



**Reading Supports**

**Teacher’s Guide:**

**“What’s Artificial Snow, and How Is It Made?”**

*December 2018/January 2019*

<http://www.acs.org/chemmatters>



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# Reading Supports

The pages that follow include reading supports in the form of an Anticipation Guide, a Graphic Organizer, and Student Reading Comprehension Questions. These resources are designed to help students prepare to read the article, and then locate and analyze information from the article.

* **Anticipation Guide (p. 5):** The Anticipation Guide helps to engage students by activating prior knowledge and stimulating student interest before reading. If class time permits, discuss students’ responses to each statement before reading each article. As they read, students should look for evidence supporting or refuting their initial responses.

**Or** consider the following ideas to engage your students in reading:

**What’s Artificial Snow, and How Is It Made?**

* Before reading, ask students where artificial snow might be needed. Also, ask students how they think real snow forms, and how that might be different from artificial snow.
* As they read the article, students should compare their original ideas to the information in the article.
* **Graphic Organizer (p. 6):** The Graphic Organizer is provided to help students locate and analyze information from the article. Student understanding will be enhanced when they explore and evaluate the information themselves, with input from the teacher, if students are struggling. Encourage students to use their own words and avoid copying entire sentences from the article. The use of bullets helps them do this.

If you use the aforementioned organizers to evaluate student performance, you may want to develop a grading rubric such as the one below.

|  |  |  |
| --- | --- | --- |
| **Score** | **Description** | **Evidence** |
| 4 | Excellent | Complete; details provided; demonstrates deep understanding. |
| 3 | Good | Complete; few details provided; demonstrates some understanding. |
| 2 | Fair | Incomplete; few details provided; some misconceptions evident. |
| 1 | Poor | Very incomplete; no details provided; many misconceptions evident. |
| 0 | Not acceptable | So incomplete that no judgment can be made about student understanding |

* **Student Reading Comprehension Questions (p. 7):** The Student Reading Comprehension Questions are designed to encourage students to read the article (and graphics) for comprehension and attention to detail, to provide the teacher with a mechanism for assessing how well students understand the article and/or whether they have read the assignment, and, possibly, to help direct follow-up, in-class discussion, or additional, deeper assignments.

Some of the articles in this issue provide opportunities, references, and suggestions for students to do further research on their own about topics that interest them.

To help students engage with the text, ask students which article **engaged** them most and why, or what **questions** they still have about the articles. The “Web Resources for More Information” section of the Teacher’s Guide: Tools and Resources provides sources for additional information that might help you answer these questions.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Anticipation Guide

**Directions: *Before reading***, in the first column, write “A” or “D” indicating your agreement or disagreement with each statement. As you read, compare your opinions with information from the article. In the space under each statement, cite information from the article that supports or refutes your original ideas.

|  |  |  |
| --- | --- | --- |
| **Me** | **Text** | **Statement** |
|  |  | 1. Originally, large blocks of ice were pulverized to create fake show. |
|  |  | 1. Snow guns used at ski resorts use water and pressurized air to make artificial snow. |
|  |  | 1. No Olympic Winter Games have ever used artificial snow. |
|  |  | 1. Snow guns at ski resorts can produce as much artificial snow as needed if the temperature is 0 °C or lower. |
|  |  | 1. Artificial snow and natural snow crystals look the same under a microscope. |
|  |  | 1. Nucleation sites are needed for natural snow to form. |
|  |  | 1. Ice crystals have a hexagonal structure. |
|  |  | 1. If a surfactant is added to reduce the surface tension of water, the water droplets freeze more slowly. |
|  |  | 1. Most snow made for movie and television sets is made from cornflakes painted white. |
|  |  | 1. Cloud seeding projects to make rain were introduced in the 1990s. |

## Graphic Organizer

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Directions**: As you read, complete the graphic organizer below to compare the requirements and materials used for making artificial snow and natural snow.

|  |  |  |
| --- | --- | --- |
|  | **Artificial Snow** | **Natural Snow** |
| Materials needed |  |  |
| Air temperature required |  |  |
| Structure (drawings OK) |  |  |
| Nucleators |  |  |
| Surfactants |  | N/A |
| Cloud seeding |  |  |
| Artificial snow in films and TV |  | N/A |

**Summary:** On the back of this paper, write a short explanation (2-3 sentences) of how artificial snow might impact the environment, providing reasons supported by information in the article.

## Student Reading Comprehension Questions

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Directions**: Use the article to answer the questions below.

* 1. List two reasons why ski resorts may use machines to make snow.
  2. Why is it predicted that the 2022 Winter Olympics in Beijing will need to rely almost entirely on artificial snowmaking?
  3. Under what temperature conditions can snow guns usually produce as much snow as is needed?
  4. (a) What is a nucleator and, (b) what are three materials that can serve as nucleation sites?
  5. What material is used in Snomax as a nucleating agent?
  6. How does the use of a surfactant in the Drift snowmaking additive help in making artificial snow?

**Student Reading Comprehension Questions, cont.**

* 1. What causes water to bead up on the surface of a greasy material?
  2. Explain how a surfactant works to allow water molecules to remove greasy stains.
  3. List seven materials that have been used, or are still used, as faux snow in movies or on television.
  4. (a) Define hygroscopic, and (b) give an example of a hygroscopic substance.

**Critical-Thinking Questions**

***Write your answers on another piece of paper if needed.***

* 1. While the article doesn’t explicitly state them, what problems with cloud seeding might be inferred?
  2. Research and evaluate the benefits and environmental impacts of ski resorts producing artificial snow.

## Answers to Reading Comprehension Questions

1. **List two reasons why ski resorts may use machines to make snow.**

Two reasons why ski resorts may use machine s to make snow are

1. to extend the ski season, and
2. to enhance existing natural snow.
3. **Why is it predicted that the 2022 Winter Olympics in Beijing will need to rely almost entirely on artificial snowmaking?**

The 2022 Winter Olympics in Beijing will need to rely almost entirely on artificial snowmaking because of that region’s minimal precipitation.

1. **Under what condition can snow guns usually produce as much snow as is needed?**

As long as the temperature remains below about –8 °C (18 °F) snow guns can generally produce as much snow as is needed.

1. **What is a nucleator, and (b) what are three materials that can serve as nucleation sites?**
2. A nucleator is a particle that serves as a scaffold to begin ice-crystal formation in snow.
3. Three materials that can serve as nucleation sites are
4. mineral dust,
5. clay particles, and
6. bacteria.
7. **What material is used in Snomax as a nucleating agent?**

Snomax uses *Pseudomonas syringae* bacteria as a nucleating agent.

1. **How does the use of a surfactant in the Drift snowmaking additive help in making artificial snow?**

The surfactant in Drift reduces the surface tension of the water sprayed out of the snow guns and helps the water droplets freeze more rapidly into artificial snow rather than clumping together.

1. **What causes water to bead up on the surface of a greasy material?**

Water beads up on the surface of a greasy material because the attractive forces inside water are greater than its attraction to the greasy surface.

1. **Explain how a surfactant allows water molecules to remove a greasy stain.**

Surfactants contain both polar and nonpolar components that interrupt the attraction among the polar water molecules. This allows the nonpolar grease molecules to integrate with the water and permits attractions between the polar water and the nonpolar grease. The nonpolar portions of the surfactant molecules surround the grease stain and the polar portion of the surfactant molecules attract to the polar water molecules, allowing the stain to rinse away.

1. **List seven materials that have been used, or are still used, as faux snow in movies or on television.**

Seven materials that have been used, or are still used, as faux snow in movies or on television are

1. cornflakes painted white,
2. firefighting foam,
3. instant potato flakes,
4. flour,
5. marble dust,
6. gypsum, and
7. paper.
8. **Define hygroscopic, and (b) give an example of a hygroscopic substance.**
9. A hygroscopic material is one that attracts and holds water vapor molecules.
10. An example of a hygroscopic substance is table salt, NaCl.

**Critical-Thinking Questions**

1. **While the article doesn’t explicitly state them, what problems with cloud seeding might be inferred?**

Problems with cloud seeding that might be inferred from the article could involve costs, including the seed material (AgI), equipment (aircraft), and labor; inconsistent and unpredictable results; possible pollution from using seeding materials; difficulty in measuring any positive results; complex atmospheric conditions; the effects of transferring potential rainfall from one region to a different one; and moral issues, such as whether people should manipulate the weather.

1. **Research and evaluate the benefits and possible negative environmental impacts of ski resorts producing artificial snow.**

The benefits could include

1. the extended skiing season for customers,
2. the more reliable skiing conditions for customers,
3. the safer skiing conditions for customers,
4. the control of the type of snow produced,
5. that artificial snow can last longer than natural snow,
6. that artificial snow may be preferred for some winter sports like snowboarding,
7. the job security for ski resort employees, and
8. the protection of businesses and investments in ski resorts and the associated hospitality industry around ski resorts.

The negative environmental impacts of artificial snow could include

1. the vast amounts of surface or ground water used to produce the snow (estimated to be about 75,000 gallons for six inches of snow over a 200 foot by 200 foot area),
2. the delayed melting in the spring affects plants and animals in the area,
3. the delayed snow melt flowing into lower elevations later in the season,
4. the noise from compressed air used in the snow guns,
5. the large amounts of energy required to produce the snow,
6. the introduction of minerals such as zinc, copper, and lead from water sources (including treated sewage water) onto the landscape,
7. the carbon dioxide emissions from the electric energy or the diesel fuel powering the machines, and
8. the cost, which ESPN reports that ski areas spend between $500,000 to over $3.5 million per season.

(<http://www.espn.com/action/freeskiing/story/_/id/8809682/cost-snowmaking>)