Learning Activities

Grade 8

Suggested Learning Activities for Grade 8 students during the COVID-19 school closure.

Seattle Public Schools is committed to making its online information accessible and usable to all people, regardless of ability or technology. Meeting web accessibility guidelines and standards is an ongoing process that we are consistently working to improve.

While Seattle Public Schools endeavors to only post documents optimized for accessibility, due to the nature and complexity of some documents, an accessible version of the document may not be available. In these limited circumstances, the District will provide equally effective alternate access.

Due to the COVID-19 closure, teachers were asked to provide packets of home activities. This is not intended to take the place of regular classroom instruction but will help supplement student learning and provide opportunities for student learning while they are absent from school. Assignments are not required or graded. Because of the unprecedented nature of this health crisis and the District’s swift closure, some home activities may not be accessible.

If you have difficulty accessing the material or have any questions, please contact your student’s teacher.
Middle School Math
Grade 8
Topic 7
Lessons 7-1 & 7-2

Understand and Use the Pythagorean Theorem
How to Access & Use Pearson Bounce Pages

The Bounce Page app is a place where you can access Virtual Nerd videos. These are interactive tutorial videos that go over the fundamental math concepts of each lesson.

You can download Pearson Bounce Pages from your Android or Apple store.

TIPS FOR USING BOUNCE PAGE

1. AIM the camera so the FULL page is easily viewable on your screen. For best results, flatten the page, or if scanning a screen be sure the entire page is visible on your phone screen.

2. TAP the screen to scan the entire front of the page. Scan the ENTIRE page. Scanning a single problem will not work. Scan the page BEFORE students write on the page.

3. BOUNCE the page to life by clicking your Bounce Pages program icon.

4. Update the operating system on your device and the Bounce Pages app as needed.
A shelf support is in the shape of a right triangle with a leg length of 7 inches and a hypotenuse length of 15 inches. What is the length of the other leg to the nearest tenth of an inch?

Draw and label a diagram.

Write the Pythagorean Theorem.
Substitute \(a = 7\) and \(c = 15\).
Simplify and solve for \(b\).
The length of the other leg is about 13.3 inches.

A slide and its ladder form a right triangle with the ground, with the slide representing the hypotenuse. The top of the ladder is 10 feet above the ground, and the bottom of the ladder is 12 feet from the bottom of the slide. What is the length of the slide to the nearest tenth of a foot?

1. Use the information in the problem to label the diagram.

2. Substitute the given information into the Pythagorean Theorem. Then solve for the missing length.

3. What is the length of the slide to the nearest tenth of a foot?

On the Back!

4. An 8 foot wire extends from the top of a 5 foot post to the ground, forming a right triangle. To the nearest tenth of a foot, what is the distance from the bottom of the post to the point where the wire meets the ground?
**7-1 Additional Practice**

**Leveled Practice** In 1 and 2, find the missing side length of each triangle.

1. \( \begin{align*} \quad 15 & \quad c \\ 36 \\ \quad \end{align*} \)

\[ 15^2 + 36^2 = c^2 \]

\[ c = \sqrt{15^2 + 36^2} \]

The length of the hypotenuse is _______ units.

2. \( \begin{align*} \quad 5 \text{ in.} & \quad b \\ 13 \text{ in.} \\ \quad \end{align*} \)

\[ 5^2 + b^2 = 13^2 \]

\[ b = \sqrt{13^2 - 5^2} \]

The length of leg \( b \) is _______ inches.

3. What is the length of side \( a \) rounded to the nearest tenth of a centimeter?

\( \begin{align*} \quad a & \quad 12.8 \text{ cm} \\ 8 \text{ cm} \\ \quad \end{align*} \)

4. What is the length of side \( c \) rounded to the nearest tenth of an inch?

\( \begin{align*} \quad 17 \text{ in.} & \quad c \\ 19 \text{ in.} \\ \quad \end{align*} \)

5. Two dimensions of a right triangle are 5 units and 13 units. A student writes the equation \( 5^2 + 13^2 = c^2 \) to find the length of the third side.

a. If all the side lengths are integers, is the student’s equation correct? Explain.

b. If the student is incorrect, write an equation that will give the length of the third side, and show that the equation is correct.
6. What is the length of the hypotenuse of the triangle when \( x = 3 \)? Round your answer to the nearest tenth.

7. A student was asked to find the length of the unknown leg of the right triangle. The student incorrectly said that the length of the unknown leg of the right triangle is about 6.2 centimeters.
   a. Find the length of the unknown leg of the right triangle to the nearest tenth of a centimeter.
   b. What mistake might the student have made?

8. Higher Order Thinking Dillon places a ladder against a wall. The base of the ladder is 5 feet from the wall. The ladder is 12 feet long.
   a. How high will the ladder reach?
   b. How will shortening the distance between the base of the ladder and the wall affect the dimensions of the triangle they form? Explain in terms of the Pythagorean Theorem.

9. What is the length of the hypotenuse of the right triangle?

10. What is the length of the unknown leg of the right triangle rounded to the nearest tenth of a meter?
A shelf support is in the shape of a right triangle with a leg length of 7 inches and a hypotenuse length of 15 inches. What is the length of the other leg to the nearest tenth of an inch?

\[ a^2 + b^2 = c^2 \]

Draw and label a diagram.

\[ (7\text{ in})^2 + b^2 = (15\text{ in})^2 \]

Write the Pythagorean Theorem.

\[ b^2 = 176 \]

Substitute \( a = 7 \) and \( c = 15 \).

Simplify and solve for \( b \).

The length of the other leg is about 13.3 inches.

A slide and its ladder form a right triangle with the ground, with the slide representing the hypotenuse. The top of the ladder is 10 feet above the ground, and the bottom of the ladder is 12 feet from the bottom of the slide. What is the length of the slide to the nearest tenth of a foot?

1. Use the information in the problem to label the diagram.

   **Check students’ work.**

2. Substitute the given information into the Pythagorean Theorem. Then solve for the missing length.

   \[ a^2 + b^2 = c^2 \]

   \[ 10^2 + 12^2 = c^2 \]

   Choices for \( a \) and \( b \) may vary.

   \[ 100 + 144 = c^2 \]

   \[ 244 = c^2 \]

   \[ \sqrt{244} = c \]

   \[ 15.6 \text{ feet} \]

   The length of the hypotenuse is **15.6 feet**.

3. What is the length of the slide to the nearest tenth of a foot?

   **15.6 feet**

   **On the Back!**

4. An 8 foot wire extends from the top of a 5 foot post to the ground, forming a right triangle. To the nearest tenth of a foot, what is the distance from the bottom of the post to the point where the wire meets the ground?

   **6.2 feet**

5. Two dimensions of a right triangle are 5 units and 13 units. A student writes the equation \( 5^2 + 13^2 = c^2 \) to find the length of the third side.

   **a.** If all the side lengths are integers, is the student’s equation correct? Explain.

   **b.** If the student is incorrect, write an equation that will give the length of the third side, and show that the equation is correct.

   \[ 5^2 + 13^2 = c^2 \]

   \[ 25 + 169 = 194 \]

   \[ 194 \approx 13.9 \text{ units} \]

   This is not an integer.

6. Higher Order Thinking. Dillon places a ladder against a wall. The base of the ladder is 5 feet from the wall. The ladder is 12 feet long.

   **a.** How high will the ladder reach?

   **b.** How will shortening the distance between the base of the ladder and the wall affect the dimensions of the triangle they form? Explain in terms of the Pythagorean Theorem.

   Sample answer: The wall and the distance between the wall and the base of the ladder form two legs of a right triangle, \( a \) and \( b \). The ladder is the hypotenuse, \( c \). If you shorten the distance between the base of the ladder and the wall, the leg becomes shorter. The hypotenuse will not change because the ladder just reaches higher up the wall. Since \( a^2 + b^2 = c^2 \), if one leg gets shorter the other leg must get longer.

**Assessment Practice**

9. What is the length of the hypotenuse of the right triangle?

\[ a = 7 \text{ in} \]

\[ c = 13 \text{ in} \]

10. What is the length of the unknown leg of the right triangle rounded to the nearest tenth of a meter?

\[ a = 26 \text{ in} \]

\[ b = 24 \text{ in} \]

\[ c = 43.8 \text{ m} \]

\[ \text{About } 41.6 \text{ m} \]
The side lengths of a triangle are 6 centimeters, 9 centimeters, and $\sqrt{115}$ centimeters. Is this triangle a right triangle?

Apply the Converse of the Pythagorean Theorem.

The longest side is $\sqrt{115}$. Substitute this value for $c$.
The other two sides are $a = 6$ and $b = 9$.
The triangle is not a right triangle.

The side lengths of a triangle are 8 inches, 11 inches, and $\sqrt{185}$ inches. Is this triangle a right triangle? Explain.

1. Which side lengths are $a$, $b$, and $c$?
   \[ a = \quad b = \quad c = \]

2. Apply the Converse of the Pythagorean Theorem.
   \[ a^2 + b^2 \overset{?}{=} c^2 \]

3. Is the triangle a right triangle? Explain.

On the Back!

4. A triangle has side lengths 1.2 meters, 1.6 meters, and 2 meters. Is this triangle a right triangle? Explain.
7-2 Additional Practice

Leveled Practice In 1 and 2, determine whether each triangle is a right triangle.

1. \[a^2 + b^2 = c^2\]

\[8^2 + 15^2 = 17^2\]

Is the triangle a right triangle? [ ]

2. \[a^2 + b^2 = c^2\]

\[12^2 + 11^2 = 10^2\]

Is the triangle a right triangle? [ ]

3. Model with Math \(\triangle LMN\) is an equilateral triangle. Is \(MQ\) the height of \(\triangle LMN\)? Explain.

\[\sqrt{30}\] \[\sqrt{15}\]

\[\sqrt{30}\]

\[\frac{\sqrt{30}}{2}\]

4. The side lengths of three triangles are shown. Which of the triangles are right triangles?

<table>
<thead>
<tr>
<th>Triangle</th>
<th>Side Lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 (\sqrt{425}) 5</td>
</tr>
<tr>
<td>2</td>
<td>14 21 10</td>
</tr>
<tr>
<td>3</td>
<td>6 (\frac{\sqrt{11}}{2}) 8 (\frac{\sqrt{11}}{2}) 10 (\frac{\sqrt{11}}{2})</td>
</tr>
</tbody>
</table>

5. The length of one leg of a right triangle is 8 centimeters shorter than the hypotenuse. The hypotenuse is 42 centimeters. What is the length of the unknown leg of the right triangle rounded to the nearest tenth?
6. **Model with Math**  \( \triangle ABC \) is an isosceles triangle. Is \( AD \) the height of \( \triangle ABC \)? Explain.  

7. **Higher Order Thinking**  The side lengths of three triangles are given.

   Triangle 1: \( \sqrt{519} \) units, 27 units, \( \sqrt{210} \) units
   Triangle 2: 21 units, \( \sqrt{109} \) units, \( \sqrt{420} \) units
   Triangle 3: \( \sqrt{338} \) units, 26 units, \( \sqrt{338} \) units

   a. Which lengths represent the side lengths of a right triangle? Explain.

   b. For any triangles that are not right triangles, use any two of the sides to make a right triangle. Explain.

8. Is the \( \triangle ABC \) a right triangle? Explain.

9. Which lengths represent the side lengths of a right triangle?

   Triangle 1: 4, 6, 10
   Triangle 2: 6, 8, 10
   Triangle 3: 10, 24, 26

   a Triangle 1 and Triangle 3 are right triangles.
   b Triangle 2 and Triangle 3 are right triangles.
   c All of the triangles are right triangles.
   d None of the triangles are right triangles.
The side lengths of a triangle are 6 centimeters, 9 centimeters, and \( \sqrt{115} \) centimeters. Is this triangle a right triangle?

Apply the Converse of the Pythagorean Theorem.

The longest side is \( \sqrt{115} \). Substitute this value for \( c \).

The other two sides are \( a = 6 \) and \( b = 9 \).

The triangle is not a right triangle.

The side lengths of a triangle are 8 inches, 11 inches, and \( \sqrt{185} \) inches. Is this triangle a right triangle? Explain.

1. Which side lengths are \( a \), \( b \), and \( c \)? Choices for \( a \) and \( b \) may vary.

\[ a = 8 \quad b = 11 \quad c = \sqrt{185} \]

2. Apply the Converse of the Pythagorean Theorem.

\[ a^2 + b^2 = c^2 \]

\[ 8^2 + 11^2 = \sqrt{185}^2 \]

\[ 64 + 121 = 185 \]

\[ 185 = 185 \]

3. Is the triangle a right triangle? Explain.

Yes; the side lengths satisfy the Pythagorean Theorem.

On the Back!

4. A triangle has side lengths 1.2 meters, 1.6 meters, and 2 meters. Is this triangle a right triangle? Explain.

Yes; \( 1.2^2 + 1.6^2 = 2^2 \) so the side lengths satisfy the Pythagorean Theorem.

6. Model with Math. \( \triangle ABC \) is an isosceles triangle. \( AD \) is the height of \( \triangle ABC \). Explain.

Yes; Sample answer: Using the Pythagorean Theorem:

\[ \sqrt{5} \times 5 = 5 \sqrt{5} \] so \( \triangle ADC \) is a right triangle. Since \( \triangle ADC \) is a right triangle, \( AD \) is perpendicular to \( BC \).

7. Higher Order Thinking The side lengths of three triangles are given.

Triangle 1: \( \sqrt{177} \) units, \( \sqrt{5} \) units, \( \sqrt{152} \) units

Triangle 2: \( \sqrt{21} \) units, \( \sqrt{25} \) units, \( \sqrt{12} \) units

Triangle 3: \( \sqrt{32} \) units, \( \sqrt{27} \) units, \( \sqrt{50} \) units

a. Which lengths represent the side lengths of a right triangle? Explain.

Triangles 1 and 2. Sample answer: Use the Converse of the Pythagorean Theorem:

\( \sqrt{177} \times \sqrt{5} = \sqrt{182} \), \( 21 \times 25 = 525 \), \( 152 \times \sqrt{21} = 324 \), \( 5 \times 25 = 125 \), \( 12 \times \sqrt{27} = 36 \), \( 12 \times \sqrt{50} = 60 \), \( 21 \times 25 = 525 \), \( 182 = 182 \), \( 525 = 525 \), \( 324 = 324 \), \( 125 = 125 \), \( 36 = 36 \), \( 60 = 60 \), \( 525 = 525 \)

b. For any triangles that are not right triangles, use any two of the sides to make a right triangle. Explain.

Sample answer: For Triangle 2, change the side that is 21 units to 23 units: \( 21^2 = \sqrt{27} \times \sqrt{27} = 529 \), \( 21^2 = 441 \), \( 441 + 27 = 468 \), \( 468 = 468 \).

8. Is the \( \triangle ABC \) a right triangle? Explain.

No. Sample answer: \( 18.75^2 = 343.75 \), \( 28.75^2 = 823.0625 \).

9. Which lengths represent the side lengths of a right triangle?

Triangle 3: 10, 24, 26

\( \triangle 1 \) and \( \triangle 3 \) are right triangles.

\( \triangle 2 \) and \( \triangle 3 \) are right triangles.

All of the triangles are right triangles.

None of the triangles are right triangles.
Hello Families,

We hope you and your family are well and safe during this time. During this unprecedented out-of-school time, the SPS middle school science team will be offering instructional opportunities for students that align with the district’s adopted middle school science instructional materials.

This investigation packet is part of a series of district-aligned lessons for middle school science developed by AmplifyScience and adopted by SPS in 2019. While Amplify Science lessons are designed to be done in the classroom with peers, there are some activities that students can complete at home.

In this packet you will find activities to accompany the lesson videos being aired this week through Seattle’s Public television programming on SPS TV (local channel 26). The videos and packets are also posted to the, SPS Science webpage under their corresponding grade level. These lesson videos, developed in collaboration between SPS teachers, Denver Public Schools teachers, and Amplify Science, feature teachers going through the information in the lessons. The work in this packet is intended to be completed alongside the viewing of the video of the corresponding videos.

Closed captioning for the videos is available in many home languages if this helpful to your family.
- Click CC (bottom right of video)
- Click Setting (the gear next to CC)
- Click Subtitles/CC
- Click Auto-translate
- Choose your language

For students who have access to the internet and the following devices and browsers may wish to log-in to their AmplifyScience account from home are welcome to do so. Chrome and Safari are the recommended browsers to use for full functionality of the Amplify digital tools and features.

Sincerely,
Seattle Public Schools Science Department
Hello SPS families,

We hope you and your family are well and safe during this season. During this unprecedented time away from school, SPS’s middle school science team will provide instructional opportunities for students that align with the middle school science teaching materials adopted by the district.

This learning packet is part of a series of extracurricular remote offerings, developed by AmplifyScience. Although Amplify Science lessons are designed to be completed in the classroom with classmates, students can also complete some activities at home. In this packet, you will find activities to accompany this week’s lessons that are transmitted on SPS TV (local channel 26). Videos and learning packets will also be published on the SPS website, https://www.seattleschools.org/academics/curriculum/science.

Subtitles for videos are available in many languages if this is helpful for your family.

○ Press CC (below right corner of video)
○ Press Setting (CC button next to CC)
○ Press Subtitles/CC
○ Press Auto-translate
○ Choose your language

You can access the internet and use the following devices and browsers to log into your AmplifyScience account at home.

○ Desktops and Laptops (Chrome & Safari)
○ Chromebooks
○ iPads that support iOS11.3+ (iPad5+)- Suggested browser: Safari

Sincerely,

Seattle Public Schools Science Department
Los estudiantes que tienen acceso a Internet y a los siguientes dispositivos y navegadores pueden iniciar sesión en su cuenta AmplifyScience desde casa.

- Computadoras de Escritorio y Laptops (Chrome y Safari)
- Chromebooks
- iPads con iOS11.3+ (iPad5+) – Navegador sugerido: Safari

Sinceramente,
Departamento de Ciencias de las Escuelas Públicas de Seattle

**SOMALI**

Qoysaska Dugsiga Dhexe SPS ,

Waxaan raajeyneynaa adiga iyo qoyskaada in aad caafimaad iiyo nabadgelyo qabaanta waqtigaan lagu jiro . Dig Inta lagu jiro waqtigaan caadiga ahayn ee dugsiga dibadilsa, kookoda sayniska ee dugsiga dhexe ee SPS waxay soo bandhigayaa fursadda waxbariis isla markaana ardayga oo la waafajineysa agabka tacliinta sayniska ee dugsiga dhexe ee degmadu qaaday.

Xirmadan barista sayniska waa qeyb ka mid ah taxane ah oo dugsiyada degmada inkastoo casharada Amplify Sayniska loogu talagalay in lagu sameeyo fasalka dhexdiisa ardayda , waxaa kale oo jira howlo qaarkood oo ay ardaydu ku dhamayn karaan guriga warqadahaan xirmadah ah dheexeedan casharada muqaalka ah waxaad ka heleysaa sitimaanka barnaamijka taleefihinka Dugsiyada Dadweynaha Seattle SPS TV (kanaalka gudaha 26). Xirmadaha warqadaha iyo fidiiyowga waxaad ka heleysaa shabakada SPS websaydhka, https://www.seattleschools.org/academics/curriculum/science .

Waxaad halkan ka heli kartaa sawiro qaar iyo luqado hadii ay tahay mid ku caawineysa qoyskaada.

- guji CC (bottom right of video)
- guji Setting (the gear next to CC)
- guji Subtitles/CC
- guji Auto-translate
- Dooro luqadaada

**Ardayga heysta Khadka internet raacana tilmaanta isticmaalka ka dibna ay galaan koontadooda AmplifyScience guriga .**

- Desktops and Laptops (Chrome & Safari)
- Chromebooks
- iPads that support iOS11.3+ (iPad5+) – talo isticmaal : Safari

Mahadsanid,
Dugsiyada Dadweynaha Seattle Waaxda Sayniska

**VIETNAMESE**

Kính gửi các gia đình của học sinh cấp 2 SPS,


Phụ đề cho các video có sẵn qua nhiều ngôn ngữ để giúp ích cho gia đình của quý vị.

- Nhập CC (đởi cùng bên phải của video)
- Nhập vào Setting (biểu tượng hình bảnarel bên cạnh CC)
- Nhập vào Subtitles/CC
- Nhập vào Auto-translate
- Chọn ngôn ngữ của quý vị

Học sinh nào truy cập vào internet và các thiết bị và trình duyệt sau có thể đăng nhập vào tài khoản AmplifyScience của các em từ nhà.

- Desktops and Laptops (Chrome & Safari)
- Chromebooks
- iPads that support iOS11.3+ (iPad5+) - Suggested browser: Safari

Trân trọng,
Seattle Public Schools Science Department
In the previous lesson, you explored how traits are passed down from one generation to the next when organisms reproduce. How is it possible that, over many generations, some traits can become more common, while others become less common? Shouldn’t each generation match the generation before it? Today, you will observe one more example of how individuals in a population get their traits through reproduction.

Unit Question
• Why do populations change over time?

Chapter 2 Question
• How did the trait for increased poison level become more common in the newt population?

Learning Objectives
• Poison can serve as an adaptive trait if predators detect the poison before killing their prey.

• Organisms with adaptive traits are less likely to die than organisms with non-adaptive traits, which means they have more opportunities to reproduce.

Vocabulary

<table>
<thead>
<tr>
<th>Adaptive trait</th>
<th>Environment</th>
<th>Non-Adaptive Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause</td>
<td>Evidence</td>
<td>Population</td>
</tr>
<tr>
<td>Claim</td>
<td>Gene</td>
<td>Prediction</td>
</tr>
<tr>
<td>Distribution</td>
<td>Generation</td>
<td>Protein Molecule</td>
</tr>
<tr>
<td>Effect</td>
<td>Natural Selection</td>
<td></td>
</tr>
</tbody>
</table>

Materials you will need
• Pencil or Pen

• Different colored writing utensils (colored pencils, crayons, highlighters, markers, etc.)

• Someone near you to talk through your ideas with
Let’s Warm Up!

Read Sherman’s Story #3 below and answer the questions that follow.

Sherman’s Stories #3: Green Dragonflies

1. What is Sherman right about?

__________________________________________________________________________________________________
__________________________________________________________________________________________________
__________________________________________________________________________________________________

2. What is Sherman wrong about?

__________________________________________________________________________________
__________________________________________________________________________________________________
____________________________________________________________________________
______________________
__________________________________________________________________________________________________

Actually, Sherman, you are only partially right. The correct explanation is . . .
Rough-Skinned Newt Defenses

In 1979, friends dared a 29-year-old man in Oregon to swallow a living rough-skinned newt. The man didn’t realize how poisonous rough-skinned newts are. A lethal, fast-acting poison called tetrodotoxin (TTX) oozes from their skin. The man swallowed the newt whole and started feeling weak a few minutes later. He described a numb feeling all over his body. His friends tried to take him to a hospital, but he refused. Just 20 minutes later, the man was dead.

Of course, the newt the man swallowed died, too. In that particular case, being poisonous didn’t help that individual newt survive. If newts have to be eaten in order to defend themselves, being poisonous doesn’t sound like a very good defense! How is being poisonous—having a high level of TTX poison—an adaptive trait for a rough-skinned newt?

Why Poison Is Adaptive

One reason TTX is adaptive is that it acts quickly. A predator that tries to eat a poisonous newt may become sick before it’s able to kill the newt, allowing the newt to escape. In fact, TTX acts so quickly that sometimes predators die before finishing their meals. Scientists have observed rough-skinned newts crawling out of dead or paralyzed predators.

Even more important, predators can smell and taste TTX poison. The main predator of rough-skinned newts is the garter snake. Scientists have found evidence that garter snakes use their senses of smell and taste to tell whether a rough-skinned newt is too poisonous to eat. They have even observed garter snakes doing quick “taste tests”—licking rough-skinned newts before deciding whether to eat them.

Scientists have studied whether garter snakes are able to detect TTX poison in newts. Biologists have placed one newt and one garter snake together in a cage to see whether the snake would eat the newt. They have tried this test over and over again, using different snakes and different newts. Even though the newts are placed directly in front of the snakes, not every newt gets eaten! Biologists are able to consider the cause-and-effect relationship between high poison levels and survival in newts by examining a population of
newts with high variation. The newts in the test range from having no poison to having very high levels of TTX in their bodies. In these tests, the snakes consistently eat the newts with the lowest levels of TTX, and do not eat the newts with high levels of TTX. These results are evidence that garter snakes can detect TTX and that they prefer to eat rough-skinned newts with lower levels of TTX. The more poisonous a rough-skinned newt is, the less likely it is to be eaten by a garter snake. That means high levels of TTX are an adaptive trait in rough-skinned newts that live near garter snakes.

How Adaptive Traits Spread

If snakes are in its environment, a poisonous newt is less likely to die from being eaten than a newt that isn’t poisonous. The newts that don’t get eaten have a better chance of living longer, and that’s important because it means more chances to reproduce. Organisms have to reproduce in order to pass on their genes, which are the instructions for making the protein molecules that determine traits: if they don’t reproduce, their traits die with them. In the newt population, more poisonous newts are more likely to survive long enough to reproduce and pass down their genes, and therefore the trait of being poisonous, to the next generation. As a result, there will be more and more highly poisonous rough-skinned newts in each generation. This will cause the distribution of traits in the population to change over many generations. Scientists call this process natural selection. This process does not only happen in rough-skinned newts. It has been observed in populations of different species all over the world.

How Natural Selection Works

1. There are different inherited traits in the population.
2. Adaptive traits help organisms survive in their environment. Organisms with adaptive traits are more likely to survive long enough to reproduce.
3. The organisms that reproduce pass on their traits to the next generation.

**KEY**
- : amount of TTX poison
- : death
- : reproduction
Other Poisonous Organisms

Being poisonous is an adaptive trait for many different organisms, not just rough-skinned newts. There are many poisonous plants, such as deadly nightshade, hemlock, and mint. You might be surprised to see mint on this list, since you’ve probably eaten mint yourself! The poisons in mint are harmless to humans, but deadly to some plant-eating insects. These poisons are what give mint its minty taste and smell—they are warning signals telling insects to stay away.

Like rough-skinned newts, poisonous plants are poisonous as a defense against being eaten. Plants can’t run away from animals that want to eat them, so they have to defend themselves in other ways—with adaptive traits like tough bark, sharp thorns, and being poisonous.

Deadly nightshade (left) is an extremely poisonous plant; eating just a few berries can kill a human. Mint (right) is harmless to humans, but deadly to some insects.

Comprehending the Reading

1. What is the definition of Natural Selection?

______________________________________________________________________________________________
______________________________________________________________________________________________

2. In the study that scientists conducted where garter snakes were paired with newts in a cage, why did the garter snake sometimes eat the newt but other times did not?

______________________________________________________________________________________________
______________________________________________________________________________________________
______________________________________________________________________________________________
______________________________________________________________________________________________

3. How did more highly poisonous newts end up in the population generation after generation? Why is every generation more poisonous than the generation before?

______________________________________________________________________________________________
______________________________________________________________________________________________
______________________________________________________________________________________________
______________________________________________________________________________________________

Besides poison, plant defenses include sharp thorns and thick bark.
Making sense of the information

Observe the diagram and answer the questions below.

1. What is the diagram showing? __________________________
2. What do the dots in the newts represent? __________________________
3. What does the X represent? __________________________
4. What does the little line of dots represent? ____________________
5. How would you describe the newt population in Diagram 1? (circle)
   a. There are fifteen poison levels shown, and each individual has a different amount of poison.
   b. There is one poison level shown, and all newts have the same amount of poison.
   c. There are three poison levels shown, and no poison-level trait is more common than the others.
   d. There are three poison levels shown, and one poison-level trait is the most common.
6. In diagrams 2 and 3 did all newts reproduce? (circle)  YES  NO
7. In diagram 2, did newts from all poison levels die? (circle)  YES  NO
8. How would you describe the newt population in Diagram 3? (circle)
   a. There are fifteen poison levels shown, and each individual has a different amount of poison.
   b. There is one poison level shown, and all newts have the same amount of poison.
   c. There are three poison levels shown, and no poison-level trait is more common than the others.
   d. There are three poison levels shown, and one poison-level trait is the most common.
Making sense of the information (continued)

Use the diagram from the previous page and the “Deadly Dare” article to answer the following questions.

1. Which individuals are more likely to die before reproduction, those with adaptive traits or non-adaptive traits? Explain why.

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

2. When many individuals with the same trait die before reproducing, what happens to the distribution of that trait in the population? Why?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

3. Why are there more newts with high-poison level in the population in Diagram 3 than the population in Diagram 1?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________

4. Are the newts with high poison in Diagram 3 simply the oldest newts? How do you know?

____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
____________________________________________________________________________________________________________
Putting the Pieces together

Now that we understand more about the process of natural selection, we are ready to answer the **Chapter 2 Question: How did the trait for increased poison level become more common in the newt population?** Make sure your explanation includes detail and evidence that we have gathered so far from the article and SIM.

*Sentence Starter: “The less poisonous newts.... And the more poisonous ones....”*
Scientific Argument: Writing about the Rough-Skinned Newts

Remember in this unit we started with the question: How does a population over time? Using the example of the rough skinned newt population, we now have sufficient evidence to provide an explanation to this question. Based on ALL of the evidence we have collected in this unit, use evidence and reasoning to support the following claim:

**CLAIM:** The newt population became more poisonous because the snakes in this environment caused poison to be an adaptive trait, and Poison Level 10 is the most common because the newts with this trait were able to live longer and reproduce more than other newts.

Sentence starters

**Describing evidence:**
- The evidence that supports my claim is . . .
- My first piece of evidence is . . .
- Another piece of evidence is . . .
- This evidence shows that . . .

**Describing how the evidence supports the claim:**
- If __________, then . . .
- This is important because . . .
- Since __________, . . .
- Based on the evidence, I conclude that . . .
- This claim is stronger because . . .

**ORGANIZE YOUR WRITING FIRST**

<table>
<thead>
<tr>
<th>Paragraph 1</th>
<th>Question: How did the Rough-Skinned Newt population become more poisonous over time?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claim:</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Paragraph 2</th>
<th>Evidence 1:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Key Concept from Class related to Evidence 1:</td>
</tr>
<tr>
<td>Paragraph 3</td>
<td>Evidence 2:</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>Key Concept from Class related to Evidence 2:</td>
</tr>
<tr>
<td></td>
<td>Explanation of how Evidence 2 and Key Concept explain your claim:</td>
</tr>
</tbody>
</table>

| Paragraph 4 | Conclusion: (quick summary of everything you’ve said; start with question and end with conclusion.) |
Writing an Explanation for the Park Visitors

**Question:** How did the Rough-Skinned Newt population become more poisonous over time?

**Vocabulary**

<table>
<thead>
<tr>
<th>Adaptive trait</th>
<th>Environment</th>
<th>Non-Adaptive Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause</td>
<td>Evidence</td>
<td>Population</td>
</tr>
<tr>
<td>Claim</td>
<td>Gene</td>
<td>Prediction</td>
</tr>
<tr>
<td>Distribution</td>
<td>Generation</td>
<td>Protein Molecule</td>
</tr>
<tr>
<td>Effect</td>
<td>Natural Selection</td>
<td>Trait</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variation</td>
</tr>
</tbody>
</table>
Natural Selection - Lesson 7

3.1 Introduction to Mutations: Rough-Skinned Newt Histogram from Many Generations Ago

New evidence about the rough-skinned newts is available. Below is a histogram from many years in the past, 200 generations ago! Observe the histogram and answer the questions below.

1. How did the distribution of the poison-level traits change from 200 generations ago to 50 generations ago?

____________________________________________________________________________
____________________________________________________________________________

2. What could explain this change? Record any ideas that you have.

________________________________________________________________________________________
__________________________________________________________________

Chapter 3 Question:
How did a poison-level trait that wasn’t always present in the newt population become the most common trait?

Reading: Mutations – Not Just for Super Heroes

Read the articles about mutations. Remember our active reading guidelines:

- Think carefully about what you read. Pay attention to your own understanding.
- As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
- Examine all visual representations (pictures) carefully. Consider how they go together with the text.
- After you read, talk with someone about what you have read to help you better understand it.

**Movie Mutations**

In movies and comic books, mutations make people into superheroes. In the real world, mutations often have no visible effect at all.

In movies, mutations are always exciting: they might give special powers or extra limbs. However, real mutations can be very boring: they might not have any noticeable effect at all. mutation, anyway? The answer has to do with genes and the passed down when organisms reproduce.

Genes are instructions for making protein molecules, and those molecules determine an organism’s traits. When organisms they pass down copies of their genes to their offspring. However,
aren’t always perfect: as genes are duplicated, changes can occur. These changes are called mutations, and they can be passed from parent to offspring when organisms reproduce. Most of the changes are minor and don’t affect traits at all, but every once in a while, mutated genes give instructions to make a new protein molecule that leads to a new trait in the offspring.

The new traits that arise from mutations may be adaptive or non-adaptive, or they may have no effect on survival and reproduction. It all depends on the organisms’ environment. If a new trait makes organisms less likely to survive and reproduce in their environment, the trait is non-adaptive. Organisms born with that trait don’t have a very good chance of surviving long enough to reproduce and pass their mutated genes down to the next generation. If they don’t pass the mutated genes down, they don’t pass the new trait down either. Mutated traits that are non-adaptive usually remain uncommon in the population.

On the other hand, mutated genes sometimes result in a new trait that turns out to be adaptive. Adaptive traits help organisms survive and reproduce in their environments. If a mutation results in an adaptive trait, organisms with that trait are more likely to reproduce and pass on their mutated genes to the next generation.

Through natural selection, adaptive traits become more and more common in the population over time. A trait that is adaptive in one environment may be non-adaptive in another, and that’s what makes mutations so important. Environments don’t stay the same forever. Mutations can introduce new traits, increasing the chance that one of those traits might help make a population better able to adapt to a changing environment. To learn more about mutations, you can explore one or more of the following readings about Cane Toads and Lobsters.

**Cane Toad Invaders**

Huge poisonous toads have invaded Australia! Humans brought cane toads from Asia to Australia in the 1930s, hoping the toads would eat beetles that were destroying crops. Unfortunately, the toads didn’t eat many beetles. They ate almost anything else that could fit into their mouths, however. These big toads grow up to 22 centimeters (9 inches) long and weigh up to 1.8 kilograms (4 pounds). Cane toads are extremely poisonous, and no Australian predators can survive eating them. Without predators in their new environment, the cane toad population began growing and spreading. Today,
Cane toads are common in areas more than 1,500 kilometers (932 miles) from the place where they were first introduced to Australia.

Because there are so many cane toads in Australia, they compete with each other for food. The cane toads are eating everything in sight, so food becomes scarce in any area where they live. To survive, cane toads have to keep moving into new areas with more food sources. The first toads to reach new territory get to eat all the food they want. Slower toads are stuck with whatever is left.

Recently, Australian scientists have been finding cane toads with bigger, more muscular legs. These bigger legs can be traced back to mutations that changed the toads’ genes. Scientists compared the big-legged toads to ordinary cane toads. They identified several gene mutations that gave the cells instructions to make protein molecules that were different from the protein molecules that other toads could make. These new protein molecules affected the cane toads’ legs, increasing the leg size and strength. Having bigger legs is an adaptive trait that helps cane toads survive in an environment where there isn’t much food to go around. Bigger, stronger legs help these toads outrun other cane toads and be the first ones to get to the food in new areas. With better chances of getting food, big-legged toads are more likely to survive and reproduce. Because of this, they are also more likely to
pass on their mutated genes to their offspring. Along with these mutated genes, they pass on their adaptive traits.

When humans introduced cane toads to Australia, the cane toads’ environment changed. With no predators hunting them in their new environment, there were more cane toads and therefore much less food was available. However, mutations led to a new trait in the population that turned out to be adaptive in the new environment. The mutated trait for bigger legs was adaptive for cane toads in an environment with scarce food because it helped them get more food and survive. Through the process of natural selection, big-legged cane toads are becoming more and more common in the cane toad population. These stronger, faster toads are spreading across Australia, invading new areas all the time.

**Red Lobster, Blue Lobster**

What color are lobsters? In pictures, they’re usually red. However, that’s only after they’ve been caught and cooked. When they’re alive and living in the ocean, lobsters are usually a greenish brown that blends into the ocean floor—except when a genetic mutation causes them to be bright blue! About one in every two million wild lobsters is blue in color. Why? A genetic mutation caused the lobster’s body to produce more of a certain protein molecule than
usual, which turned its shell blue instead of the normal green. This mutation introduced a new trait into the lobster bright blue shells.

Having a blue shell may sound like the kind of trait that might less likely to survive in its environment. After all, blue lobsters into their environment as well as greenish-brown ones do.

research shows that being blue doesn’t seem to make the blue more or less likely to survive in their environments. In the scientists studied blue lobsters: they mated a female blue male blue lobster, producing all blue offspring. They released into the wild and studied them to see whether they survived as lobsters with normal greenish-brown coloring. The scientists difference in the blue lobsters’ survival rates compared with lobsters. The genetic mutation that results in blue shells a neutral mutation—that is, the trait is not adaptive in the but it’s not non-adaptive either. Blue shells seem to have no survival and reproduction.

The trait for blue shells has not caused a big change in the population. The mutated trait still passes from one lobster to the next, just like the traits for greenish-brown shells. with blue shells are just as likely to survive as lobsters with greenish-brown shells, so lobsters with these two color traits are likely to have about the same number of offspring. That means that the mutated trait has become neither more common nor less common in the population.

Lobsters also come in other colors: occasionally, people catch lobsters that are yellow, orange, red, or white! All of those other colors are also caused by genetic mutations. These rare lobsters’ colors make them stand out in a crowd of living lobsters, but once cooked, colorful lobsters look just like their brownish-green relatives: like nearly all other lobsters, they turn bright red when boiled. (The only lobsters that don’t turn color when they’re cooked are extremely rare albino lobsters, which have no coloring at all.)

Be sure to talk with someone about your annotations!
These chromosomes are pieces of DNA that contain many genes. The gene labeled in red has a mutation that may lead to a new trait in the organism.

Predicting Changes in the Ostrilope Population

These two histograms show the initial distribution of fur traits in two populations from an earlier Sim activity. In both cases, the ostrilopes’ environment became much colder and the populations did not experience any mutations. Choose the statement for each histogram that best describes what happened to these populations.
1. This population survived and traits for more fur became more common. (circle one)

   Population A       Population B

2. This population died out because it did not have the fur traits needed to survive (circle one)

   Population A       Population B

You will see the resulting histogram when the environment of Population B becomes much colder. However, this time the ostrilope population will experience mutations that can cause new traits to appear in the population.

3. What do you think will happen to Population B when they can experience mutations and when their environment gets colder? Use what you know about adaptive traits, environments, and mutations to make a prediction.

   ________________________________________________________
   ________________________________________________________
   ________________________________________________________
   ________________________________________________________
   ________________________________________________________

Sim Predicting Changes in the Ostrilope Population

Goal: Use the Sim to test your prediction about what will happen to the ostrilope population with mutations when the environment gets colder. Since mutations occur randomly, be sure to perform multiple tests.

Do:
- Open the Natural Selection Simulation to the mode: Mutations Introduction.
- Change the temperature of the environment to cold (Level 1) by moving the Temperature slider.
- Turn ostrilope fur-trait mutations on by pressing the Ostrilope icon and then by pressing the Mutations toggle to on.
- Press RUN and observe the population for at least 70 generations.
- Press ANALYZE and compare starting and ending histograms.
4. Which fur trait was most common in the population at Generation 70? (circle one)

   1  2  3  4  5  6  7  8  9  10

5. Was that trait present in the starting ostrilope population? (check one)

   □ yes  □ no

6. This population died out when there were no mutations. How did having mutations allow the population to survive the environmental change?

   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

3.2 Mutations in a Population (Part 1)
1. What similarities do you notice in what happened to the population with mutations and to the population without mutations?

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

2. What differences do you notice in what happened to the population with mutations and to the population without mutations?

____________________________________________________________________________
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Re-Reading Movie Mutations

Re-Read about mutations seen in **Cane Toads** and in **Lobsters** then answer the questions below for both organisms.

<table>
<thead>
<tr>
<th>Cane Toad Invaders</th>
<th>Red Lobster, Blue Lobster</th>
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<tbody>
<tr>
<td>1. Did the cane toad population change?</td>
<td>4. Did the lobster population change?</td>
</tr>
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<td>__________________</td>
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<td>2. What was the cause?</td>
<td>5. What was the cause?</td>
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<tr>
<td>3. What was the effect?</td>
<td>6. What was the effect?</td>
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