeze out the air from the bag and then submerge in water tank. What did you observe and what does it mean? . .			
Glue/Water + Borax/Water	.	.	Mass of container+substance _____ Subtract container _____ Final mass: _____ . Volume: . Mass/volume=density . _____g / _____ml = _____g/ml . .

AFTER:

Analyze the data on the class chart. Answer in complete sentences.

Teacher hands out class chart with all measurable data: temperature, mass, volume, and density.

13.	What relationships among mass, volume, and density do you notice? .
14.	What did you observe about heat energy of the substance? .
15.	Three statements about the data in the chart: Is all the data congruent (all the same)? Look for data among groups that stands out and explain why you think that particular data is different from the rest of the group. 1.

	2. 3. .
16.	How does the chart help you analyze the data?
17.	What were the physical changes and chemical changes in this lab? .

Physical Changes	Chemical Changes
. . .	

	.
18.	Observe teacher demo on chemical properties. List the chemical properties you observed. . . .

CONCEPT BOX

Physical	**Chemical**
Density of water is 1g/ml Color Solid, liquid, gas Viscosity Amorphous solid Flexibility Porous Transparent, translucent, opaque Mass divided by volume = density Texture Mass--Volume Density Temperature Liter (l) Milliliter (ml) Gram (g) Smell Absorb	Toxic Combustible Flammable Biodegradable Endothermic Exothermic Polymer

Assessing Projects: Accidental Discoveries
Adapted Lab Three

Slime Lab - Level 3 Adaptation

This lab is adapted for students with severe learning challenges. Concepts and tasks have been reduced or eliminated to a more significant degree. Only a few of the original learning objectives are addressed and many prompts and scaffolding are given. Scoring guide and rubric should be modified to reflect adaptations.

INITIAL

1. Observe the substances on the lab tray. Write down as many *properties* of each substance that you can observe and/or *measure*.

.	**Physical Properties**	**Measurements of mass, volume, and density label numbers**
White Powder (Borax)	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Mass/volume=density _____g / _____ml = _____g/ml . .
Glue	Even though all boxes are available to input data for measurement, it may be decided that the student will only need to complete measurement data for only one or two of the substances. Chemical properties have been eliminated. This concept is probably too abstract fort this level of learner and not necessary to participate in the lab assessment. Mastery of content is not the goal for this student but following directions, completing multiple steps, applying reading, writing and math skills, and communicating are the main goals.	. Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Mass/volume=density _____g / _____ml = _____g/ml
Water	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume: _____ Mass/volume=density _____g / _____ml = _____g/ml. .

DURING

2. Mix the 50 ml of water with the 50 ml of glue in cup **a. Stir until mixed. Set aside.**
3. Mix the 1 ml of borax (white powder) with the 50 ml of water in cup **b. Stir until dissolved. Set aside**.
4. *Predict* what will happen if you combine the two mixed substances (cup "a" and cup "b").

Prediction Statement for glue/water + borax/water when mixed together: . .

5. Squeeze all the air out of the bag and submerge in water tank.

What did you observe and what does it mean? . .

6. Slowly pour the borax/water in the glue/water stirring *vigorously*.
7. Take new substance out of the cup and *massage* in your hands.
8. Play with the new *substance*, observing *properties* and behavior.
9. List new *properties*, including mass, volume and density.
10. Give data of all properties that have been *measured* to teacher to record in class chart.

.	**Properties**	**Measurements of mass, volume, and density label numbers**
Glue/Water + Borax/Water	.	Mass of container+substance _____ Subtract container _____ Final mass _____ Volume . Mass/volume=density. _____g / _____ml = _____g/ml . .

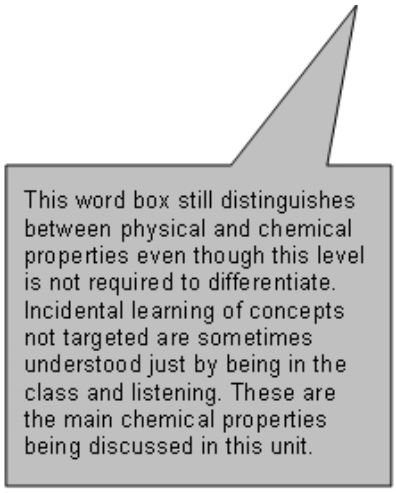
AFTER

Teacher hands out class l chart with all measurable data: temperature, mass, volume, and density.

Analyze the data on the class chart. Answer in complete sentences.

11.	Relationships among mass, volume, and density:
12.	Use the chart to answer the following: Generally, these questions would be facilitated by a paraprofessional if available. 1. What are the most common measurements for mass, volume, and density? Mass _____ Volume _____ Density _____ 2. List the numbers for mass, volume, and density that are different from the majority. Mass | Volume | Density

	. . .
	3. Why do you think these numbers are different from the others? .
	4. When the mass and volume measurements are close to the same, the density closely matches the density of_____ and equals close to _____g/ml. This means the new substance will _____ in water. .
	5. Make your own statement about the data in the chart: . .
13.	How did the chart help you answer the above questions? .
14.	In this lab, which of the following are physical changes and which are chemical changes? . When I mixed the glue with the water. _____ . When I mixed the borax with the water. _____ . When I mixed the borax water with the glue water. _____

CONCEPT BOX	
Physical	**Chemical**
Mass - Gram (g) **Volume** - Liter (l), Milliliter (ml) **Density** (Mass divided by volume—g/ml) Density of water is 1g/ml Color Solid, liquid, gas Flexibility Texture Temperature Odor-smell Absorbent	**Toxic** **Combustible** **Flammable** **Biodegradable** 

The following words would need to be pre-taught in language arts small group or other pull-out time before the lab:

- Analyze
- Combine
- Vigorously
- Properties
- Predict
- Massage

- Substance
- Measure
- Observe

These are the main science concepts for this level:

- Mass
- Volume
- Density
- Physical properties
- Physical changes
- Chemical changes—introductory level only--optional
- Heat energy

Assessing Projects: Accidental Discoveries
Assessing Experimental Processes

Experiment Process Rubric

Students and teachers use this when assessing the two experiments on slime to prove their idea will work for the intended purpose.

	4	3	2	1
Procedure	My procedure could be replicated exactly. I included detailed step-by-step instructions to conduct the experiment.	My procedures are well written. There is slight confusion/missing items within my step -by-step instructions.	My procedures make sense but some parts aren't totally clear or a small part is missing.	My procedures are poorly written. I included very few directions on how to conduct this experiment.
Materials	I listed all materials. The list is very specific using proper names of items and exact amounts.	All my materials are listed but some of the materials are not specific.	Most of my materials are listed here. Some seem to be missing or are not specific.	I did not list many of the materials or they are not specific.
Knowledge of Concept	I demonstrated thorough knowledge of concept matter. My experiment is significant and a real-life question is addressed. My experiment clearly states a solid problem and the data collection and analytical techniques are explained in detail.	I demonstrated adequate knowledge. My experiment investigation is sound. I used analytical techniques. I clearly stated the problem and data collection is organized.	I demonstrated some knowledge or problem. My problem and data collection has some misconceptions or inaccuracies.	I demonstrated little or no knowledge. My experiment does not reflect an understanding of the problem nor did I use accurate methods of collecting data and analyzing information.

Assessing a Science Experiment

	4	3	2	1
Results	I included detailed information about what took place during the experiment. I showed the information in many ways; graphs, data charts, pictures, logs, etc. My calculations are clearly presented and accurate. I used appropriate methods for calculations.	My results show an understanding of the experiment. I provided documentation in multiple ways but some are not accurately labeled. My calculations are listed and accurate .	My data is only in one format and I showed minimal results. My calculations contain some errors. I was confused on the methods for my calculations.	The results of my experiment do little to show what happened. My calculations do not use formulas or do not show work. Some of my calculations are not accurate.
Conclusion	My conclusion shows analysis of the hypothesis. My explanations of all variables are clear and	I stated conclusions that make connections between hypothesis and experiment. I explained some	I made connections between variables and results but I did not analyze or explain the connections.	I did not make connections to the results and process of the experiment.

	support the conclusion. My findings are based on research and data within the results.	variables. I provided evidence to support or explain findings.		
Presentation	My experiment report includes all required components in a logical sequence. I labeled all components clearly and they are organized for easy interpretation.	My experiment report includes all required components. All components are labeled and organized for interpretation.	My experiment report has required components but they are not labeled or in a logical order. It is hard to read and understand.	My experiment report is missing required components. It is impossible to understand my experiment.

Assessing Projects: Accidental Discoveries
Assessment Task

Performance-Based Assessment Task

Name_____

Show all math work

STATION 1: Licorice with wrapper
Take all measurements with wrapper

PHYSICAL PROPERTIES List 6 physical properties of the substance (include mass, volume, density)	**PHYSICAL CHANGES** List 2 physical changes you can do to this substance.
1. 2. 3. 4. 5. 6.	7. 8.
CHEMICAL PROPERTIES	**CHEMICAL CHANGES**
List three chemical properties of this substance: 9. 10. 11.	12. What one chemical change can you create with the substance? 13. Why do you think what you chose is a chemical change?

STATION 2: Diaper polymers
Find the density of the object Show your work. Round to the nearest tenth. Show your math work.

14. Mass 15. Volume 16. Density

If the mass of the polymer sample above was 1.1666g before adding the water, figure out how many times this sample holds its weight in water:

How much would 5.5 g of polymers weigh after adding water:

STATION 3: Blocks
Answer question 19 and 20 for the block station:

17. Each block has the same

a. mass b. volume c. density

18. What is the correct ranking for the blocks from least dense to the densest? (Use density formula):

a. 1, 2, 3 b. 2, 3, 1 c. 3, 1, 2 d. 3, 2, 1 e. 1, 3, 2

Performanced-Based Assessment Scoring Guide

.	Mastery (30 points)	Still Working for Mastery (15 points)	Comments
Observation of Physical and Chemical Properties	Correctly identifies six physical properties and three chemical properties of a substance.	Has identified some correct physical and chemical properties but some are incorrect or only listed a few.	.
Identifying Chemical and Physical Changes of Matter	Accurately describes two physical and chemical changes of a substance.	Some physical and chemical changes are not described completely or are described inaccurately.	.
Calculations for Mass, Volume, and Density	Correctly uses appropriate tools to measures mass, volume, and accurately calculates density.	Some calculations are incorrect and some tool use for measuring mass, volume, and density is incorrect.	.
Understanding of Mass, Volume, and Density	Can differentiate among mass, volume, and density.	Exhibits misconceptions concerning one or all of the concepts of mass, volume, and density.	.
Total			

Assessing Projects: Accidental Discoveries
Checking My Label

Label Checklist

Team Product Idea:

- [ ] Our idea serves a real need for society

Team Product Slogan:

- [ ] Our slogan is catchy, reveals purpose and states why you need it

Team Product Logo:

- [ ] Our logo is eye popping
- [ ] Our logo shows relevance to the product

Label Format:

- [ ] My label format is creative
- [ ] I used design principles
- [ ] I used a computer to generate my label

Description:

- [ ] I described how to use the product and gave a rationale for its use

Evidence:

- [ ] I used a logical evidence that is congruent with the properties of my product
- [ ] My experiment(s) are explained in a way that persuades the consumer

Writing for a Purpose:

- [ ] I used persuasive writing techniques
- [ ] I wrote grammatically correct
- [ ] I used peer or adult edits

Flair:

- [ ] I used extra flair such as background stories, extra design, or other creative twists
- [ ] My label exclaims, "WOW!"

Questions to ask reviewer:

- How can I make it better?
- Would you pick my product off a shelf?
- Would you buy it?

Assessing Projects: Accidental Discoveries
Conference Questions

Conference Questions

Questions	Notes
1. How does your experiment prove your idea will work?	.
2. In what ways did you validate or invalidate your hypothesis?	.
3. How can you emphasize the information from your experiment that validates your group's product? How will you deal with conflicting data?	.
4. In what ways did you modify your experiment?	.
5. In what ways can you combine data from each other's experiment to make the promotion of your product more powerful?	.
6. What measurable data do you have and how did you communicate that data?	.
7. Could someone else repeat your experiment accurately and get the same results? Are your instructions clear?	.
8. What resources did you use to help with your experiment?	.
9. How does your experiment fit with the overall goal of the task?	.
10. Can you identify a control and independent variable in your experiment?	.
11. Based on this conference, how can you modify your experiment? What areas do you need to improve?	.

Assessing Projects: Accidental Discoveries
Investigation Rubric

Physical Properites Rubric

Criteria	Exemplary: All Proficient Criteria Plus:	Proficient	Progressing	Not Yet
Follows Directions	Completed tasks without any assistance from peers or teachers.	Consistency of slime is evidence of proper procedures and measurements. All tasks and questions are completed clearly with minimal assistance from teacher.	Consistency of slime is evidence of inaccurate procedures or measurements. Some tasks are not completed thoroughly or help from teacher is needed.	Directions are not followed and measurements are inaccurate. Many tasks are not completed and help from teacher is needed.
Procedures of Data and Calculations	Information is displayed in a detailed data table showing all math work.	Measurement for mass, volume, temperature, and density are recorded accurately. Measurement data is organized and legible. Uses measurement tools accurately (temperature probes, digital or triple beam balance, and graduated cylinders) and without help.	Minor inaccuracies in measurements and calculations of either mass, volume, density, or/and temperature. Measurement data is unorganized but legible. Needs help with use of tools for measuring.	Measurements for either mass, volume, density, and/or temperature are grossly inaccurate and calculations are incorrect. Measurement data is unorganized and illegible. Needs help with use of tools for measuring. Needs help with use of tools for measuring.
Content	Describes and/or predicts chemical change (endothermic) and chemical properties (flammable, non-toxic, etc.) that took place during experiment.	Describes the physical changes that took place during lab activity clearly and accurately. Relationships among mass, volume, and density are communicated accurately. Includes an accurate statement about the heat energy that took place during experiment. Of the major physical properties discussed in class, nine properties are correctly identified	Describes the physical changes in substance (s), but descriptions are vague or inaccurate, and illegible. Relationships among mass, volume, and density are inaccurate or illogical. Heat energy analysis is incorrect. Six to seven physical properties are listed which include at least three measurable properties (mass, volume, and density).	Physical changes are not described or are inaccurate. No attempt at analyzing the relationships among mass, volume, and density. Heat energy analysis is not made. Less than six physical properties are identified and some of those are inaccurate.

		including mass, volume, and density.		
Data Organization	Other graphic organizers, beyond charts, are used to enhance and communicate information.	Data charts are organized so measurement, descriptions, predictions, and conclusions are clearly communicated.	Data charts are used but are hard to read and understand or are illegible.	Data is unorganized and illegible. Charts or other organizing structures are not used.
Analysis of Data	Statements incorporate generalization and synthesis. Descriptors in prediction and reflection statements use scientific language and are quantified.	Five analysis statements about mass, volume, temperature, and density are made using the data from class charts. Two logical graphs are constructed using spreadsheet software that represents personal conclusions derived from class data chart. Reflection statements include thoughtful analysis of the use of data management strategies and comparison of student's own data to the class data. Predictions made are congruent with the existing data.	Two logical conclusions are made using the class data charts. Two graphs are constructed but not congruent with data from chart. Reflection statements are not explained clearly. Predictions made about physical changes in properties of new substance do not match existing data.	Analysis statements are missing or statements are not based on data. Graphs are not constructed. Reflection statements are shallow or not explained clearly. No predictions are made .

Assessing Projects: Accidental Discoveries
Monitoring My Experiment

Experiment Checklist

Problem or Hypothesis

- [ ] My hypothesis can be tested
- [ ] Written in correct format

Description of Experiment

- [ ] My experiment could be repeated based on my instructions and get similar results

Measurable Data

- [ ] My data is organized
- [ ] My data is accurate
- [ ] Numbers are labeled in correct units
- [ ] My work is shown
- [ ] My numbers make sense

Organization

- [ ] I used charts, diagrams, or pictures to enhance my explanations and procedures
- [ ] My organization is legible

Conclusion/Analysis

- [ ] I used data to support or disprove my hypothesis
- [ ] I made logical conclusions based on my data

Evaluation

- [ ] I analyzed how to modify my experiment to make it more powerful
- [ ] I used feedback and ideas given

Variables

- [ ] I can correctly identify the control and independent variables in my experiment

Collaboration

- [ ] I listen to other members of my team as they explain their experiments
- [ ] I analyze how to use that information
- [ ] I provide feedback for team members
- [ ] I help make team decisions as we plan next steps

Assessing Projects: Accidental Discoveries
Slime Lab

Slime Lab: Recreating the Accident

INITIAL:

1. Observe the substances on the lab tray (50 ml of glue, 100 ml of water, and 1.0 ml of borax). Write down as many physical properties of each substance that you can observe and/or measure.
2. Predict chemical properties of each substance.

DURING:

Part I

3. Mix the 50 ml of glue with 50 ml of water in cup a: list the new physical and chemical properties. Did they change? Only list the ones that are new (Key words: solution, mixture, density, homogenous, heterogeneous). How did the density change?
4. Mix 50 ml of water with the 1.0 ml of borax (white powder) in cup b: list the new physical and chemical properties. Did they change? Only list the ones that are new. (Key words: solution, mixture, density, homogenous, heterogeneous). How did the density change?
5. Predict what will happen if you combine the two mixed substances (cup "a" and cup "b").

Part II

6. Slowly pour the borax/water in the glue/water stirring vigorously.
7. Take new substance out of the cup and knead in your hands.
8. Play with the new substance, observing properties and behavior.
9. Did any of the physical properties change? Is so list, include mass, volume, and density.
10. With substance in a sealed bag, squeeze all the air out and drop in water tank. Observe the density. Does it match your calculations? Explain in complete sentences.
11. Did any of the chemical properties change? Predict new chemical properties (teacher will confirm predictions later as a class demonstration--these can not be tested at this point).
12. Give data of all properties that have been measured to teacher to record in class spreadsheet.

AFTER: (Teacher hands out class spreadsheet with all measurable data: temperature, mass, volume, and density). Analyze the data on the class chart.

13. In general, what are the relationships among mass, volume, and density?
14. What did you observe concerning the heat energy of the new substance? Explain your reasoning.
15. Make at least five analysis statements about the data in the class chart. Is all the data congruent? Look for data among groups that stands out and explain why you think that particular data is different from the rest of the groups.
16. In what ways does this chart help you analyze the data more thoroughly?
17. Go to a computer station and create two different graphs representing your conclusions from the class chart.
18. Compare your data to the rest of the data on the class chart. Is your data valid? Why or why not? Give reasons if it isn't valid.
19. Name two physical changes and one chemical change that took place during this lab. Write in complete sentences and explain your thinking.
20. Compare the temperature changes that occurred during the lab. Explain the temperature changes scientifically.
21. Observe teacher demonstration on chemical properties of new substance. List the chemical properties that you observed.
22. Were your predictions on the chemical properties correct? Explain which ones were correct and which ones were not.

***Teacher note: Conduct a burn test on each substance individually and also the mixtures and new substance (slime). Show pictures of biodegradability of new substance (this needs to be prepared in advance). Show molecule structure of each substance (water: monomer, glue: polymer, borax: cross linker). Just give students toxic and combustibility reports.*

Assessing Projects: Accidental Discoveries
Using Data to Persuade

Using Data to Persuade Rubric

Criteria	4	3	2	1
Displays Data	I accurately displayed data using rank ordering and skillful organization. I used technology to effectively display data that is organized, easy to interpret, and enhances the selling of the product.	I accurately displayed data using rank ordering. I displayed data that is accurate and clear and enhances the selling of the product.	I displayed data using rank ordering with some errors. I displayed compiled data, but presentation may be muddled or contain errors so that it detracts from selling the product.	I displayed data unclearly or in a confusing way. My data is incomplete or does little to sell the product.
Makes a Persuasive Argument	I used data from my experiments for a creative and unique purpose that persuades consumer to buy product.	I used data from my experiments to persuade consumers to buy product.	I used experiments to persuade consumer to buy product but is only partially supported by the data.	The data from my experiments do not support or persuade consumer to buy product.
Creativity	My slogan, logo, and directions for uses are enhanced by technology or artistic design. I used creative writing techniques.	I included a slogan, logo, and complete directions to use product so that it is understandable to consumer.	My slogan or logo is weak and does not enhance the selling of the product. My directions are incomplete or confusing.	My slogan or logo (or both) is missing from the label. I did not include directions or they are too incomplete to follow.
Scientific Background of Product	I included more than five accurate physical and chemical properties of substance. I used scientific vocabulary to describe how product is made and included in-depth observations of the product's behavior.	I included at least three accurate physical and chemical properties (such as mass, volume, density, etc.) I included accurate descriptions of how the product was made and general observations of product.	I only included a few physical and chemical properties. My description of how product was made is incomplete or contains inaccuracies. My observations are not descriptive or incomplete.	The properties listed are inaccurate or not included. My descriptions and observations contain inaccuracies or are missing.