

Title: Fun with Dry Ice, Part I

Subject Area: Science

Grade: 5th

Science Connection:

- Standard I, Objective 2 - Evaluate evidence that indicates a physical change has occurred
- Standard I, Objective 3 – Investigate evidence for changes in matter that occur during a chemical reaction
- Standard I, Objective 3.d – Compare a physical change to a chemical change.

Language Arts Connection:

- Standard VIII, Objective 1.d – Use a variety of graphic organizers to organize information from multiple sources.

Explanation of Activity: In this activity, the teacher will perform a series of demonstrations that test for physical changes and chemical changes of dry ice. Students will record information about each demonstration including whether the demonstration showed a physical change or a chemical change and the evidence that supports it.

Background Knowledge: Physical properties of matter are properties that can be observed and measured without changing the substance of the matter. Physical properties can usually be described using the senses including sight, smell and touch. Examples of physical properties are color, texture, odor and state (solid, liquid or gas). Chemical properties of matter describe how the matter reacts with other substances to make new substances. Flammability, reactivity to water, and reactivity to acid are examples of chemical properties.

Physical changes change the physical properties of the matter without changing the actual substance. For example, tearing a piece of paper in half is a physical change. The paper has changed size, but it is still paper. Chemical changes change the matter into an entirely new substance with different properties. Burning a piece of paper is a chemical change. The paper is no longer paper, it is now ash. One good way to distinguish between chemical changes and physical changes is that physical changes are often reversible whereas chemical changes are not.

Dry ice is frozen carbon dioxide. It is called “dry” ice because it goes from a frozen solid to a boiled gas without slowing down long enough to be a liquid. This is called sublimation (the change of state from a solid to a gas). Because of this property, dry ice has interesting chemical and physical properties.

Materials: dry ice (can be purchased the morning of the lesson from most grocery stores), Styrofoam cooler, water, medium sized balloons, hammer or crushing tool, bromothymol blue, phenolphthalein, baking soda, dish soap, metal spoon, candle,

matches, mason jar, pitcher or large beaker, test tube, Styrofoam cup, 2 beakers, 1 pair of gloves, 1 pair of goggles, plastic bag, copies of student sheet

Procedures:

1. Gather the materials and place them on a demonstration table.
2. Hand out the student sheet and read through the background information and directions with them.
3. Do the demonstrations listed below (remember to wear your goggles and glove – only handle the dry ice with your glove on!). As you do the demonstrations have students record whether it is a physical or a chemical change. Each demonstration has an explanation as what kind of change it is and why. You may want students to try to figure out what kind of change each demonstration is for themselves and then discuss their results at the end of the demonstrations.
4. Have students complete the worksheet. Help them answer the questions and fill out the Venn diagram. Sample answers are given.

Demonstrations:

1. Place a piece of dry ice in a plastic bag and seal it. Using a hammer, crush the dry ice into small pieces. Place a few of the pieces into a test tube. Stretch a balloon over the top of the test tube. Turn the test tube upside down and let the pieces of dry ice fall into the balloon. Take the balloon off the test tube and tie it. Hold up the balloon to the students so they can watch it expand. **Explanation:** This is a physical change for both the dry ice and balloon. The dry ice is changing state from a solid to a gas (sublimation) and the balloon is changing size.
2. Place a piece of dry ice on the table and press a metal spoon down onto it. The dry ice will squeak. **Explanation:** This is a physical change also caused by the sublimation of the dry ice. The dry ice gas vibrates the metal as it tries to get around the metal spoon. This causes a little bit of pressure and the pressure difference makes noise.
3. Fill a test tube with a little bit of water (it's nice to add some food coloring to the water to make it easier to see). Place the test tube in a Styrofoam cup and fill in the cup with pieces of dry ice around the test tube. You may want to have someone time how long it takes for the water to freeze (usually 2-3 minutes) and you can walk around the room to show students the progress of the freezing to take up the time. **Explanation:** This is a physical change. The dry ice is causing the water to change from a liquid state to a solid state.
4. Allow students to play “dry ice” hockey by setting up goals on their table and shooting small chunks of ice through them by hitting the dry ice with their pencils. Make sure to tell students that they are not to touch the dry ice with their bare skin because it will burn them. Do not give students pieces larger than a penny. The dry ice hockey game ends when the ice is gone. Ask students if they can explain why the ice “floats” across the table. **Explanation:** This is a physical change. Dry ice floats because it has a cushion of carbon dioxide gas around it.

5. Melt the bottom of a candle and stick it to the bottom of a Mason jar. Place some pieces of dry ice in a pitcher and let the dry ice sublime. Light the candle and let it burn. Tip the pitcher and let the carbon dioxide gas pour onto the candle. The candle should go out. **Explanation:** This is a chemical change. One of dry ice's chemical properties is that it is nonflammable. Fire needs oxygen to burn, the carbon dioxide smothers the flame.
6. Fill a beaker with water. Pour in some bromothymol blue. Add a few pieces of dry ice and allow the bromothymol solution to bubble. Eventually, the bromothymol will bubble to yellow. **Explanation:** this is a chemical change. Bromothymol blue will turn yellow in the presence of an acid. As the dry ice bubbles, carbon dioxide is dissolved into the water. When carbon dioxide dissolves into a liquid it turns into carbonic acid.
7. Fill a beaker with water and stir in a couple spoonfuls of baking soda. Add some phenolphthalein to the solution and it will turn pink. Add a few pieces of dry ice and allow the phenolphthalein solution to bubble. Eventually it will bubble to clear. **Explanation:** this is a chemical change. Phenolphthalein turns pink in the presence of a base (baking soda is a base). As the dry ice bubbles, carbonic acid is added to the phenolphthalein solution making it acidic.
8. Fill a beaker with water and add some dish soap to it. Add dry ice and watch the bubbles. Walk around the room and allow kids to take a handful of bubbles to play with. **Explanation:** This is a physical change. The dry ice is mixing the soap and water to make bubbles.

*Safety concern: Caution students not to hold dry ice to their skin or put it in their mouth.

Key to Student Analysis Questions

1. frozen carbon dioxide
2. dry ice is much colder, it 'smokes' or sublimates, does not melt into a liquid
3. Dry Ice: colder, smokes, doesn't melt, squeaks on a spoon, sinks in water, (any of the demonstration results would fit here)
Water Ice: melts into water, doesn't burn your skin, doesn't smoke, can be put in your mouth, floats in water
Both: cold, slippery, whitish

Title: Fun with Dry Ice, Part I

Introduction: Dry ice is frozen carbon dioxide. It is called “dry” ice because it goes from a frozen solid to a boiled gas without slowing down long enough to be a liquid. Because of this property, dry ice is interesting to experiment with. You must be careful with dry ice because it is much colder than ice made from water. You should not touch it with your bare skin.

Procedures:

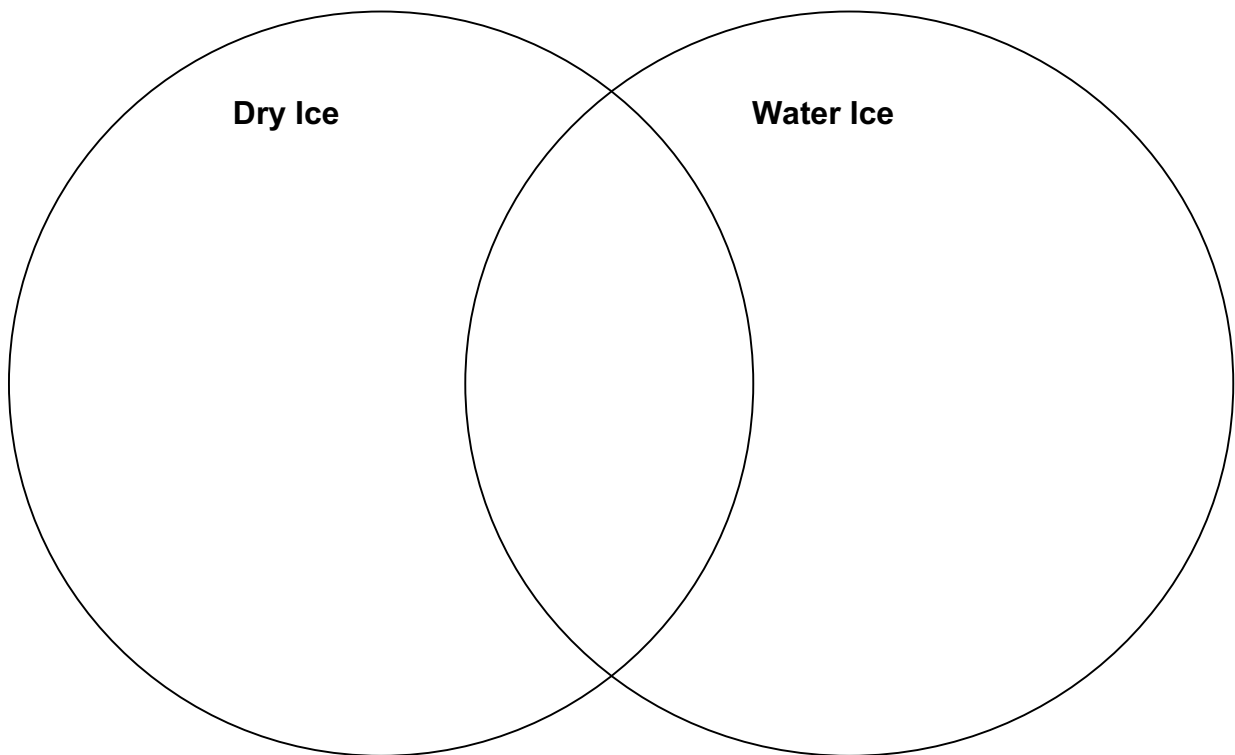
1. Watch as your teacher demonstrates some chemical and physical changes with the dry ice.
2. Record what happens and what evidence you think makes the change a physical change or a chemical change.
3. Answer the questions and write a conclusion.

Data:

| Demonstration | Chemical or Physical change? | Evidence |
|----------------------|-------------------------------------|-----------------|
| Balloon | | |
| Squeaky Spoon | | |
| Freezing Water | | |
| Dry Ice Hockey | | |
| Candle | | |
| Blue Water | | |
| Pink Water | | |
| Bubbles | | |

Analysis:

1. What is dry ice made of?
2. Why is dry ice different than ice made from water?
3. Fill out the Venn Diagram and compare dry ice to ice made from water:



Conclusion: Write 2 things you learned.

Title: Fun with Dry Ice, Part II

Subject Area: Language Arts

Grade: 5th

Language Arts Connection:

- Standard VIII, Objective 1 – Prepare to write by gathering and organizing information and ideas (pre-writing)
- Standard VIII, Objective 1.c – Identify audience, purpose, and form for writing
- Standard VIII, Objective 1.d – Use a variety of graphic organizers to organize information from multiple sources
- Standard VIII, Objective 2 – Compose a written draft
- Standard VIII, Objective 2.c – Use strong verbs and precise and vivid language to convey meaning
- Standard VIII, Objective 3 – Revise by elaborating and clarifying a written draft.
- Standard VIII, Objective 4 – Edit written draft for conventions.
- Standard VIII, Objective 5 – Use fluent and legible handwriting to communicate.
- Standard VIII, Objective 6 – Write in different forms and genres
- Standard VIII, Objective 6.b – Produce traditional and imaginative stories

Science Connection:

- Standard I, Objective 2 - Evaluate evidence that indicates a physical change has occurred
- Standard I, Objective 3.d – Compare a physical change to a chemical change.

Explanation of Activity: In this activity, the students will use the teacher demonstrations they observed in Part I of the lesson to write a creative narrative.

Background Knowledge: A RAFT is a form of creative writing. R=role (person or object), A=audience (family, friends, teacher), F=format (letter, newspaper article, journal entry), and T=topic. In this RAFT the students will pretend to be a piece of dry ice. The audience is their parents. The format is a letter. The topic is ‘The Changes I’m Going Through at Dry Ice Summer Camp.’ The students will take the demonstrations done in Part I of the lesson, and turn them into ‘changing experiences’ at summer camp. For example, the squeaky spoon demonstration could represent the time at camp the piece of dry ice became lost on the woods and used his/her whistle to be found, or the candle demonstration could represent putting out the camp fire after roasting marshmallows. In their letter, students should also identify each change as a physical or chemical change.

Materials: copies of student sheet

Procedures: You can decide how you would like to do the procedures. The student sheet is set up into 6 steps. Each step can be done separately or combined in any way that works best for the pace of your class.

1. Hand out student sheets.
2. Go over the introduction with students. Explain to the students that they will be writing a RAFT (see background information above).
3. Have the class brainstorm vivid language that describes each dry ice demonstration from Part I of the lesson and write it in the chart.
4. Next, explain to students that they need to relate each dry ice demonstration to a summer camp activity (see examples above in background information). Break the students into groups to brainstorm. After giving students time in their groups, you may want to discuss what each group came up with as a class.
5. Have students organize their letters. They should identify what they will write in the beginning, middle and end of the letter. The beginning of the letter should introduce the parts of the RAFT, the role, audience, format and topic. It should also establish a purpose for the letter, for example to tell the parents that summer camp is fun, horrible, or exciting because of all the changes that dry ice is going through. The middle of the letter should describe each change dry ice has gone through, and identify each change as either physical or chemical. The students sheet says that students should pick at least four demonstrations. You can change that number based on student ability. The end of the letter should describe how dry ice feels after all of these changes and what dry ice wants his/her parents to do about it: let dry ice come home early because he/she hates all of the changes or let dry ice stay at camp forever because it is so great.
6. Once students have organized the beginning middle and end of their letter, go over the requirements for the rough draft:

| Requirements |
|--|
| Role is a piece of dry ice. |
| Audience is to the dry ice's parent. |
| Format is a letter. |
| Topic is 'The changes I am going through at dry ice summer camp.' |
| Includes 4 demonstrations, each one representing a different camp activity. |
| Each demonstration (camp activity) is identified as a chemical or physical change. |
| Uses vivid language. |
| Is well organized (clear beginning, middle and end). |
| Uses correct capitalization, punctuation, spelling, and grammar. |
| Handwriting is neat and legible. |

Give students time to work on the rough draft and set a due date. Students should check off each requirement as they complete their rough drafts. You may want to tell students that they will be peer-grading the rough drafts on the day they are due.

7. After completing their rough drafts, have students switch with other students to peer grade the rough drafts. Give each student the 'Step 5: Peer Grade' page. Students should read through the rough draft and rate it based on the rubric given. Students should already have had some practice looking for capitalization, punctuation, spelling, and grammar errors. If they have not, choose which ever category you are currently working on in class, and have students peer grade only that category. After rating the rough draft according to the rubric, they should answer the questions regarding the rough draft. The rough draft, along with the 'Peer Grade' page should be returned to the author.
8. Once students have received their rough draft and the peer grade sheet back they need to choose 5 sentences from their rough draft to fix. They can choose sentences based on their conventional errors, content errors or to include more vivid language. Students will write the sentence they originally wrote in the first column, why it needed to be fixed in the second column and the revised sentence in the third column.
9. Last, students will write their final drafts, including the revisions they made. You may want to review the students rough drafts and revisions before they write the final drafts to address any other problems they might need to fix.

Title: Fun with Dry Ice, Part II

Name _____

Introduction: In Part I, you saw demonstrations that your teacher did with dry ice. You are now going to write a RAFT about dry ice. A RAFT is a type of creative story. Each letter in RAFT stands for a part of the story:

R – Role: The role of the story is the character you pretend to be.

A – Audience: The audience is who the character is writing to.

F – Format: The format is the form of writing the character is using like a letter, a newspaper article or a journal entry.

T – Topic: The topic is what the character is writing about.

In the RAFT you are going to write your role is dry ice, the audience is your parents, the format is a letter, and the topic is ‘The changes (physical and chemical) I am going through at dry ice summer camp’. The changes you are going through are all of the demonstrations your teacher did in Part I.

Step 1: Brainstorm Vivid Language

Brainstorm with the class to come up with vivid language to describe each demonstration with dry ice to include in your creative story.

| Demonstration | Vivid Language |
|----------------------|-----------------------|
| Balloon | |
| Squeaky Spoon | |
| Freezing Water | |
| Dry Ice Hockey | |
| Candle | |
| Blue Water | |
| | |

| | |
|------------|--|
| Pink Water | |
| Bubbles | |

Title: Fun with Dry Ice, Part II

Name _____

Step 2: Brainstorm Camp Activities

Now you will brainstorm with a small group of students to relate each demonstration to a summer camp activity. For example, the squeaky spoon demonstration could represent using a whistle because you are lost in the woods, or the blue water demonstration could represent what happens when you swim in the lake.

| Demonstration | Camp Activity |
|----------------------|----------------------|
| Balloon | |
| Squeaky Spoon | |
| Freezing Water | |
| Dry Ice Hockey | |
| Candle | |
| Blue Water | |
| Pink Water | |
| Bubbles | |

Title: Fun with Dry Ice, Part II

Name _____

Step 3: Organize the Letter

The next step is to organize your letter before you begin to write your rough draft. Organize your ideas into the beginning, middle and end of your letter. Remember your role – you are a piece of dry ice, your audience is your parents, your format is a letter, and your topic is the changes (physical and chemical) you are going through at dry ice camp. Remember to include vivid language from step 1.

In the **beginning** of your letter make sure to introduce the topic. You may want to tell your parents whether you are having a good time at camp or a bad time at camp.

In the **middle** of your letter, explain what is happening at camp and how it is changing you. You only need to include four demonstrations (camp activities) in your story. Make sure to explain each camp activity as a chemical or physical change.

At the **end** of your letter tell your parents how you feel and what you want to happen. Do you want to stay at camp forever or do you want to come home right now?

| Organization | |
|---------------------|--|
| Beginning | |
| Middle | |
| | |

| | |
|------------|--|
| End | |
|------------|--|

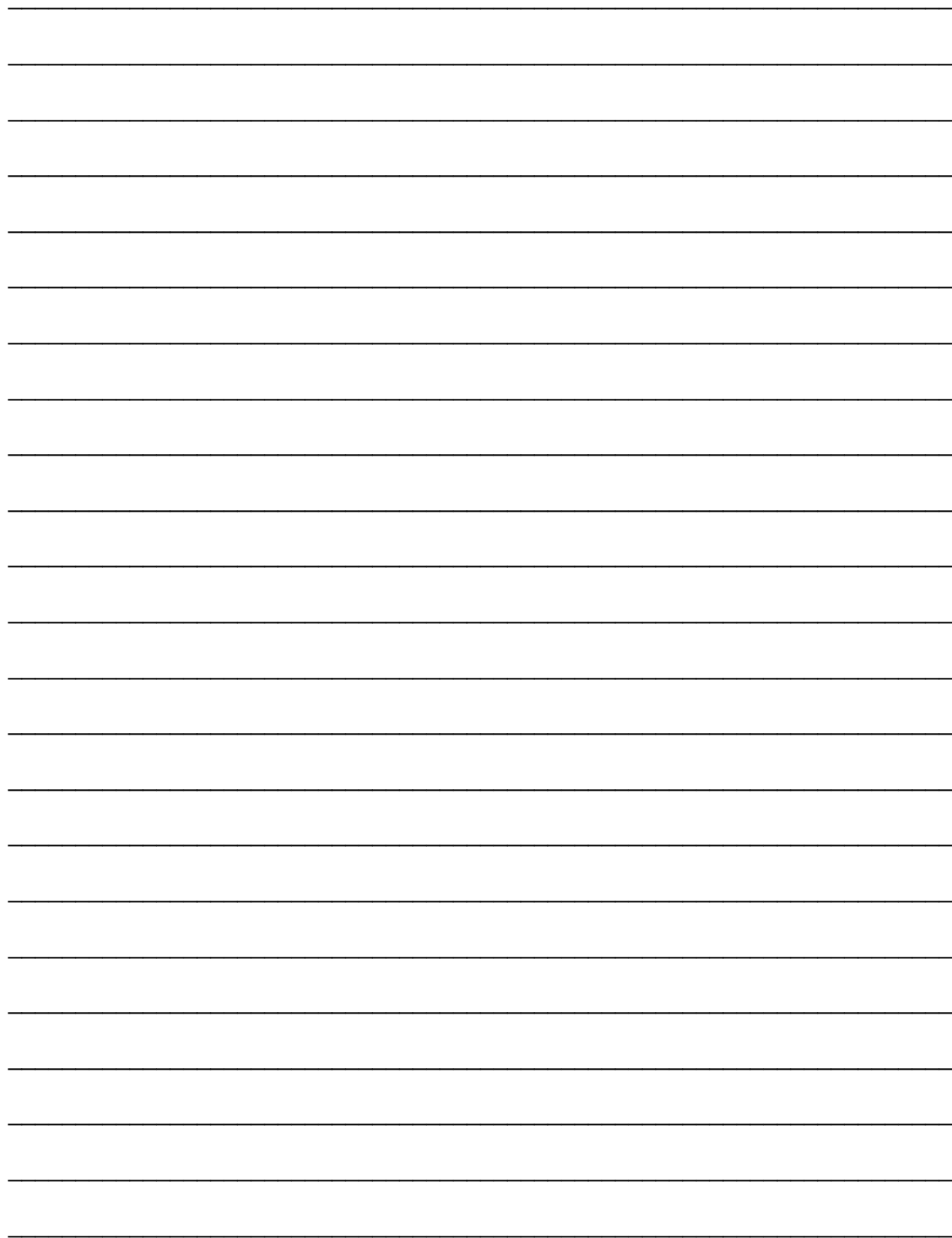
Title: Fun with Dry Ice, Part II **Name** _____

Step 4: Write Rough Draft

Now it is time for you to write a rough draft. Below is a chart with all of the requirements for your story. When you are finished with your story, make sure to check off each requirement that you have completed.

| Requirements | Completed |
|--|------------------|
| Role is a piece of dry ice. | |
| Audience is to the dry ice's parent. | |
| Format is a letter. | |
| Topic is 'The changes I am going through at dry ice summer camp.' | |
| Includes 4 demonstrations, each one representing a different camp activity. | |
| Each demonstration (camp activity) is identified as a chemical or physical change. | |
| Uses vivid language. | |
| Is well organized (clear beginning, middle and end). | |
| Uses correct capitalization, punctuation, and grammar. | |
| Handwriting is neat and legible. | |

Rough Draft:



Title: Fun with Dry Ice, Part II

Name _____

Step 5: Peer Grade

Trade rough drafts with another student. Use the rubric below to rate the rough draft. Give each category a score from 1-4. Then, answer the questions that follow.

| Category | 4 | 3 | 2 | 1 | Rating |
|---------------------------------------|---|--|---|--|---------------|
| Capitalization and Punctuation | There are no capitalization or punctuation errors. | There are 1 to 5 capitalization or punctuation errors. | There are 6 to 10 capitalization or punctuation errors. | There are more than 10 capitalization or punctuation errors. | |
| Spelling | There are no spelling errors. | There are 1 to 5 spelling errors. | There are 6 to 10 spelling errors. | There are more than 10 spelling errors. | |
| Grammar | All of the verbs are the right tense and agree with the subject | There are 1 to 5 incorrect verbs. | There are 6 to 10 incorrect verbs. | There are more than 10 incorrect verbs. | |
| Handwriting | The handwriting is neat and easy to read. | The handwriting is neat but has a few messy corrections. | The handwriting is messy, but can still be read. | The handwriting is too messy to read. | |

1. What was the best part of the rough draft? Why?
2. What part of the rough draft could use some improvement? What could be done to make it better?
3. Look at the list of requirements for the rough draft. Did the author complete all of the requirements? Which requirements, if any, did the author forget to do in his/her rough draft?

4. Does the rough draft use any vivid language? Give an example from the rough draft.

5. Does the author do a good job pretending to be a piece of dry ice? Why or why not?

Title: Fun with Dry Ice, Part II

Name _____

Step 6: Revise Rough Draft

Use the suggestions given on the Peer Grade paper to revise your rough draft. Pick 5 sentences from your rough draft to fix. You may need to fix grammar, spelling, or punctuation, or add more vivid language to make your rough draft better. Write the sentence of your rough draft you originally wrote in the first column, why it needed to be fixed in the second column, and then write your revised sentence in the third column.

| Original Sentence | Why it Needed to be Fixed | Revised Sentence |
|-------------------|---------------------------|------------------|
| | | |
| | | |
| | | |
| | | |

