

Science & Literacy Activity

GRADES 6-8

OVERVIEW

This activity, which is aligned to the Common Core State Standards (CCSS) for English Language Arts, introduces students to scientific knowledge and language related to the effects of poison upon body systems. Students will read content-rich texts, visit *The Power of Poison* exhibition, and use what they have learned to complete a CCSS-aligned writing task, creating an illustrated text that includes examples of three poisons, indicates what plant or animal uses them and explains their effects.

Materials in this activity include:

- Teacher instructions for:
 - Pre-visit student reading
 - Visit to *The Power of Poison* and student worksheet
 - Post-visit writing task
- Text for student reading: “The Power of Poison as Medicine”
- Student Worksheet for *The Power of Poison* visit
- Student Writing Guidelines
- Teacher rubric for writing assessment

SUPPORTS FOR DIVERSE LEARNERS: An Overview

This resource has been designed to engage all learners with the principles of Universal Design for Learning in mind. It represents information in multiple ways and offers multiple ways for your students to engage with content as they read about, discuss, view, and write about scientific concepts. Different parts of the experience (e.g. reading texts, or locating information in the exhibition) may challenge individual students. However, the arc of learning is designed to offer varied opportunities to learn. We suggest that all learners experience each activity, even if challenging. We have provided ways to adapt each step of the activities for students with different skill-levels. If any students have an Individualized Education Program (IEP), consult it for additional accommodations or modifications.

Common Core State Standards:

WST.6-8.2, WST.6-8.8, WST.6-8.9
RST.6-8.1, RST.6-8.2, RST.6-8.4, RST.6-8.10

New York State Science Core Curriculum:

LE 5.1f

Next Generation Science Standards:

PE HS-LS1-3
DCI LS1.A: Structure and Function
Systems of specialized cells within organisms help them perform the essential functions of life. Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

1. BEFORE YOUR VISIT

This part of the activity engages students in reading a non-fiction text about poisons. The reading will prepare students for their visit by introducing them to the topic and framing their investigation.

Student Reading

Have students read “The Power of Poison as Medicine.” Have them write notes in the large right-hand margin. For example, they could underline key passages, paraphrase important information, or write down questions that they have.

Ask:

- Where are poisons found in nature and what is their role? (*Answers may include: Poisons are found throughout nature and are used by plants and animals as a chemical defense by affecting normal body processes.*)
- How can poisons be turned into medicine? (*Answers may include: Medicines and poisons are similar in that they both impact physiological processes. Understanding how those poisons act upon body systems can provide clues about some of the medical uses they might have. For example, knowing that the African saw scale viper venom causes reduced blood clotting led to the development of a medication that is used to reduce blood clotting in humans.*)

During discussion, remind students to use evidence from the text to explain their thinking, and to give specific examples.

Have students create a three-column chart to compare and contrast “poison,” “toxin,” and “venom” to illustrate the relationship between them. They can work in pairs, small groups, or as a class.

SUPPORTS FOR DIVERSE LEARNERS: Student Reading

- “Chunking” the reading can help keep them from becoming overwhelmed by the length of the text. Present students with only a few paragraphs to read and discuss before moving on to the next section.
- Provide “wait-time” for students after you ask a question. This will allow time for students to search for textual evidence or to more clearly formulate their thinking before they speak.

2. DURING YOUR VISIT

This part of the activity engages students in exploring the exhibition.

Museum Visit & Student Worksheet

Explain to students that they will be focusing on three areas of the exhibition: Chocó Forest, Poison in Myth & Legend, Poison for Good. Students will use worksheets to gather information about three plants or animals that use poison, and create a labelled illustration. Tell students that back in the classroom they will refer to these notes when completing the writing assignment.

SUPPORTS FOR DIVERSE LEARNERS: Museum Visit

- Review the Student Worksheet with students, clarifying what information they should collect during the visit.
- Have students explore the exhibition in pairs, with each student completing their own Student Worksheet.
- Encourage student pairs to ask you or their peers for help locating sources of information. Tell students they may not share answers with other pairs, but they may point each other to places in the exhibition where answers may be found.

3. BACK IN THE CLASSROOM

This part of the activity engages students in an informational writing task that draws on the pre-visit reading and on observations made at the Museum.

Writing Task

Distribute the Student Writing Guidelines handout, which includes the following prompt for the writing task:

Based on the reading, your visit to *The Power of Poison* exhibition, and your discussions, write an essay in which you:

- define “poison”
- name three poisons, indicate what plant or animal uses them and explain their effects

Support your discussion with evidence from the reading and notes from your visit to *The Power of Poison*.

Go over the handout with students. Tell them that they will use it while writing, and afterwards, to evaluate and revise their essays.

Before they begin to write, have students use the prompt and guidelines to frame a discussion around the information that they gathered in *The Power of Poison*, and compare their findings. They can work in pairs, small groups, or as a class. Referring to the writing prompt, have students underline or highlight all relevant passages and information from the reading, the charting exercise, and their notes from the exhibition, that can be used in their response to the prompt. Instruct each student to take notes on useful information that their peers gathered as they compare findings. Students should then write their essays individually.

SUPPORTS FOR DIVERSE LEARNERS: Writing Task

- Re-read the “Before Your Visit” assignment with students. Ask what they saw in the exhibition that helps them understand how each of the plants or animals uses their poison and an explanation of the poisons effects.
- Allow time for students to read their essay drafts to a peer and receive feedback based on the Student Writing Guidelines.

Student Reading

The Power of Poison as Medicine

The yew tree has a legendary connection to death. Its seeds, leaves, and bark are highly poisonous to humans. In recent decades, however, this long-lived plant genus has earned a different reputation: as a potential preserver of life. In the 1960s, researchers working for the U.S. National Cancer Institute discovered that the bark of the Pacific yew, contained a toxic ingredient that could be harnessed on a cellular level to inhibit the progress of some cancers. A derived compound produced in the laboratory and available commercially since the late 1990s, has been found to be effective in the treatment of breast, lung, and other cancers, among other medical uses. The drug is a prime example of the use of poisons in the service of medicine, a challenge to the modern view of poison as an instrument of death, whether by accident, suicide, or murder.

Of course, nature's poisons have been used for medicinal purposes for millennia. Small doses of poisonous plants such as mandrake, henbane, and hemlock numbed the pain of surgery for more than 1,000 years. In William Shakespeare's time, 400 years ago, poisonous extracts were combined into cough medicine. Well into the 20th century, the element mercury was an ingredient in popular remedies.



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Hemlock contains a toxin that was used to sedate and to treat spasms, but can cause death.

But modern scientific techniques have allowed researchers to better understand, and then take advantage of, the underlying mechanisms by which plant toxins and animal venoms attack normal metabolic processes. For example, some neurotoxins block the release of chemical messengers called neurotransmitters; some stop neurotransmitter messages from being received; some send false signals; and still others disrupt nerve cell activity by opening channels in cell walls. If muscles in the heart or lungs fail to get the proper signal to function, the results are fatal. But applying the same effect in nonlethal doses can stem tremors or the registering of pain.

"What is a poison?" asks Mark Siddall, curator in the Division of Invertebrate Zoology who is also curator of the special exhibition *The Power of Poison*. "It's a substance that interferes with normal physiological processes, that alters or stops them, or makes things happen. That is essentially what medicines are, too."

The potential for tapping nature is staggering. By conservative estimates, some 100,000 animals, from lizards and snakes to sea anemones and jellyfish, produce venom, which in turn can contain hundreds of different toxins. So far, only about 10,000 animal toxins have been identified, and 1,000 of these have been studied in depth, with a view to developing drugs.



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Toxins in black mamba venom that block pain signals in the nervous system may lead to new pain medications.

Two medications that reduce blood clotting, tyrofabin and hirudin, have been derived from animal sources, respectively, the blood-thinning venom of the African saw-scaled viper and a substance secreted by leeches. The diabetes drug Exenatide, which lowers blood sugar and increases the body's production of insulin, is a synthetic version of a component in the saliva of Gila monsters, large venomous lizards found in the southwestern U.S. and northwestern Mexico.



© AMNH/C.Chesek

Venom injected by cone snails paralyzes their prey, but these toxins can also block pain signals, making them useful as an anesthetic.

Plants are an even richer mine, with more than 400,000 identified species and many of them toxic to one degree or another. Fixed in place, plants are especially adept at producing chemical defenses against insects, larger plant-eaters, and even other plants – a process that has allowed land plants to flourish for about 450 million years. Caffeine and nicotine are both plant-based products with well-known pleasurable effects on the body until taken in excess, revealing their essentially poisonous nature. But just as with animal toxins and venoms, plant compounds that affect the human body can be employed for medicinal purposes. Salicylic acid, the active ingredient in aspirin, for example, is found in a number of plants, including the willow tree *Salix*, from which it takes its name.

Researchers are in a race against time as they seek to unlock the potential of poisons. "Habitat loss from overpopulation, climate change and other factors have put more species of plants and animals at risk," says Siddall. Consider those toxin-rich snakes: by conservative estimates, one in five reptiles is now threatened with extinction, a loss that could radically diminish a promising source for healing.

This reading was adapted from "The Power of Poison as Medicine," an article in the Fall 2013 issue of Rotunda, the Member magazine of the American Museum of Natural History.

Student Worksheet

Stop 1: Poison in Nature: Chocó Forest

Choose one plant or animal from this section. Sketch it, and label its poison delivery mechanism.

Animal or plant name:

Name of its poison:

Describe the poison's effect:

Stop 2: Poison in Myth and Legend

Read the Enchanted Book and learn about one of the plants. Sketch it, and label its poison delivery mechanism.

Plant name:

Name of its poison:

Describe the poison's effect:

Stop 3: Poison for Good

Choose one plant or animal from this section. Sketch it, and label its poison delivery mechanism.

Animal or plant name:

Name of its poison:

Describe the poison's effect:

Student Writing Guidelines

Based on the reading, your visit to *The Power of Poison* exhibition, and your discussions, write an essay in which you:

- define the word “poison”
- name three poisons, indicate what plant or animal uses them and explain their effects

Support your discussion with evidence from the reading and notes from your visit to *The Power of Poison*.

Use this checklist to ensure that you have included all of the required elements in your essay.

- I introduced the topic of poison.
- I defined “poison.”
- I clearly named three poisons and described the plants or animals that use them and their effects.
- I included a labeled illustration of each plant or animal, including poison delivery methods.
- I only included relevant information about the three poisons, the plants or animals that use them, and their effects.
- I used information from “The Power of Poison as Medicine” to explain poisons, the plants or animals that use them, and their effects in detail.
- I used information from *The Power of Poison* exhibition to explain poisons, the plants or animals that use them, and their effects in detail.
- I used academic, non-conversational tone and language.
- I included a conclusion at the end.
- I proofread my essay for grammar and spelling errors.

Assessment Rubric

Scoring Elements		1 Below Expectations	2 Approaches Expectations	3 Meets Expectations	4 Exceeds Expectations
RESEARCH	Reading	Attempts to present information in response to the prompt, but lacks connections to the texts or relevance to the purpose of the prompt.	Presents information from the text relevant to the purpose of the prompt with minor lapses in accuracy or completeness.	Presents information from the text relevant to the prompt with accuracy and sufficient detail.	Accurately presents information relevant to all parts of the prompt with effective paraphrased details from the text.
	AMNH Exhibit	Attempts to present information in response to the prompt, but lacks connections to the Museum exhibit content or relevance to the purpose of the prompt.	Presents information from the Museum exhibit relevant to the purpose of the prompt with minor lapses in accuracy or completeness.	Presents information from the Museum exhibit relevant to the prompt with accuracy and sufficient detail.	Accurately presents information relevant to all parts of the prompt with effective paraphrased details from the Museum exhibit.
WRITING	Focus	Attempts to address the prompt, but lacks focus or is off-task.	Addresses the prompt appropriately, but with a weak or uneven focus.	Addresses the prompt appropriately and maintains a clear, steady focus.	Addresses all aspects of the prompt appropriately and maintains a strongly developed focus.
	Development	Attempts to provide details in response to the prompt, including retelling, but lacks sufficient development or relevancy.	Presents appropriate details to support the focus and controlling idea.	Presents appropriate and sufficient details to support the focus and controlling idea.	Presents thorough and detailed information to strongly support the focus and controlling idea.
	Conventions	Attempts to demonstrate standard English conventions, but lacks cohesion and control of grammar, usage, and mechanics.	Demonstrates an uneven command of standard English conventions and cohesion. Uses language and tone with some inaccurate, inappropriate, or uneven features.	Demonstrates a command of standard English conventions and cohesion, with few errors. Response includes language and tone appropriate to the audience, purpose, and specific requirements of the prompt.	Demonstrates and maintains a well-developed command of standard English conventions and cohesion, with few errors. Response includes language and tone consistently appropriate to the audience, purpose, and specific requirements of the prompt.
SCIENCE	Content Understanding	Attempts to include science content in explanations, but understanding of the topic is weak; content is irrelevant, inappropriate, or inaccurate.	Briefly notes science content relevant to the prompt; shows basic or uneven understanding of the topic; minor errors in explanation.	Accurately presents science content relevant to the prompt with sufficient explanations that demonstrate understanding of the topic.	Integrates relevant and accurate science content with thorough explanations that demonstrate in-depth understanding of the topic.