

# Science & Literacy Activity

GRADES K-2

## OVERVIEW

This activity introduces students to scientific knowledge and language related to how animals use poison to help them survive. Students will read content-rich texts, visit *The Power of Poison* exhibition, and use what they have learned to complete a writing task, creating an illustrated text about how animals use poison to help them survive.

### Materials in this packet 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: “Look but Don’t Lick!”
- Sample Concept Map for “Look but Don’t Lick!”
- Student Worksheet for *The Power of Poison* visit
- Chaperone Group Worksheet
- Student Writing Guidelines
- Teacher rubric for writing assessment

### Grades K-2

#### English/Language Arts

K-1.RN.2.1  
K-2.RN.2.3  
1-2.RV.2.2  
K-2.RV.3.2  
2.W.3.2  
K-2.SL.3.1  
K.SL.2.5

#### Science

K.LS.2  
K.LS.3  
2.LS.3

### 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.

## 1. BEFORE YOUR VISIT

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

### Student Reading

Before reading, introduce students to the topic by having them surface all the associations they have with the word “poisonous.” Either individually, in pairs, or as a class, have students write down as many words as they can that they associate with the word “poisonous.” Once they’ve done this, create a class list as a group, discussing how students think their words relate to poison. Keep the list posted to refer back to throughout the pre- and post-visit activity.

Have students read the article “Look but Don’t Lick!” 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.

If it is not possible to create color handouts, use a computer projector to display the reading so that students can see the colorful frog photos. You may also have them color their black and white copies to match the actual colors.

Ask:

- What does it mean for an animal to be poisonous? (A: An animal is poisonous if its body contains a substance that is harmful or fatal to other animals.)

- How does being poisonous help the frogs in this article survive? (*A: Predators will not eat an animal that is poisonous to them. The frogs signal that they are poisonous by their bright colors, which warn predators not to eat them. The frogs can be active during the day and do not need to hide because they are not in danger of being eaten.*)

They can work in pairs, small groups, or as a class. During discussion, remind students to use evidence from the text to explain their thinking, and to use specific examples.

As a class, have students create a concept map about golden poison frogs, using information from the reading to illustrate what they learned.

After they have created their concept maps, go back to the list that the class generated before reading and decide as a group which words on the list relate the best to the frogs that they read about. Circle or highlight those words for later reference.

#### SUPPORTS FOR DIVERSE LEARNERS: Student Reading

- “Chunking” the reading can help keep them from becoming overwhelmed by the length of the text. Present them with only a few sentences or a single paragraph to read and discuss before moving on to the next “chunk.”
- 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 the Chocó Forest area of the exhibition (see map in the Educator’s guide), and using worksheets to gather all the necessary information about how animals use poison to help them survive. Instruct them to choose a second animal other than poison frogs for their focus. 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.
- For those who may have trouble taking notes in the exhibition, teachers and chaperones may use the included worksheets to transcribe students’ observations; use as many worksheets as necessary to record all students’ observations. Teachers and chaperones may also take photos for students to refer to when back in the classroom.

## 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 your reading, your visit to *The Power of Poison*, and your discussions, write an essay in which you describe how animals use poison to help them survive.

Be sure to:

- define the word “poison”
- include two examples of how poison helps animals survive
- include labeled illustrations of each animal

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 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 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 poison helps animals survive.
- Allow time for students to read their essay drafts to a peer and receive feedback based on the Student Writing Guidelines.

## Student Reading

### Look But Don't Lick!

In the 1970s and early 1980s, Museum scientists made a few trips each year to the Colombian rain forest. They were interested in tiny, brightly colored frogs that could be spotted dotting the plants and rocky streams of the jungle.



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Although they're beautiful, many of these Central and South American frogs are also very poisonous. The visiting scientists noticed that people who live in the Colombian rain forest – the

Emberá – used the poisons that ooze out of the frogs to make their blowgun darts deadly. They rubbed dart tips along the animals' backs to transfer the toxins to their weapons, and hunted for animals using the poisoned darts.

***Dendrobates tinctorius***  
(blue poison frog)

**Size:** 1 to 1.75 inches

**Range and habitat:** forests in northern South America

**Frog Fact:** Some blue poison frog "morphs" combine white, black, yellow-and, of course, brilliant blue.

The Emberá used three frog species to poison their darts. One of these species was a bright yellow or sometimes orange frog that the scientists had not seen before. Over several years, they collected hundreds of this new-to-science species. The frogs were about two inches long, larger than any other species of poison frog.



© AMNH

***Phylllobates terribilis***  
(golden poison frog)

**Size:** About 2 inches

**Range and habitat:** tropical rainforests in Colombia

**Frog Fact:** The most poisonous dendrobatid, golden poison frogs are also excellent "tongue hunters," rarely missing a strike.

The scientists found that these frogs were also 20 times more toxic than any other kind of frog. Each of them oozed enough poison to kill up to 10 people. The scientists gave this frog species a frightening name: *Phylllobates terribilis*. The common name for the species is less scary: the golden poison frog.

## Warning Colors

Many small animals in the rainforest are nocturnal, which means active at night. This may help them avoid predators that are active and hunting during the day. But poison frogs are diurnal instead, which means active during the day. You'd think predators like snakes, birds or other hungry animals could easily spot one in the forest where it lives.

As it happens, however, powerful colors and patterns are often used in the natural world to tell hungry predators to stay back. The bright colors advertise that species – from butterflies to berries – are not tasty, and perhaps are even poisonous.



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*Dendrobates auratus*  
(green and black poison frog)

**Size:** 1 to 2 inches

**Range and habitat:** rain forests and plantations, Nicaragua to Colombia

**Frog Fact:** Like most dendrobatids, green and black poison frogs are diurnal and are active all day long.

## Getting the Poison

How do these frogs get their poison? It actually comes from their diets!

Recent studies have found that insects like certain mites, ants, beetles, and millipedes in the frogs' diets contain chemicals that the frogs can turn into poisons after eating them.

In captivity, poison frogs' natural foods are easily replaced by non-toxic foods. They are fed different types of live fruit flies, crickets and beetles, because the frogs need to see the prey moving in order to catch it. These insects don't contain the same chemicals that are found in the frogs' wild prey, so the frogs can't produce poison.



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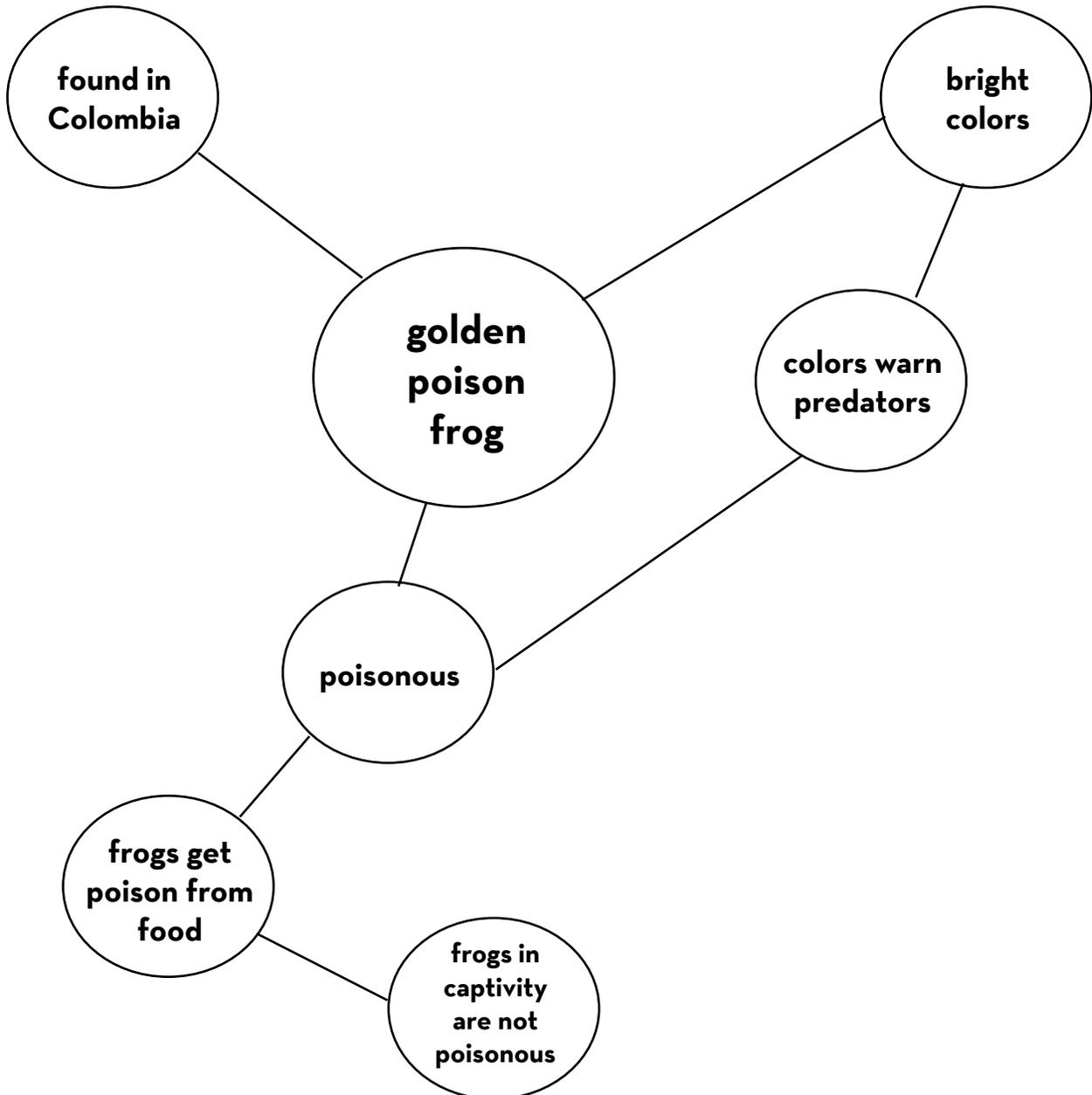
*Dendrobates leucomelas*  
(bumble bee poison frog)

**Size:** 1 to 1.5 inches

**Range and habitat:** western Venezuela to Guyana

**Frog Fact:** Native to dry forests, this species often hides away until the rains come, after which it ventures forth to forage.

## Sample Concept Map for “Look But Don’t Lick!”



## Student Worksheet

Sketch a poisonous animal that is not a frog. Label its poisonous parts.

Animal's name:

How does this animal use poison?

## Chaperone Group Worksheet

**Instructions:** Record students' observations about poisonous animals below. Use one section for each animal; some students may require multiple sections if they observe different animals.

---

Student's name:

Animal's name:

How does this animal use poison?

---

Student's name:

Animal's name:

How does this animal use poison?

---

Student's name:

Animal's name:

How does this animal use poison?

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Student's name:

Animal's name:

How does this animal use poison?

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Student's name:

Animal's name:

How does this animal use poison?

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Student's name:

Animal's name:

How does this animal use poison?

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## Student Writing Guidelines

Based on your reading, your visit to *The Power of Poison*, and your discussions, write an essay in which you describe how animals use poison to help them survive.

Be sure to:

- define the word “poison”
- include two examples of how poison helps animals survive
- include labeled illustrations of each animal

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 two animals and described how they use poison to survive.
- I included an illustration of two poisonous animals.
- I labeled my illustrations.
- I used information from “Look but Don’t Lick!” to explain how animals use poison to help them survive.
- I used information from *The Power of Poison* exhibition to explain how animals use poison to help them survive.
- I included a conclusion at the end.
- I proofread my essay for grammar and spelling errors.

# Assessment Rubric

Scoring Elements		<b>1</b> Below Expectations	<b>2</b> Approaches Expectations	<b>3</b> Meets Expectations	<b>4</b> Exceeds Expectations
<b>RESEARCH</b>	<b>Reading</b>	Does not reference information from the text.	Presents information from reading materials using facts, vocabulary, examples, or other references but may lack accuracy. or relevance.	Presents information from reading materials using facts, vocabulary, examples, or other references but may lack relevance.	Presents accurate and relevant information from reading materials to inform or explain using facts, vocabulary, examples, or other references.
	<b>AMNH Exhibit</b>	Does not reference information from the exhibit.	Presents information from Museum exhibit content using examples, quotes, or other references but may lack accuracy.	Presents information from Museum exhibit content using examples, quotes, or other references relevant to the purpose of the prompt.	Accurately and effectively presents important information from Museum exhibit to inform or explain content using examples, quotes, or other references.
<b>WRITING</b>	<b>Focus</b>	Does not address the prompt.	Addresses the prompt, but significant sections of writing are off topic.	Addresses the prompt with minimal distractions.	Addresses the prompt with no distractions.
	<b>Development</b>	No detail is included to explain the topic	Informs or explains by presenting details.	Informs or explains using accurate details.	Informs or explains by providing accurate and relevant information.
	<b>Conventions</b>	Lacks cohesion and control of grammar, usage, and mechanics appropriate to grade level	Demonstrates an uneven command of standard English conventions appropriate to grade level.	Demonstrates a command of standard English conventions, with few errors as appropriate to grade level.	Maintains a well-developed command of standard English conventions, with few errors. Response includes language and tone appropriate to the audience, purpose, and specific requirements of the prompt.
<b>SCIENCE</b>	<b>Content Understanding</b>	Content is irrelevant, inappropriate, or inaccurate.	Shows uneven understanding of disciplinary content related to the prompt	Presents generally accurate disciplinary content related to the prompt.	Presents accurate and relevant disciplinary content to enhance understanding of the topic.

# Science & Literacy Activity

**GRADES 3-5**

## OVERVIEW

This activity introduces students to scientific knowledge and language related to how animals use poison to help them survive. Students will read content-rich texts, visit *The Power of Poison* exhibition, and use what they have learned to complete a writing task, creating an illustrated text about how animals use poison to help them survive.

### Materials in this packet 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: “Look but Don’t Lick!”
- Student Vocabulary Chart
- Student Worksheet for *The Power of Poison* visit
- Student Writing Guidelines
- Teacher rubric for writing assessment

### Grades 3-5

#### English/Language Arts

3-4.RN.2.1  
 3-5.RN.2.3  
 5.RN.3.2  
 5.RN.4.2  
 3-5.RV.2.1  
 3-5.RV.3.2  
 4-5.RV.2.5  
 3-5.W.3.2  
 3-5.W.5  
 3-5.SL.2.1  
 5.SL.2.2  
 3-5.SL.3.1  
 5.SL.4.1

#### Science

3.LS.3

### SUPPORTS FOR DIVERSE LEARNERS: An Overview

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## 1. BEFORE YOUR VISIT

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

### Student Reading

Have students read the article “Look but Don’t Lick!” 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. If it is not possible to create color handouts, use a computer projector to display the reading so that students can see the colorful frog photos. You may also have them color their black and white copies to match the actual colors.

Ask:

- What does it mean for an animal to be poisonous? (*A: An animal is poisonous if its body contains a substance that is harmful or fatal to other animals.*)
- How does being poisonous help the frogs in this article survive? (*A: Predators will not eat an animal that is poisonous to them. The frogs signal that they are poisonous by their bright colors, which warn predators not to eat them. The frogs can be active during the day and do not need to hide because they are not in danger of being eaten.*)

Have students complete the Student Vocabulary Chart to define these vocabulary words from the reading and explain how these attributes benefit poison frogs: poisonous, diurnal, aposematic.

They can work in pairs, small groups, or as a class. During discussion, remind students to use evidence from the text to explain their thinking, and to use specific examples.

**SUPPORTS FOR DIVERSE LEARNERS: Student Reading**

- “Chunking” the reading can help keep them from becoming overwhelmed by the length of the text. Present them with only a few sentences or a single paragraph to read and discuss before moving on to the next “chunk.”
- 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.
- For the charting activity, have students locate and circle the key vocabulary words in the text and underline where the word is defined to help them with the definitions.

**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 the Chocó Forest area of the exhibition (see map in the Educator’s guide), and using worksheets to gather all the necessary information about how animals use poison to help them survive. 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 your reading, your visit to *The Power of Poison* exhibition, and your discussions, write an essay in which you describe how animals use poison to help them survive.

Be sure to:

- define the word “poison”
- include at least three examples of poisonous animals and how they use their poison
- include labeled illustrations of all three poisonous animals

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 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 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 poison helps animals survive.
- Allow time for students to read their essay drafts to a peer and receive feedback based on the Student Writing Guidelines.

## Student Reading

### Look But Don't Lick!

In the 1970s and early 1980s, Museum scientists made a few trips each year to the Colombian rain forest. They were herpetologists, people who study reptiles and amphibians. The scientists were interested in tiny, brightly colored frogs that could be spotted dotting the plants and rocky streams of the jungle.



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Although they're beautiful, many of these Central and South American frogs are also very poisonous. The visiting scientists noticed that people who live in the Colombian rain forest – the Emberá – used the poisons that ooze out of the frogs to make their blowgun darts deadly. They rubbed dart tips along the animals' backs to transfer the toxins to their weapons, and hunted for animals using the poisoned darts.

***Dendrobates tinctorius***  
(blue poison frog)

**Size:** 1 to 1.75 inches

**Range and habitat:** forests in northern South America

**Frog Fact:** Some blue poison frog "morphs" combine white, black, yellow-and, of course, brilliant blue.

The Emberá used three frog species to poison their darts. One of these species was a bright yellow or sometimes orange frog that the scientists had not seen before. Over several years, they collected hundreds of this new-to-science species. The frogs were about two inches long, larger than any other species of poison frog.



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***Phyllobates terribilis***  
(golden poison frog)

**Size:** About 2 inches

**Range and habitat:** tropical rainforests in Colombia

**Frog Fact:** The most poisonous dendrobatid, golden poison frogs are also excellent "tongue hunters," rarely missing a strike.

The scientists found that these frogs were also 20 times more toxic than any other kind of frog. Each of them oozed enough poison to kill up to 10 people. The scientists gave this frog species a frightening name: *Phyllobates terribilis*. The common name for the species is less scary: the golden poison frog. It's one of about 180 poison frog species that have been identified so far. New poison frogs are still being discovered today.

## Warning Colors

Many small animals in the rainforest are nocturnal, which means active at night. This may help them avoid predators that are active and hunting during the day. But poison frogs are diurnal instead, which means active during the day. You'd think predators like snakes, birds or other hungry animals could easily spot one in the forest where it lives.

As it happens, however, powerful colors and patterns are often used in the natural world to tell hungry predators to stay back. The bright colors advertise that species – from butterflies to berries – are not tasty, and perhaps are even poisonous. Animals with this coloration are called aposematic (Ah-poe-sehm-AH-tick), which is the opposite of camouflage. Because bright colors are a warning, sometimes creatures that are not poisonous at all will have the same bright colors as creatures that are truly toxic. This copycat adaptation may deter would-be hunters.

It has long been thought that the poison frogs' bright colors ward off animals that hope to eat them. In 2007, an experiment in Costa Rica provided evidence to back up that belief. Researchers created 400 life-size clay models of a bright red poison frog species. They also made 400 models of a small, dull-brown frog species. Then the researchers placed the red frog and brown frog models in similar places outdoors. During the study, predators attacked about 100 of the models, but the brown frog models were attacked twice as often as the bright red ones. So brighter coloration in poison frogs does seem to keep some potential predators away.



© Reptiland

*Dendrobates auratus*  
(green and black poison frog)

**Size:** 1 to 2 inches

**Range and habitat:** rain forests and plantations, Nicaragua to Colombia

**Frog Fact:** Like most dendrobatids, green and black poison frogs are diurnal and are active all day long.



© AMNH

*Dendrobates leucomelas*  
(bumble bee poison frog)

**Size:** 1 to 1.5 inches

**Range and habitat:** western Venezuela to Guyana

**Frog Fact:** Native to dry forests, this species often hides away until the rains come, after which it ventures forth to forage.

## Getting the Poison

How do these frogs get their poison? Many poisonous animals create poisons through processes in their own bodies, but these poisonous frogs get the necessary chemicals from their diets.

Recent studies have found that insects like certain mites, ants, beetles, and millipedes in the frogs' diets contain compounds called alkaloids. The frogs are able to concentrate and in some cases modify the alkaloids into poison that oozes out of glands in their skin. The poison comes out of the glands when the frogs are frightened or attacked.

In captivity, poison frogs' natural foods are easily replaced by non-toxic foods. They are fed different types of live fruit flies, crickets and beetles, because the frogs need to see the prey moving in order to catch it. These insects don't contain the alkaloids that are found in the frogs' wild prey, so the frogs can't produce poison.



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Because of their diet, frogs in captivity, like those in the Museum's *The Power of Poison* exhibition, are perfectly harmless.

## Passing on Poison

Now we know how these wild adult frogs get their poison. But how do frog tadpoles protect themselves with poison? Taran Grant is a poison frog expert and research associate at the Museum. He says that some tadpoles may get their poisons directly from their parents.

In at least two species of frog, the tadpoles are fed the mother's unfertilized eggs. Since the eggs contain the same poisons found in the skin of the adult frogs, these chemicals eaten by the tadpoles may protect them, until the growing frog is able to produce its own poison.

## Student Vocabulary Chart

**Instructions:** Fill in the blank boxes below to define key vocabulary from the reading and explain how it helps poison frogs survive.

Vocabulary Words	Definition of the vocabulary word	How does this help the frog survive?
Poisonous		
Diurnal		
Aposematic		

## Student Vocabulary Chart

## ANSWER KEY

**Instructions:** Fill in the blank boxes below to define key vocabulary from the reading and explain how it helps poison frogs survive.

Vocabulary Words	Definition of the vocabulary word	How does this help the frog survive?
Poisonous	<i>(harmful or fatal to another animal)</i>	<i>(predators avoid poisonous prey)</i>
Diurnal	<i>(active during the day)</i>	<i>(it is easier to find food during the day than at night*)</i>
Aposematic	<i>(brightly colored as a warning that it is poisonous)</i>	<i>(other animals know the frog is poisonous and that they should avoid it)</i>

*\*Note to teachers: This is not explicitly stated in the text; students may need to brainstorm the advantages with each other and as a class*

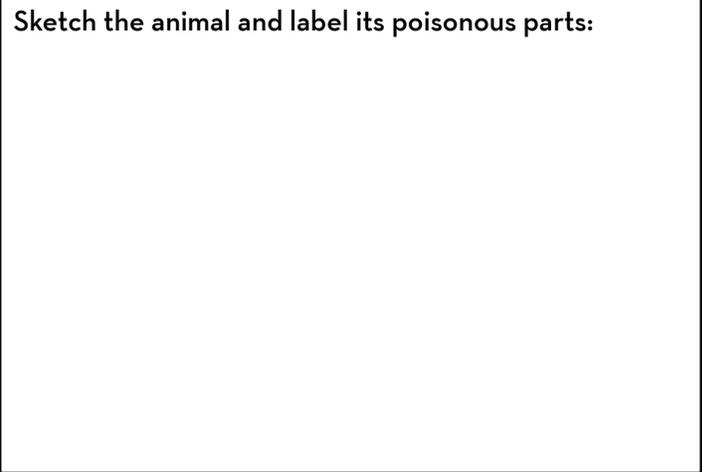
## Student Worksheet

**Instructions:** In the Chocó Forest section, find three poisonous animals. Fill in the information for each.

1. Animal name:

How does this animal use poison to survive?

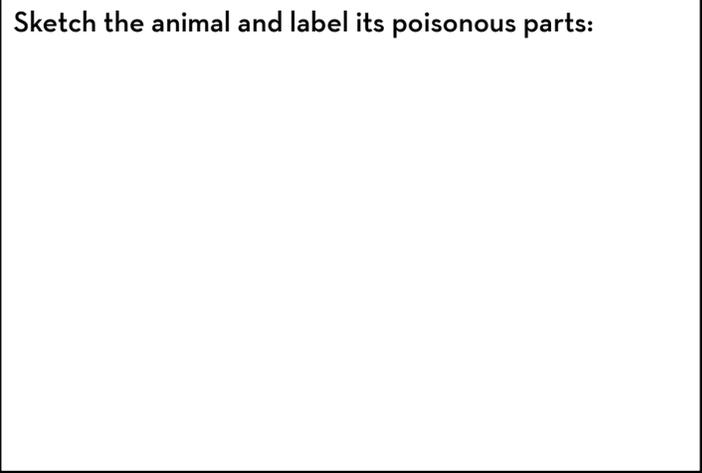
Sketch the animal and label its poisonous parts:



2. Animal name:

How does this animal use poison to survive?

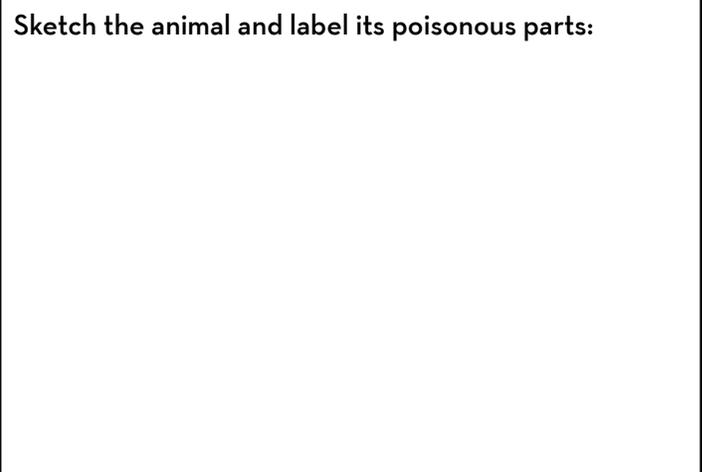
Sketch the animal and label its poisonous parts:



3. Animal name:

How does this animal use poison to survive?

Sketch the animal and label its poisonous parts:



## Student Writing Guidelines

Based on your reading, your visit to *The Power of Poison* exhibition, and your discussions, write an essay in which you describe how animals use poison to help them survive.

Be sure to:

- Define the word “poison”
- Include at least three examples of poisonous animals and how they use their poison
- Include labeled illustrations of all three poisonous animals

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 animals and described how they use poison to survive.
- I included labeled illustrations of three poisonous animals.
- All the information I presented is relevant to how animals use poison to help them survive.
- I used information from “Look but Don’t Lick!” to explain how animals use poison to survive.
- I used information from *The Power of Poison* exhibition to explain how animals use poison to survive.
- I included a conclusion at the end.
- I proofread my essay for grammar and spelling errors.

## Assessment Rubric

Scoring Elements		<b>1</b> Below Expectations	<b>2</b> Approaches Expectations	<b>3</b> Meets Expectations	<b>4</b> Exceeds Expectations
<b>RESEARCH</b>	<b>Reading</b>	Attempts to include text using examples, quotes, or other references.	Presents some information from reading materials but may lack accuracy or relevance.	Accurately presents information from reading materials relevant to the purpose of the prompt to develop argument or claim.	Accurately and effectively presents important information from reading materials to inform or explain.
	<b>AMNH Exhibit</b>	Attempts to include Museum exhibit content using examples, quotes, or other references.	Presents some information from Museum exhibit but may lack accuracy or relevance.	Accurately presents information from Museum exhibit relevant to the purpose of the prompt to develop argument or claim.	Accurately and effectively presents important information from Museum exhibit to inform or explain.
<b>WRITING</b>	<b>Focus</b>	Attempts to address the prompt, but is off-task.	Addresses the prompt, but focus is uneven.	Addresses the prompt with an adequately detailed response; stays on task.	Addresses key aspects of prompt in a detailed response; stays on task.
	<b>Development</b>	Attempts to inform or explain but lacks details.	Informs or explains by presenting some details.	Informs or explains using appropriate details.	Informs or explains by providing detailed and relevant information.
	<b>Conventions</b>	Lacks cohesion and control of grammar, usage, and mechanics appropriate to grade level	Demonstrates an uneven command of standard English conventions appropriate to grade level.	Demonstrates a command of standard English conventions, with few errors as appropriate to grade level.	Maintains a well-developed command of standard English conventions, with few errors. Response includes language and tone appropriate to the audience, purpose, and specific requirements of the prompt.
<b>SCIENCE</b>	<b>Content Understanding</b>	Content is irrelevant, inappropriate, or inaccurate.	Shows uneven understanding of disciplinary content related to the prompt	Presents generally accurate disciplinary content related to the prompt.	Presents accurate and relevant disciplinary content to enhance understanding of the topic.

# Science & Literacy Activity

**GRADES 6-8**

## OVERVIEW

This activity 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 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.

### Grades 6-8

#### English/Language Arts

6-8.RN.2.1  
 6-8.RN.2.2  
 6-7.RN.2.3  
 6-7.RN.4.2  
 6-8.RV.2.1  
 6-8.RV.3.2  
 6-8.W.3.1  
 6-8.W.5  
 6-8.SL.2.1  
 7-8.SL.2.2  
 6-8.SL.3.1  
 6.SL.2.3

#### Science

6-8.LST.2.1  
 6-8.LST.2.2  
 6-8.LST.4.3  
 6-8.LST.7.3

## 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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AGE Fotostock

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.



© H. Schmidbauer/Blickwinkel/  
AGE Fotostock

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.

## 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:

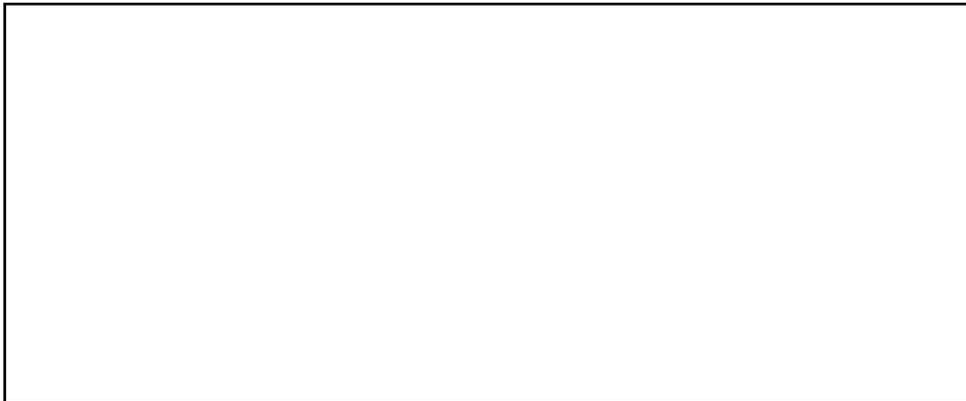
\_\_\_\_\_

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		<b>1</b> Below Expectations	<b>2</b> Approaches Expectations	<b>3</b> Meets Expectations	<b>4</b> Exceeds Expectations
<b>RESEARCH</b>	<b>Reading</b>	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.
	<b>AMNH Exhibit</b>	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.
<b>WRITING</b>	<b>Focus</b>	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.
	<b>Development</b>	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.
	<b>Conventions</b>	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.
<b>SCIENCE</b>	<b>Content Understanding</b>	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.

# Science & Literacy Activity

**GRADES 9-12**

## OVERVIEW

This activity introduces students to scientific knowledge and language related to poisons and the effects of poisons on organisms. Students will read content-rich texts, visit *The Power of Poison* exhibition, and use what they have learned to write and illustrate a document that investigates poison.

### 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

### Grades 9-12

#### English/Language Arts

9-12.RV.2.1  
9-12.RV.3.2  
9-12.W.3.1  
9-12.W.5  
9-12.SL.2.1

#### Science

9-12.LST.2.2  
9-12.LST.1.1  
9-10.LST.5.1  
11-12.LST.5.2

### 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.

## 1. BEFORE YOUR VISIT

This activity engages students in reading a non-fiction text about poison. 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 or paraphrase important information.

Ask:

- What is a poison? (*A poison is any substance that interferes with the normal functions of life. This may mean changing the way that cells or molecules function, or preventing natural processes from happening. Poisons may stop organs from functioning, or even shut down entire organ systems, killing the organism.*)
- Why are poisons so common in nature? What role do they play? (*Poisons are common in nature because they play an important role; poisons are used to capture prey, and in turn to resist predation. Many poisonous organisms, such as the Chilean rose tarantula, subdue or even kill prey by injecting them with poisons. Others, such as the dart frogs of the Amazon, deter predators with poisons. In both cases, the poisons help these organisms survive and reproduce, and are evolutionary adaptations.*)
- The author states that nature is “one huge laboratory.” What does the author mean by this? (*During the course of evolution, many molecules are used by organisms both internally and externally. Organisms are constantly producing new molecules as they evolve, in response to the environment and each other.*)

- How can a single substance be both deadly and a helpful medicine? (*Because poisons can alter the function of body systems within an organism, or even stop these functions, they can be both harmful and helpful. Some poisons can fight off disease, while others can reduce the harm caused by diseases and their symptoms.*)

During class discussion, remind students to use evidence from the text to explain their thinking, and to use specific examples, including specific poisons and poisonous organisms, as well as real examples of poisoning events.

Have students create a chart to communicate the sources of different poisons, as well as ways that poisons can both harm and help a living organism's internal systems. They can work in pairs or small groups.

#### **SUPPORTS FOR DIVERSE LEARNERS: Student Reading**

- “Chunking” the reading can help keep them from becoming overwhelmed by the length of the text. Present them with only a few sentences or a single paragraph to read and discuss before moving on to the next “chunk.”
- 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 activity engages students in exploring the exhibition.

#### **Museum Visit & Student Worksheet**

Explain to students that they will be focusing on poisons in both nature and culture, and the ways that these poisons can harm an organism. They will use worksheets to gather all the necessary information about poisons. 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 is to engage 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 article “The Power of Poison as Medicine,” your visit to *The Power of Poison* exhibition, and your discussion, write an essay in which you:

- define “poison”
- explain how poisons can harm an organism
- provide at least three examples of poisons, describing their effects on an organism

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 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 poison's 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, *Taxus*, 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 *Taxus brevifolia*, 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 known as paclitaxel, 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, as well as AIDS-related Kaposi's sarcoma. It has also been found useful in preventing a re-narrowing of coronary arteries in stent recipients. 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 most foul.

Of course, nature's poisons have been used for medicinal purposes for millennia. Small doses of opium, 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, mercury was an ingredient in popular remedies, from purgatives to infants' teething powder.



© Shutterstock

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. The anticoagulants tyrofabin and hirudin were 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.

The development of the first oral ACE (angiotensin-converting enzyme) inhibitor, which treats hypertension, was based on an understanding of how the venom of the Brazilian pit viper, *Bothrops jararaca*, causes a drastic drop in blood pressure in its prey.



Gila monster

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. Similarly, the antimalarial drug artemisinin is derived from the herb sweet wormwood, *Artemisia annua*.

“Plants and animals are doing complex biochemistry all the time, creating things we couldn't imagine making without the temperature of the Sun and the pressure of the center of Earth,” says Dr. Siddall.

In many ways, nature is one huge laboratory, making and testing countless plant and animal substances in each species' efforts to prevail. In what has been called an evolutionary arms race, as predators up the potency of their poisons, prey strengthen their resistance. This is especially apparent at the microscopic level, where microbes compete endlessly by developing their own antibiotics to fight off other microbes, teaching us in turn what works and what doesn't. Bacteria, algae, and fungi, including molds, that produce toxins could all potentially yield medicines. As it turned out, *Taxus*, the yew tree, was not the original source of the toxic compound used to create the chemotherapy drug: it was a fungus living in the yew tree's bark.

Other examples of small but powerful agents abound. The microbe *Clostridium botulinum*, one of the most toxic substances, is known to most of us as a deadly source of food poisoning in improperly sterilized canned foods. One-millionth of a gram can kill a person, causing fatal paralysis by blocking the release of acetylcholine, a neurotransmitter used by the nerves to signal muscles to contract. In carefully controlled doses, it is famously used as Botox to eliminate wrinkles by paralyzing muscles that, when tensed, cause folds in the face. But it can also be used selectively to treat cerebral palsy spasms, stop uncontrolled jaw clenching, correct crossed eyes, or moderate sweating or twitching.

Whether at the microscopic level or the level of plants and animals, 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. “If the world was populated by only pine trees and pandas,” says Siddall, “we wouldn’t have this rich diversity of resources to help us understand the physiology of diseases and find out what’s out there that might target them.”

# Student Worksheet

1. In the Chóco rainforest, find and record information about three different organisms in the data table:

Common/Scientific name of organism	Poison type and location in the body	How does this poison help the organism survive in its environment?

2. Continue exploring the exhibition. When you arrive at the “Mad Hatter” diorama, complete the following questions:

What poison was responsible for harming real-life hat makers?

Why was this chemical used to make hats?

What does this poison do to the human body?

3. Continue exploring until you arrive at the “Emperor Qin” diorama.

What poison caused the untimely death of this first emperor of unified China?

What does this poison do to the human body?

## Student Worksheet

4. Continue exploring until you arrive at the “Enchanted Book.” Use this book to research and record three plant species in the data table below:

Common/Scientific name of plant	Symptoms caused by human consumption of this plant

5. View the presentation in the poison theater. Record any useful information, including information about arsenic or other poisons and their effects on the human body in the space below:

6. Continue exploring the exhibition until you arrive at the last section, Poison as Medicine.

Walk under the yew tree, scientific name *Taxus baccata*. How is this tree poisonous?

How does poison help this tree survive in its environment?

How is this tree used in medicine?

# Student Worksheet

# ANSWER KEY

1. In the Chóco rainforest, find and record information about three different organisms in the data table:

Common/Scientific name of organism	Poison type and location in the body	How does this poison help the organism survive in its environment?
<i>(Sample Answer: wandering spider, Phoneutria boliviensis)</i>	<i>(Sample Answer: venom located in fangs.)</i>	<i>(Sample Answer: used to hunt for food or defend the spider from predators or other threats)</i>

2. Continue exploring the exhibition until you arrive at the Mad Hatter diorama.

What poison was responsible for harming real-life hat makers? *(mercuric nitrate)*

Why was this chemical used to make hats?

*(This chemical was useful because it removed hair from animal skins and helped turn that hair into felt.)*

What does this poison do to the human body?

*(exposure causes tremors, weakness, kidney disease, vision loss, speech and hearing impairment, and mental illness)*

3. Continue exploring until you arrive at the “Emperor Qin” diorama.

What poison caused the untimely death of this first emperor of unified China? *(mercury)*

What does this poison do to the human body?

*(Mercury damages the nervous system causing mental illness, brain damage, and possibly even death.)*

## Student Worksheet

## ANSWER KEY

4. Continue exploring until you arrive at the “Enchanted Book.” Use this book to research and record three plant species in the data table below:

Common/Scientific name of plant	Symptoms caused by human consumption of this plant
<i>(Sample Answer: hemlock, Conium maculatum)</i>	<i>(Sample Answer: make a human drowsy, dizzy, slow their heart rate, cause paralysis, trouble breathing, and death)</i>

5. View the presentation in the poison theater. Record any useful information, including information about arsenic or other poisons and their effects on the human body.

6. Continue exploring the exhibition until you arrive at the last section, Poison as Medicine.

Walk under the yew tree, scientific name *Taxus baccata*. How is this tree poisonous?  
*(Eating just a small amount, such as a handful of needles from this tree, could kill a human.)*

How does poison help this tree survive in its environment?  
*(Because it is so poisonous, few animals try to eat this tree.)*

How is this tree used in medicine?  
*(This tree is the source for Taxol, an anti-cancer chemical.)*

## Student Writing Guidelines

Based on the article “The Power of Poison as Medicine,” your visit to *The Power of Poison* exhibition, and your discussion, write an essay in which you:

- define the word “poison”
- explain how poisons can harm an organism
- provide at least three examples of poisons, describing their effects on an organism

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 clearly defined “poison” and described a range of effects poison can have on different organisms.
- I only included relevant information.
- The information I presented is accurate.
- All of the information I presented addresses the effects poison can have on different organisms.
- I used science vocabulary correctly.
- I used information from the reading “The Power of Poison as Medicine” to explain the topic in detail.
- I used information from the exhibition to explain the topic 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		<b>1</b> Below Expectations	<b>2</b> Approaches Expectations	<b>3</b> Meets Expectations	<b>4</b> Exceeds Expectations
<b>RESEARCH</b>	<b>Reading</b>	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.
	<b>AMNH Exhibit</b>	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.
<b>WRITING</b>	<b>Focus</b>	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.
	<b>Development</b>	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.
	<b>Conventions</b>	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.
<b>SCIENCE</b>	<b>Content Understanding</b>	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.