

**Teacher’s Guide**

**Leaves of Three, Let It Be:**

**The Itchy Chemistry of Poison Ivy**

***December 2022***

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

[***Reading Comprehension Questions***](#_heading=h.3znysh7) ***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***](#_heading=h.9f8azrtnp6p5) ***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***](#_heading=h.djipzn7z1r1b) ***6***

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

[***Additional Resources***](#_heading=h.8qbtv1wio6jt) ***9***

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

**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. Poison ivy grows better in areas where there is less CO2. |
|  |  | 2. Poison ivy remains green all year round. |
|  |  | 3. Birds and deer like poison ivy seeds. |
|  |  | 4. Poison ivy is in the same family as cashews and mangos. |
|  |  | 5. Urushiol, the chemical in poison ivy that causes a rash, contains only carbon, hydrogen, and oxygen. |
|  |  | 6. Urushiol has a nonpolar hydrocarbon tail. |
|  |  | 7. More than 90% of the population is allergic to poison ivy. |
|  |  | 8. Your skin is coated with nonpolar oils. |
|  |  | 9. Many things can transfer urushiol oil. |
|  |  | 10. There is clinical evidence that repeated exposure to poison ivy reduces sensitivity to its allergic effects. |

# Student Reading Comprehension Questions

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

1. What is the most common allergic reaction in the United States?
2. Poison ivy does not impact all organisms in the same way. Name two organisms that find poison ivy useful and two organisms that are irritated by poison ivy.
3. Name four members of the anacardiaceae family.
4. How long can urushiol remain potent outside of a plant?
5. Name two cells responsible for the human body’s immune response to urushiol.
6. In which seasons are people more likely to get poison ivy? Why might that be the case?
7. What role does polarity play in enabling urushiol to enter the epidermis?
8. What function might urushiol serve in plants?
9. Name the three elements that compose a catechol.

**Student Reading Comprehension Questions, cont.**

**Questions for Further Learning**

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

1. Describe three ways that increasing levels of CO2 in the environment impact poison ivy.
2. Explain how the structure of the hydrocarbon tail of catechols in urushiol impacts the severity of an allergic response.
3. Describe the difference between a polar molecule and a nonpolar molecule.
4. Beginning with lymphocytes and ending with macrophages, describe the steps of the immune response at the cellular level when urushiol reaches the second layer of human skin.
5. Review the article’s list of possible remedies for rashes caused by poison ivy. Select one method, research it, and explain the chemistry involved in the remedy. For instance, research and explain how the ingredients in a corticosteroid impact an allergic reaction.

# Graphic Organizer

**Directions**: As you read, complete the graphic organizer below to explain the chemistry of poison ivy and how to protect yourself.

|  |  |
| --- | --- |
|  | **Chemistry Involved** |
| **Urushiol** | *Include structural formula* |
| **Other sources of urushiol** |  |
| **What causes the itching** |  |
| **How the urushiol is transferred from the plant to you** |  |
| **How the rash develops** |  |
| **How to treat the rash** |  |
| **How to protect yourself** |  |

**Summary:** On the back of this sheet, explain what you learned in a short email to a friend who is highly allergic to poison ivy.

# Answers to Reading Comprehension Questions & Graphic Organizer Rubric

1. What is the most common allergic reaction in the United States?

Poison ivy is the most common allergic reaction in the United States.

1. Poison ivy does not impact all organisms in the same way. Name two organisms that find poison ivy useful and two organisms that are irritated by poison ivy.

Deer and birds find poison ivy useful as food while guinea pigs and some primates are irritated by poison ivy.

1. Name four members of the anacardiaceae family.

Mangos, cashews, poison ivy, poison oak.

1. How long can urushiol remain potent outside of a plant?

Urushiol can be potent for up to five years after being transferred from a plant.

1. Name two cells responsible for the human body’s immune response to urushiol.

T-cells and macrophages are two cells responsible for the human body’s immune response to urushiol.

1. In which seasons are people more likely to get poison ivy? Why might that be the case?

People are more likely to get poison ivy in spring and summer. This may be because people spend more time outside in spring and summer.

1. What role does polarity play in enabling urushiol to enter the epidermis?

Urushiol and the oils on human skin have the same polarity, which allows urushiol to mix with the oils and enter the epidermis.

1. What function might urushiol serve in plants?

Urushiol may help plants ward off microbial infections.

1. Name the three elements that compose a catechol.

The elements included in a catechol are carbon, hydrogen, and oxygen.

1. Describe three ways that increasing levels of CO2 in the environment impact poison ivy.

Increasing levels of CO2 cause poison ivy to grow faster, increase in biomass, and produce urushiols that have higher degrees of unsaturation.

1. Explain how the structure of the hydrocarbon tail of catechols in urushiol impacts the severity of an allergic response.

The longer the alkyl chain or an increase in the number of double bonds increases the severity of the allergic reaction.

1. Describe the difference between a polar molecule and a nonpolar molecule.

A nonpolar molecule has charges that are evenly dispersed but a polar molecule has charges that are separated. Nonpolar molecules are hydrophobic while polar molecules are hydrophilic.

1. Beginning with lymphocytes and ending with macrophages, describe the steps of the immune response at the cellular level when urushiol reaches the second layer of human skin.

When urushiol reaches the second layer of skin, lymphocytes send cytokines to inform the body to send macrophages to attack the antigens.

1. Review the article’s list of possible remedies for rashes caused by poison ivy. Select one method, research it, and explain the chemistry involved in the remedy. For instance, research and explain how the ingredients in a corticosteroid impact an allergic reaction.

Student responses will vary.

**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**
  + [Solubility and Compound Type](https://teachchemistry.org/classroom-resources/solubility-and-compound-type) - In this lab students test the solubilities of unknown substances that are polar, nonpolar, or ionic. This lab can help students understand how urushiol enters the skin.
  + [Modeling Bond Polarity](https://teachchemistry.org/classroom-resources/modeling-bond-polarity) - This hands-on activity provides students with the opportunity to create model representations of polar and non-polar bonding, which can help them understand the chemistry involved in allergic reactions to poison ivy.
* **Lessons and lesson plans**
  + [Insect Herbivores and Plants](https://learn.genetics.utah.edu/content/herbivores) - By exploring the pages on this site, students can learn more about the various chemicals that plants can produce for protection.
  + [The Immune System](https://www.biointeractive.org/classroom-resources/immune-system) - This HHMI Biointeractive lesson plan includes videos, simulations, and readings to help students understand the parts of the immune system as well as the functions associated with the immune response.

**Teaching Strategies**

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

* **Alternative to Anticipation Guide:** Before reading, ask students if they are allergic to poison ivy, how they think the rash develops, how they protect themselves, and how they treat a poison ivy rash. 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 how chemistry can help us understand allergic reactions to poison ivy.
* After students have read and discussed the article, ask students what they would like to share with friends and family about why poison ivy produces a rash, and how they can protect themselves.

# Chemistry Concepts and Standards

**Connections to Chemistry Concepts**

The following chemistry concepts are highlighted in this article:

* Solutions
* 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.

**Disciplinary Core Ideas:**

* PS.1.A: Structure and Properties of Matter

**Crosscutting Concepts:**

* Cause and effect
* Structure and function

**Science and Engineering Practices:**

* Obtaining, evaluating, and communicating information

**Nature of Science:**

* Scientific knowledge is based on empirical evidence.

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).