

**Teacher’s Guide**

**How Hair Removers Get Rid of Unwanted Fuzz**

***April 2022***

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

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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 5](#hairremoversorganizer)

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 6](#hairremoversanswers)

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

[Additional Resources 9](#hairremoversresources)

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

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# Anticipation Guide

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

**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. Chemical hair removers have been used for about 100 years. |
|  |  | 1. Depilatory creams contain acid salts and bases. |
|  |  | 1. Keratin, a protein found in hair, is cross-linked by covalent bonds, hydrogen bonds, and ionic bonds. |
|  |  | 1. Chemical hair removers also affect cotton fibers. |
|  |  | 1. Skin has a pH of 7. |
|  |  | 1. The bad smell from depilatory creams is the cream itself. |
|  |  | 1. Sugaring and waxing both work by pulling out hairs. |
|  |  | 1. Sugaring wax can be made from table sugar, water, and lemon. |
|  |  | 1. Laser hair removal works best on dark hair against light skin. |
|  |  | 1. Hair removal methods are constantly being developed. |

# Student Reading Comprehension Questions

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

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

1. Quicklime, CaO, is classified as a basic compound. Write the chemical equation that shows the reaction of quicklime with water.
2. A disulfide bond is characterized as covalent, while a hydrogen bond is not. Explain the difference between these two bond types.
3. Write the chemical formula for the potassium salt of thioglycolic acid and for the calcium salt of thioglycolic acid.
4. When a base acts on the thioglycolate to remove a proton from its thiol group, what is the charge on the remaining sulfur atom? Where do the electrons come from to make this charge?
5. Keratin is a structural protein that makes up over 90% of a strand of hair. What is the role of a structural protein?
6. The article states that cream hair removers should have a pH in the range of 12-12.5.
   1. What would the concentration of hydroxide be in a cream with a pH of 12?
   2. What would the concentration of calcium hydroxide be in this same cream?
   3. Why is it important that the cream be basic, rather than acidic, to break down the keratin?
7. What is the purpose of breaking sucrose into glucose and fructose when creating sugaring wax?
8. In a hydrolysis reaction, a water molecule reacts with something to split it apart. The hydrolysis of sucrose is catalyzed by the hydrogen ion from an acid. Explain how the catalyst and water molecule work together to hydrolyze sucrose and then regenerate a hydrogen ion.

# Student Reading Comprehension Questions, cont.

**Questions for Further Learning**

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

1. How is the chemical depilatory process described in the article similar to the process of perming hair?
2. Research the different types of lasers used for hair removal and explain how laser hair removal works.

# Graphic Organizer

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

**Directions**: As you read, complete the graphic organizer below to compare different types of hair removers along with the advantages and disadvantages of each.

|  |  |  |
| --- | --- | --- |
| **Hair Removal Method** | **How they work** | **Advantages and Disadvantages** |
| **Depilatory Cream** |  |  |
| **Waxing** |  |  |
| **Laser** |  |  |

**Summary:** On the back of this sheet, write a short email to a friend explaining what you learned about hair removal, including your advice for the best hair removal method.

# Answers to Reading Comprehension Questions & Graphic Organizer Rubric

1. Quicklime, CaO, is classified as a basic compound. Write the chemical equation that shows the reaction of quicklime with water.

CaO(s) + H2O(l) 🡪 Ca(OH)2(aq) (calcium hydroxide is soluble, depending on concentration)

1. A disulfide bond is characterized as covalent, while a hydrogen bond is not. Explain the difference between these two bond types.

The disulfide bond involves an overlap of the valence shells of two sulfur atoms. This is a covalent bond. The hydrogen bond is an intermolecular force, or an attraction between a very electronegative atom on one molecule and a very positive hydrogen on another molecule. This type of bond does not involve overlapping of the valence shells.

1. Write the chemical formula for the potassium salt of thioglycolic acid and for the calcium salt of thioglycolic acid.

KHSCH2CO2 and Ca(HSCH2CO2)2

1. When a base acts on the thioglycolate to remove a proton from its thiol group, what is the charge on the remaining sulfur atom? Where do the electrons come from to make this charge?

The charge on the sulfur atom will be -1. The S-H bond contains 2 electrons. In this bond, one electron originated with the sulfur and one originated with the hydrogen. When the H is removed by the base, both electrons stay with the sulfur atom, giving it an extra negative charge.

1. Keratin is a structural protein that makes up over 90% of a strand of hair. What is the role of a structural protein?

A structural protein provides the firmness needed by a cell to maintain its structure. The keratin provides the structure for the hair shaft.

1. The article states that cream hair removers should have a pH in the range of 12-12.5.
   1. What would the concentration of hydroxide be in a cream with a pH of 12?

pOH = 14 – pH. pH = 2. [H+] = 10-2 = 0.010 M OH-

* 1. What would the concentration of calcium hydroxide be in this same cream?

Ca(OH)2 has 2 hydroxides per formula unit, so the concentration is half the hydroxide concentration, 0.0050 M Ca(OH)2.

* 1. Why is it important that the cream be basic, rather than acidic, to break down the keratin?

The base acts to remove a proton from the thiol group of the thioglycolate, which is necessary to begin the process of breaking the disulfide bond in the protein.

1. What is the purpose of breaking sucrose into glucose and fructose when creating sugaring wax?

The glucose/fructose mixture has a lower crystallizing temperature, which allows it to form a more spreadable wax than the sucrose would.

1. In a hydrolysis reaction, a water molecule reacts with something to split it apart. The hydrolysis of sucrose is catalyzed by the hydrogen ion from an acid. Explain how the catalyst and water molecule work together to hydrolyze sucrose and then regenerate a hydrogen ion.

The catalyst proton bonds to the oxygen atom that links the two rings in sucrose. This breaks the bond to one of the rings, which allows the oxygen from a water molecule to bond in its place. This removes one hydrogen from the water molecule, thus regenerating the H+.

**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 |

# Additional Resources

**Labs and demos**

* Use titration to determine the pH of a depilatory cream.
* Oxidation States of Manganese to show the pH dependence of reactions (this video shows a common demo): <https://www.youtube.com/watch?v=6UGrixD3yiQ&t=118s>

**Simulations**

* Simple simulation showing how an indicator reacts to an acid and a base: <https://www.acs.org/content/acs/en/education/resources/k-8/inquiryinaction/fifth-grade/acid-base-indicator.html>
* Video: Acid & Base Guys – short video showing the definitions of acids/bases <https://teachchemistry.org/classroom-resources/acid-base-guys-video>

**Lessons and lesson plans**

* Calculating pH- A Look at Logarithms: <https://teachchemistry.org/classroom-resources/calculating-ph-a-look-a-logarithms>
* Investigating Oxidation-Reduction Reactions: <https://teachchemistry.org/classroom-resources/investigating-oxidation-reduction-reactions>
  + Though not specifically described in the article, the breaking of the disulfide bond is classified as a redox reaction.

# Chemistry Concepts, Standards, and Teaching Strategies

**Connections to Chemistry Concepts**

The following chemistry concepts are highlighted in this article:

* Physical properties
* Intermolecular forces
* 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-ETS1-3.** Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |

**Disciplinary Core Ideas:**

* PS1.A: Structure and properties of matter
* PS2.B: Types of interactions
* ETS1.C: Optimizing the design solution

**Crosscutting Concepts:**

* Structure and function
* Cause and effect
* Systems and system models

**Science and Engineering Practices:**

* Asking questions and defining problems
* Planning and carrying out investigations

**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).

**Teaching Strategies**

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

* **Alternative to Anticipation Guide:** Before reading, ask students what hair removers they are familiar with, and how they think hair removers work. 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 removing unwanted hair.