

Lesson Plan Format

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Topic or Unit of Study: Liquid Nitrogen
Properties of Matter & Physical Changes Part 2

Grade/Level: 4th – 6th grade

Lesson Start and End Time: 45 minutes

Outcomes

PDE Standards:

3.2.4.A1

- Identify and classify objects based on measurable physical properties.
- Compare and contrast solids, liquids, gases.

3.2.5.A1

- Describe changes of water when heat is added or taken away.

3.2.6.A1

- Distinguish differences of properties in solids, liquids, gases.
- Difference between volume and masses.

Next Generation Science Standards:

5-PS1-3. Make observations and measurements to identify materials based on their properties.

Objective:

SWBAT describe and compare the properties of materials in a quick write by observing physical changes of several substances.

Instructional Materials: Be sure to name materials and resources so that they match your descriptions in the procedure of the Lesson Plan. List all websites or texts according to APA reference procedures.

Pre-Trip Information

- Three states of matter and their transitions
 - S \leftrightarrow L \leftrightarrow G, S \leftrightarrow G
- Review solid, liquid, and gas properties

Helpful Websites

Crash Course Kids (short science videos targeted for 5th grade)

- Homepage: <https://www.youtube.com/channel/UCONtPx56PSebXJOxbFv-2jQ>
- 16 videos on Physical Science: Properties of Matter
<https://www.youtube.com/playlist?list=PLhz12vamHOnaY7nvpgtQ0SIbuJdC4HA5O>

Teacher - What will the teacher need?

1. 20 L liquid nitrogen (need 4 L Dewar)
2. Styrofoam cup (to hold liquid nitrogen)
3. Pieces of 8.5 x 11 paper
4. 3 Tea Kettles
5. 100 Balloons
6. Styrofoam container (to put balloons into liquid nitrogen)

Student – What will each student or group of students need?

- Pen/Pencil
- Observation form
- Safety glasses

Procedures with Time Span

Introduction (time span: 10 minutes): Informing Students of objectives and rationale for the lesson, Gaining Attention, Activating Background Knowledge, Inquiry into the topic/concept.

Teacher pairs students up outside of the classroom. Students take seats as pairs.

Safety

- **Safety glasses on at all times**
- Do not touch the liquid nitrogen
- Do not touch the tea kettle

Teacher Demonstration with Student Volunteers

Purpose: Engage students through kinesthetic learning and activate their prior knowledge.

States of Matter – Ask for student volunteers to act out the difference of the particle proximity in different states of matter: solids, liquids, and gases.

1. Solids – students stand close together with restricted movement (students link arms)
2. Liquid – students stand arm distance from one another, have more motion and can interact (students are not linked, have to push to move around).
3. Gas – students are far apart from one another (think down the hall, out of ear shot) and have free movement to roam (use 2 students – one person goes to the other side of the room) -- football field analogy for distance between gas particles.

Assess prior knowledge

- Who has heard of Liquid Nitrogen?
- What do we know about Liquid Nitrogen?
 - o Boiling point is – 197 °C
 - o Almost 200° below the freezing point of water (*so it's really really really cold*)
- How can we keep liquid nitrogen as a liquid?
 - o Introduce styrofoam container
 - o Touch the styrofoam container (don't stick your finger into the liquid nitrogen)

Developmental Activities (time span – 40 minutes): Guided Practice, Checkpoints for Understanding, Independent Practice.

Teacher Demonstration

Purpose: demonstrate liquid nitrogen is a liquid.

1. Pour liquid nitrogen on a piece of paper.
2. Discuss:
 - a. What happened?
 - b. What did you observe? (Use your observation form to record what happened.)
3. Write 3 observations on your observation form.

Purpose: demonstrate liquid nitrogen changes from liquid --> gas.

1. Put liquid nitrogen into a tea kettle.
2. Look inside the tea kettle and observe what happens.
 - a. *Liquid nitrogen boils (evidence that liquid nitrogen --> gas)*
 - b. *Close the spout (and it whistles and you see gas coming out)*
 - c. *Frost will begin to form on the tea kettle and there will be drips coming off the tea kettle.*
3. Discuss:
 - a. What happened?
 - b. What do you observe?
 - c. What is the frost? (*Water vapor from the air depositing as a solid like frost on your windshield in the winter.*)
 - d. Why is frost forming?
 - e. What are the drips? (*This is the condensation of oxygen.*)
 - f. Why are drips forming? (*This is because the liquid nitrogen is so cold. This is how clouds form and how snow forms.*)
4. Write 3 observations on your observation form.

Extended option – Liquid Nitrogen balloon demo

Purpose: Demonstrate liquid nitrogen as a gas.

1. Inflate balloons (have students do this).
2. Fill up styrofoam container with liquid nitrogen.
3. Put the balloons into a styrofoam container.
 - a. How many balloons do you think we can put in here?
 - b. Have students make a prediction.
4. Observe what happens to the balloons.
 - a. *Students write down what they think is happening.*
 - b. *Balloons will collapse in the styrofoam container – upwards of 10-12*
5. Discuss:
 - a. What happened?
 - b. What do you observe?
 - c. Why are the balloons collapsing?

Closure/Summary (time span - 5 minutes): Making connections, Summarizing/Generalizing learning.

Review properties of gases

Review change of state/phase from liquid --> gas

What did you learn about liquid nitrogen? (*it's really cool*)

Quick Write prompt

Assessment: Name the task used in your introduction, development or closure that documents student achievement of the LO.

- Observation form
- Quick Write – prompt: Describe two similarities and two differences between boiling water in a tea kettle and boiling liquid nitrogen in a tea kettle.

Rating Scale: Rubric or other measure of student achievement of LO:

3 – Exemplary: The student clearly describes physical changes in all three activities; the student is able to compare/contrast physical changes in liquid nitrogen and water articulately.

2 – Proficient: The student clearly describes physical changes in most of the activities, but more detail could enhance the students' explanations.

0-1 – Unacceptable: The student does not clearly describe physical changes in most of the activities; the task was not submitted.

Observation Form

Student Name:

Activity 1: Liquid nitrogen on paper	Activity 2: Liquid nitrogen in a tea kettle	Activity 3: Balloons in liquid nitrogen
<p>Observations:</p> <p>1.</p> <p>2.</p> <p>3.</p>	<p>Observations:</p> <p>1.</p> <p>2.</p> <p>3.</p>	<p>Observations while balloons are submerged in the liquid nitrogen:</p> <p>Observations after balloons are removed from the liquid nitrogen:</p>

Student Name:

Quick Write – Describe two similarities between boiling water in a tea kettle and boiling liquid nitrogen in a tea kettle.

Describe two differences between boiling water in a tea kettle and boiling liquid nitrogen in a tea kettle.