



**Reading Supports**

**Teacher’s Guide:**

**“Fighting Frizz:
How Chemistry
Solved a Bad Hair Day”**

*April/May 2019*

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



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***“Fighting Frizz: How Chemistry
Solved a Bad Hair Day”***

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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 (page 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:

**Fighting Frizz: How Chemistry Solved a Bad Hair Day**

* Before reading, ask students to think about what is meant by a bad hair day and how the weather can affect hair. Ask the students what chemical and physical properties hair products might have that would help prevent a bad hair day.
* As they read, students should record information they find interesting and look for solutions to frizzy hair problems.
* **Graphic Organizer (page 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 (page 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 the article*,** 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. Many keratin treatments contain formaldehyde.
 |
|  |  | 1. A formaldehyde molecule has three carbon atoms.
 |
|  |  | 1. A carcinogen is a substance that can cause cancer.
 |
|  |  | 1. Surfactants, the cleansing ingredient in shampoos, are both hydrophilic (“water-loving”) and hydrophobic (“water-fearing”).
 |
|  |  | 1. The outer layer of a strand of hair is hydrophilic.
 |
|  |  | 1. The middle layer of hair contains proteins and the hair’s pigment.
 |
|  |  | 1. Frizzy hair occurs when the outer layer of the hair is damaged.
 |
|  |  | 1. Creating stable emulsions containing positive and negative molecules is easy.
 |
|  |  | 1. Glycolic acid, derived from sugar cane, interacts with keratin to reduce frizz and it is also used to remove dead skin cells.
 |
|  |  | 1. Surfactants containing sulfates can strip natural oils from hair.
 |

## Graphic Organizer

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

**Directions**: As you read the article, complete the graphic organizer below to describe what you learned about the chemistry of hair from reading the article.

|  |  |  |
| --- | --- | --- |
| 3 | **New things you learned about hair chemistry** |  |
| 2 | **Ideas from the article that will help you choose hair products** |  |
| 1 | **Question you have about hair products** |  |
| Contact! | **How does an understanding of chemistry help you make decisions about personal care products?**  |  |

**Summary:** On the back of this paper, write a short email (a few sentences) to a friend who wants relief from frizzy hair using information from the article.

## Student ReadingComprehension Questions

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

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

* 1. Explain how salon keratin treatments work.
	2. What is a reducing agent?
	3. Why did Alden’s father discourage her from getting a commercial keratin treatment?
	4. (a) What are surfactants, and (b) why are they added to shampoos?
	5. What is the role of polymers in shampoos?
	6. Complete the table below regarding the layers in a strand of hair.

|  |  |
| --- | --- |
| **Name of each layer, from outside to inside** | **Description and function of layer** |
|  |  |
|  |  |
|  |  |

**Student Reading Comprehension Questions, cont.**

* 1. What were three goals Clark held for his shampoo?
	2. (a) What is the principal frizz-fighting substance in Clark’s shampoo, and (b) how does it work to correct two problems in frizzy hair?
	3. What is the function of the hydrolyzed quinoa protein in the shampoo?
	4. Why did Clark eliminate sulfates from his shampoo?

**Critical-Thinking Questions**

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

* 1. In shampoo, sodium lauryl sulfate is often added as a surfactant. For cleansing purposes, why is it important that the sodium ion dissociates from the rest of the molecule?
	2. Research the difference between soap and shampoo. Would soap be just as good as shampoo to clean your hair? Use chemistry to explain your answer.

## Answers to Reading Comprehension Questions

1. **What is a reducing agent?**

A reducing agent is a substance that donates electrons in reactions.

1. **Explain how salon keratin treatments work.**

Salon keratin treatments use a mixture with reducing agents like formaldehyde, to break the disulfide bonds that maintain hair’s shape. When the hair re-bonds, amino acids from animal-derived keratin are laminated into the hair during the application of high heat, around 232°C, thus smoothing it.

1. **Why did Alden’s father discourage her from getting a commercial hair-straightening treatment?**

Alden’s father did not want her to get a commercial keratin treatment because the formaldehyde in the treatments is carcinogenic and he did not want her exposed to a cancer-causing substance [and, possibly, the time for each treatment and the cost].

1. **(a) What are surfactants, and (b) why are they added to shampoos?**
2. “Surfactants are molecules that, when added to a liquid, reduce its surface tension.”
3. They are added to shampoos to promote hair cleansing.
4. **What is the role of polymers in shampoos?**

“Polymers are the conditioning agents for hair.”

1. **Name the three layers in a strand of hair, giving a description of each layer.**

Complete the table below regarding the layers in a strand of hair

|  |  |
| --- | --- |
| **Name of each layer, from outside to inside** | **Description and function of layer** |
| Cuticle | The outer layer of hair, like a roof with shingles; hydrophobic, protective layer of hair—responsible for shine and smoothness |
| Cortex | The middle layer under the cuticle composed of dead cells packed with hydrophilic proteins that give hair strength and structure; cortex also contains the hair’s pigment |
| Medulla | The inner, spongy center of the hair strand |

1. **What were three goals Clark held for his shampoo?**

Three goals Clark held for his shampoo were that

1. the shampoo needs to clean hair,
2. the shampoo needs to protect hair from damage, and
3. the shampoo needs to be a safe product.
4. **(a) What is the principal frizz-fighting substance in Clark’s shampoo? (b) How does it work to correct two problems in frizzy hair?**
5. Glycolic acid is the principal frizz-fighting substance in Clark’s shampoo.
6. Glycolic acid works to help fight frizz by binding to the keratin in hair to make it more hydrophobic, thus reducing the moisture-induced swelling in the strands of hair. It also causes lifted hair cuticles to lie flat, which makes the hair shinier.

1. **What is the function of the hydrolyzed quinoa protein in the shampoo?**

The hydrolyzed protein in the shampoo provides shorter chains of amino acids, the same as those in hair keratin, which can be used to repair damaged segments of hair protein.

1. **Why did Clark eliminate sulfates from his shampoo?**

Clark eliminated sulfates from his shampoo because they strip natural oils from hair that are needed to guard against moisture and frizz.

**Critical-Thinking Questions**

1. **In shampoo, sodium lauryl sulfate is often added as a surfactant. For cleansing purposes, why is it important that the sodium ion dissociate from the rest of the molecule?**

When the sodium ion dissociates from the sulfate group of the molecule, the sulfate group’s resulting negative charge is attracted to the hydrogen atoms in surrounding water molecules, forming hydrogen bonds between the oxygen atoms in the sulfate and hydrogen atoms in the water. Since the oil and dirt on the hair are dissolved in the nonpolar hydrocarbon tails attached to the sulfate group, when the sulfate group bonds to water, the entire molecule and adhering dirt can be rinsed away. If the sodium ion did not dissociate, the sodium lauryl sulfate would not have a hydrophilic region to hydrogen bond with water molecules and the dirt could not be rinsed away as easily.

1. **Research the difference between soap and shampoo. Would soap be just as good as shampoo to clean your hair? Use chemistry to explain your answer.**

(The responses will vary depending on where the students find their answers. While some sources report there is no difference, the students probably have personal experience that dictates otherwise.)

Based on the editor’s research, soap would not be as good as shampoo to clean hair.

Soap is made from an oil and a base such as sodium or potassium hydroxide while shampoo is made from detergents. Soaps are mildly basic while shampoos are mildly acidic. These factors affect how the hair looks after it is washed. Soap reacts with hard water ions to create soap scum, which can be hard to rinse out of your hair, leaving it dull and sticky. Also, the basic pH of most soaps affects the keratin cuticle such that it does not lay flat and does not reflect light, making the hair appear dull.

Shampoo is made from detergents that do not react with the hard water ions, so there’s no soap scum to worry about. Also, shampoos are slightly acidic, which causes the keratin cuticle to lie flat which allows the hair to reflect more light and have more shine.