

**Teacher’s Guide**

**The Chemistry of Shaving**

***February 2023***

**Table of Contents**

[***Anticipation Guide***](#_Anticipation_Guide)***2***

Activate students’ prior knowledge and engage them before they read the article.

[***Reading Comprehension Questions***](#_Student_Reading_Comprehension) ***3***

These questions are designed to help students read the article (and graphics) carefully. They can help the teacher assess how well students understand the content and help direct the need for follow-up discussions and/or activities. You’ll find the questions ordered in increasing difficulty.

[***Graphic Organizer***](#_Graphic_Organizer) ***5***

Thishelps students locate and analyze information from the article. Students should use their own words and not copy entire sentences from the article. Encourage the use of bullet points.

[***Answers***](#_Answers_to_Reading) ***6***

Access the answers to reading comprehension questions and a rubric to assess the graphic organizer.

[***Additional Resources***](#_Additional_Resources_and) ***9***

Here you will find additional labs, simulations, lessons, and project ideas that you can use with your students alongside this article

***[Chemistry Concepts and Standards](#_Chemistry_Concepts_and) 10***

# Anticipation Guide

**Directions: *Before reading the article*,** in the first column, write “A” or “D,” indicating your **A**greement or **D**isagreement with each statement. Complete the activity in the box.

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. Removing hair has no effect on body odor. |
|  |  | 2. Hair is made of protein. |
|  |  | 3. Thin razor blades require more pressure when shaving. |
|  |  | 4. Razor blades are made of high carbon steel to increase hardness. |
|  |  | 5. Leaving razor blades wet will make them last longer. |
|  |  | 6. The first aerosol shaving cream was developed in the 1920s. |
|  |  | 7. When the button of the shaving cream can is pressed, the pressure decreases so the volume of the propellant gas increases. |
|  |  | 8. Shaving cream is basically air, water, and soap. |
|  |  | 9. Aftershave is antibacterial and also stops bleeding. |
|  |  | 10. The only way to permanently remove hair is using electrolysis to destroy the hair follicle. |

# Student ReadingComprehension Questions

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

1. How is being hairless considered hygienic?
2. Name and describe the main chemical in hair.
3. Define surfactant. How does a surfactant work when added to water?
4. How does water affect the sharpness of a razor blade?
5. How does electrolysis differ from other forms of hair removal?
6. Below is a particle diagram of an alloy of carbon (small spheres) and Iron (big spheres). Using this diagram, explain why adding carbon makes the iron alloy (called steel) much stronger.



1. Look at the figure of the molecule on page 7 of the article. Explain why the head is considered hydrophilic, and the tail is considered hydrophobic.
2. The article explains how chromium is resistant to corrosion (by forming a thin layer of chromium oxide). Aluminum undergoes a similar process. Explain why this allows aluminum to be useful for cooking and storing foods.
3. Explain how the endothermic process of evaporation allows alcohol to cool the face (or other skin on the body). (You may need to look up the definition of evaporation).
4. A metal’s ability to avoid corrosion depends on how reactive it is. Look at the activity series of metals table below. Give some examples of metals that are resistant to corrosion. List some uses for these types of metals, which would not be possible without their corrosion resistance.



**Student Reading Comprehension Questions, cont.**

**Questions for Further Learning**

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

1. Some lasers used in hair removal use light pulses with short wavelengths, and some lasers use light pulses with longer wavelengths. Explain how the different wavelengths affect the energy of the light wave. State some possible pros and cons for using each type of wavelength in lasers for hair removal.

# Graphic Organizer

**Directions**: As you read, complete the graphic organizer below to describe the chemistry of shaving.

|  |  |  |
| --- | --- | --- |
|  | **Chemicals involved** | **Purpose** |
| **Shaving blades** |  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| **Shaving cream** |  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| **Waxing** |  |  |
| **Depilatory cream** |  |  |

**Summary:** On the back of this sheet, write a short email (3-4 sentences) to a friend describing what you learned about the chemistry of shaving.

# Answers to Reading Comprehension Questions & Graphic Organizer Rubric

1. How is being hairless considered hygienic?
Hairlessness was considered hygienic, especially in Egypt, where it was always very hot. Sweaty hair can grow bacteria, lice, and other infections. Armpit hair causes body odor.
2. Name and describe the main chemical in hair.
The main chemical in hair is keratin, which is a protein that has a very strong, tough fibrous structure.
3. Define surfactant. How does a surfactant work when added to water?
A surfactant is a chemical, that when added to water, breaks down the surface tension in the water. Adding a surfactant makes water “wetter”, which means it can spread out over surfaces better.
4. How does water affect the sharpness of a razor blade?
Tap water contains ions and minerals, like calcium ions and carbonate ions. These ions can bond to the metal as calcium carbonate, causing the blade to become dull.
5. How does electrolysis differ from other forms of hair removal?
Electrolysis is different because the process actually destroys the follicle, which is where the hair begins its growth. All other methods destroy the hair, but not the follicle.
6. Below is a particle diagram of an alloy of carbon (small spheres) and Iron (big spheres). Using this diagram, explain why adding carbon makes the iron alloy (called steel) much stronger.
The carbon fills in the gaps between the iron atoms. This prevents the iron atoms from being able to move across each other as easily (AKA, malleable). Because of this, the metal is much more rigid and stronger (Note: this type of alloy is called “interstitial alloy”).
7. Look at the figure of the molecule on page 7 of the article. Explain why the head is considered hydrophilic, and the tail is considered hydrophobic.
“Hydrophilic” means attracted to water. Water is a polar molecule, and the water molecule would be attracted to the hydrogen bonds of the –OH part of the head. There will also be some attraction to the polar oxygen atom on that end. The tail is “hydrophobic”, or repels water. There are no hydrogen or dipole attractions on the tail to attract to a water molecule.
8. The article explains how chromium is resistant to corrosion (by forming a thin layer of chromium oxide). Aluminum undergoes a similar process. Explain why this allows aluminum to be useful for cooking and storing foods.
Aluminum, like chromium, forms a thin layer of aluminum oxide on the surface. This is very good for resisting corrosion. The aluminum would not react with any acidic foods, nor would it react with any moisture from the food.
9. Explain how the endothermic process of evaporation allows alcohol to cool the face (or other skin on the body). (You may need to look up the definition of evaporation).
Evaporation occurs when liquid molecules with high kinetic energy escape the surface as vapor. When these high KE molecules leave, the average KE of the remaining substance is lower. The cool feeling from the alcohol is the molecules of the alcohol absorbing heat from the body as it evaporates, and with this loss of heat, the person feels “cool”.
10. A metal’s ability to avoid corrosion depends on how reactive it is. Look at the activity series of metals table below. Give some examples of metals that are resistant to corrosion. List some uses for these types of metals, which would not be possible without their corrosion resistance.
The low end of the activity series contains metals that are very unreactive. Therefore, they are very resistant to corrosion. This is why copper is a very common metal in pipes. This is also why metals like gold, platinum, and silver are very popular in jewelry, because they do not tarnish as easily.
11. Some lasers used in hair removal use light pulses with short wavelengths, and some lasers use light pulses with longer wavelengths. Explain how the different wavelengths affect the energy of the light wave. State some possible pros and cons for using each type of wavelength in lasers for hair removal.
A good explanation can be found at this website: <https://www.laseraway.com/articles/hair-removal/types-of-lasers-for-hair-removal/>

In short: The shorter wavelengths have a greater frequency, and a higher energy. This makes the hair removal quicker, but could have some adverse effects like burning. The longer wavelengths have a lower frequency and energy, so they wouldn’t be as harmful, but it does take longer to destroy the unwanted hair.

**Graphic Organizer Rubric**

If you use the Graphic Organizer 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 |

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# Additional Resources and Teaching Strategies

**Additional Resources**

* **Labs and demos**
	+ <https://teachchemistry.org/classroom-resources/chemistry-of-art-through-alloys-and-metal-plating>
	+ <https://teachchemistry.org/classroom-resources/abe-goes-swimming>
	+ <https://teachchemistry.org/classroom-resources/sandy-beaches-a-foray-into-magic-sand>
	+ <https://teachchemistry.org/classroom-resources/activity-series-of-unknown-metals>
* **Simulations**
	+ <https://teachchemistry.org/classroom-resources/animation-activity-solubility>
* **Lessons and lesson plans**
	+ <https://www.compoundchem.com/2015/07/07/alloys/>

**Teaching Strategies**

Consider the following tips and strategies for incorporating this article into your classroom:

* **Alternative to Anticipation Guide:** Before reading, ask students how they remove unwanted body hair, and how a knowledge of chemistry might be helpful in choosing which method to use. Their initial ideas can be collected electronically via Jamboard, Padlet, or similar technology.
	+ As they read, students can find information to confirm or refute their original ideas.
	+ After they read, ask students what they learned about razor blades, shaving cream, and other methods of removing body hair.
* After students have read and discussed the article, consider showing the ACS Reactions video “What Is Shaving Cream?” (5:19)<https://youtu.be/t7QD2NuxmbE>. The video reviews information in the article and provides more details about fatty acids and triglycerides.
* The activity “State Debate” (<https://www.acs.org/education/whatischemistry/adventures-in-chemistry/experiments/state-debate.html>) would be fun for students to try and home and report what they found out.

# Chemistry Concepts and Standards

**Connections to Chemistry Concepts**

The following chemistry concepts are highlighted in this article:

* Physical properties
* Mixtures (alloys)
* Pressure
* Volume
* Molecular structure

**Correlations to Next Generation Science Standards**

This article relates to the following performance expectations and dimensions of the NGSS:

**HS-PS1-3.** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.

**HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

**Disciplinary Core Ideas:**

* PS.1.A: Structure and Properties of Matter
* ETS1.B: Developing Possible Solutions
* ETS1.C: Optimizing the Design Solution

**Crosscutting Concepts:**

* Cause and effect
* Structure and function

**Science and Engineering Practices:**

* Constructing explanations (for science) and designing solutions (for engineering)

**Nature of Science:**

* Science is a human endeavor.

See how *ChemMatters* correlates to the[**Common Core State Standards** online](https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/teachers-guide.html).