Biology with TI-Nspire™ and TI-Nspire™ Navigator™ – Day 2

I can…	TI-Nspire™ Handheld (HH) Data Collection (DC) TI-Nspire™ Navigator™ (Nav)
Use the built-in Vernier DataQuest™ application.	Nav
Send a TI-Nspire™ document from a computer to a handheld.	Nav
Locate a TI-Nspire™ activity on education.ti.com.	Nav
Download and open a TI-Nspire™ document.	Nav
Transfer TI-Nspire™ documents from a computer to handhelds using the Transfer Tool.	Nav
Analyze data produced by a simulation.	Nav
Collect data using a probe.	Nav/HH/DC

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Getting Started with the TI-Nspire™ CX Navigator™ Teacher Software

TI PROFESSIONAL DEVELOPMENT

Activity Overview

In this activity, you will explore the basic features of the Documents Workspace in the TI-Nspire™ Navigator™ Teacher Software. You will add pages with Calculator and Graphs applications, and explore menus and submenus of each application as well as the five tabs within the Documents Toolbox.

Materials

- TI-Nspire™ CX or TI-Nspire™ CX CAS Navigator™ Teacher Software (v4.x) if using TI-Nspire™ CX handhelds
- TI-Nspire™ or TI-Nspire™ CAS Navigator Teacher Software (v3.9) if using TI-Nspire™ CX, TI-Nspire™ with Touchpad, or TI-Nspire™ with Clickpad

Step 1:

Open the TI-Nspire™ CX Navigator™ Teacher Software and click on the **Documents** tab. A new document may be opened by going to **File** and selecting **New TI-Nspire™ Document – Handheld Page Size** or **New TI-Nspire™ Document – Computer Page Size.**

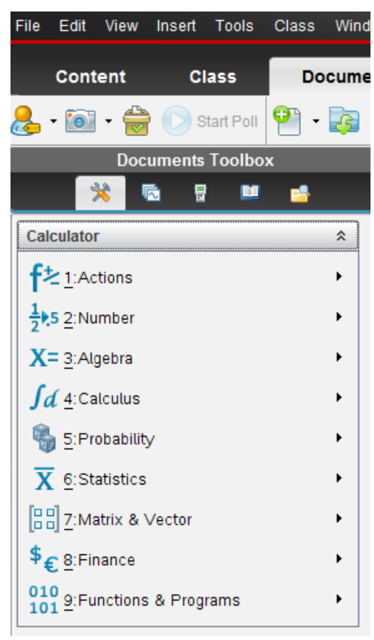
- The **Handheld Page Size** allows documents to be viewed on all platforms. The content will be scaled when viewed on a tablet or larger screen.
- In **Computer Page Size**, content will not be scaled when viewed on smaller platforms and all content may not be visible on a handheld device.

Step 2:

Go to **File > New TI-Nspire™ Document – Handheld Page Size.** Select **1:Add Calculator**.

Step 3:

The Calculator application allows you to enter and evaluate mathematical expressions as well as create functions and programs.



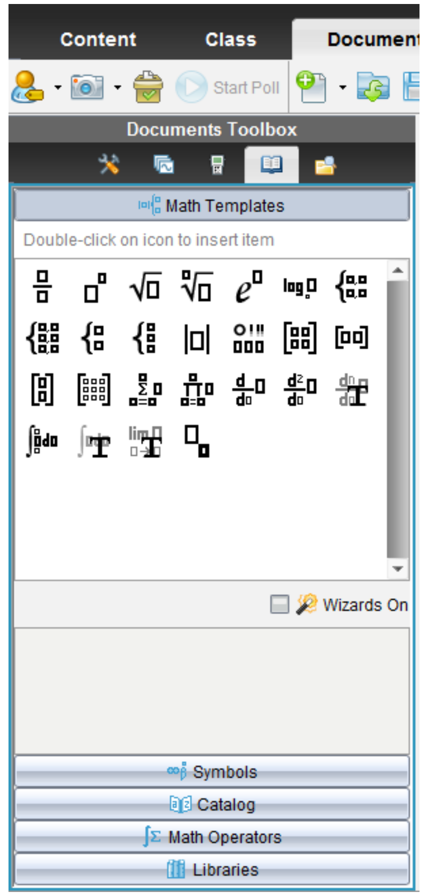
In most cases, each application has a unique menu of commands and tools. To view the Calculator menu, go to the Documents Toolbox and select the **Document Tools** tab. Each item in the Calculator menu has a submenu.

Explore the various menus and submenus by entering and evaluating your own expressions.

Note: To access the Calculator menu on the handheld, press menu.

Step 4:

The **Utilities** tab contains Math Templates, Symbols, Catalog, Math Operators, and Libraries panes. Only one pane is displayed at a time, and the Math Templates pane is the default pane. Explore each of the other panes by clicking them.

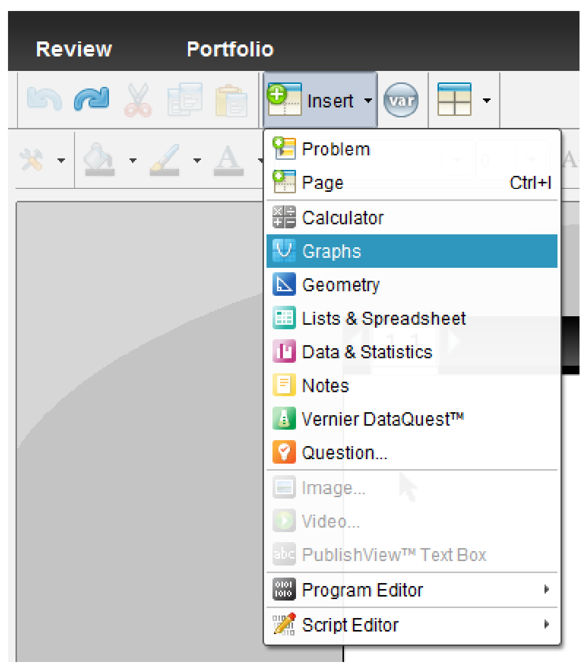


To insert a Math Template into the Calculator application, double-click it. Explore various Math Templates by evaluating your own expressions involving fractions, exponents, square roots, logarithms, and absolute value expressions.

Note: When evaluating expressions, the Calculator application displays rational expressions by default. To display a decimal approximation on a PC, press **CTRL + Enter**. To display a decimal approximation on a Mac, press **Command + Enter**.

Step 5:

The **Insert** menu allows you to insert problems and pages, along with each of the eight applications. A problem can contain multiple pages, and variables that are linked within a problem are linked across pages.



Insert a Graphs application by selecting **Insert > Graphs**.

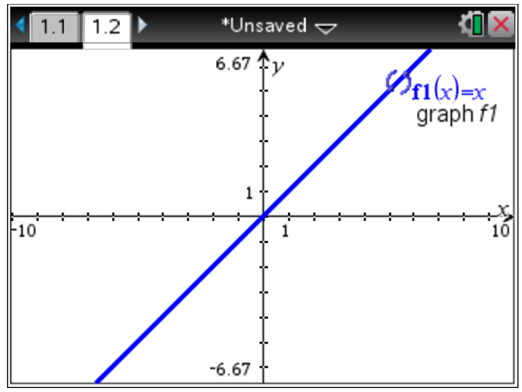
The Graphs application allows you to graph and analyze relations and functions. Explore the various menus and submenus available in the Graphs application.

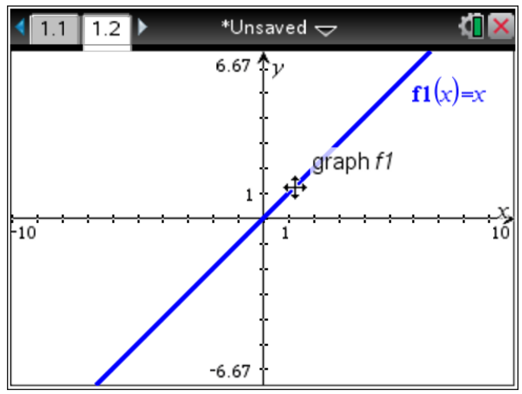
Step 6:

Graph the function *f*(*x*) = *x* by typing ***x*** into the function entry line and pressing **Enter**.

Rotate the line by hovering the cursor over the upper-right or lower-left corner of the graph. When the rotational cursor, , appears, rotate the line by clicking and dragging it.

Translate the line by hovering the cursor over the line near the y-intercept of the graph. When the translational cursor, , appears, translate the line up or down by clicking and dragging it.



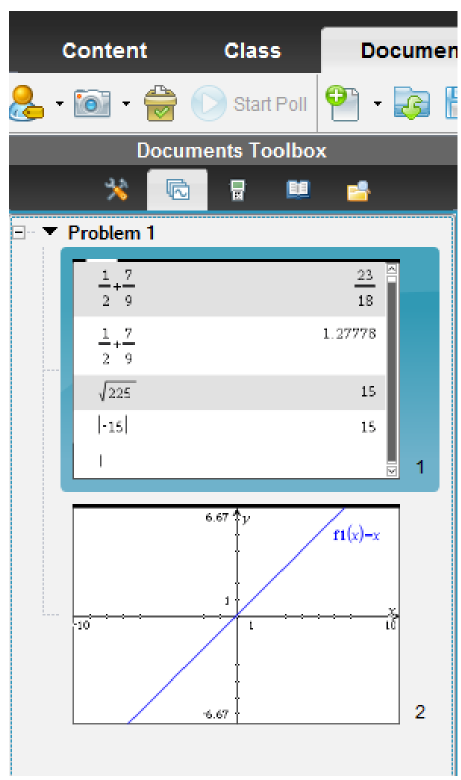


Step 7:

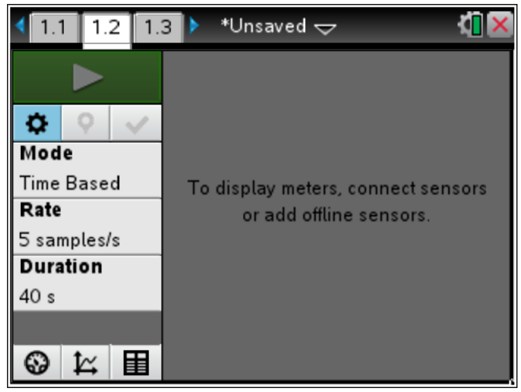
Since you have inserted a Calculator application and a Graphs application, your TI-Nspire™ document now has two pages. The Page Sorter view allows you to view thumbnail images of all pages in the current TI-Nspire™ document.

Access the Page Sorter by going to the Documents Toolbox and clicking the **Page Sorter** tab. Pages can be rearranged by grabbing and moving them. Right-clicking allows for pages to be cut, copied, and pasted.

Note: To access Page Sorter in the handheld, press ctrl ▲. To right-click in the handheld, press ctrl menu.



Step 8:



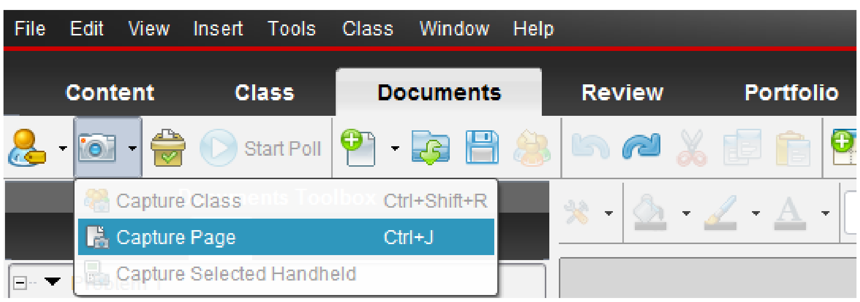
The Vernier DataQuest™ app can be used to collect, view, and analyze real-world data. Insert a page with the Vernier DataQuest app by selecting **Insert > Vernier DataQuest™**.

Though no data will be collected during this activity, the data meter will automatically launch when a Vernier sensor is connected to the computer's USB port.

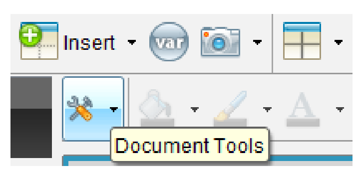
Step 9:

The Documents toolbar allows you to create, open, and save a TI-Nspire™ document. Commands such as Undo, Redo, Cut, Copy, and Paste are also available. Explore these options by hovering the cursor over each icon. Pages, problems, and applications can be inserted and variables can be stored.

Take a Screen Capture of the current page by selecting **Take Screen Capture > Capture Page**. This Screen Capture can be saved as an image.



Page layouts allow multiple applications to appear on one screen. Explore the various page layouts that are available by clicking **Page Layout**.



The **Document Tools** contains tools and commands for the current application. These are the same menu options as those in the **Document Tools** tab in the Documents Toolbox.

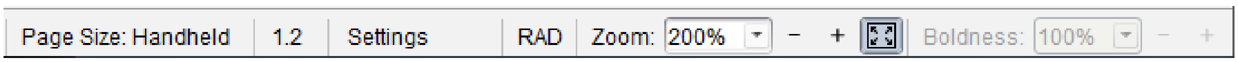
To change the fill color, line color, or text color, select an object and then select a color from the appropriate menu. To receive additional information about a given menu, hover the cursor over it. Not all color menus are available in all applications.

Getting Started with the TI-Nspire™ CX Navigator™ Teacher Software

TI PROFESSIONAL DEVELOPMENT

Step 10:

The Status Bar allows the user to access Document Properties, Settings, and to adjust the zoom of the SideScreen.

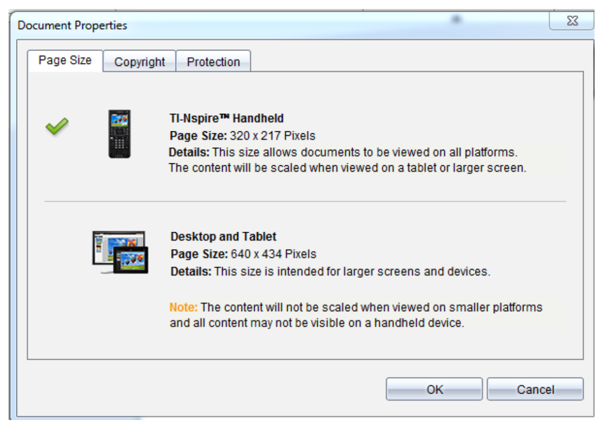


The Zoom to Fit feature automatically scales the document page to fit the available window size. Alternately, the zoom can be manually increased or decreased using the Zoom menu. The Boldness feature is enabled when using a PublishView™ document.

Note: The Zoom to Fit feature is only available in the TI-Nspire™ CX or TI-Nspire™ CX CAS Navigator Teacher Software (v4.x)

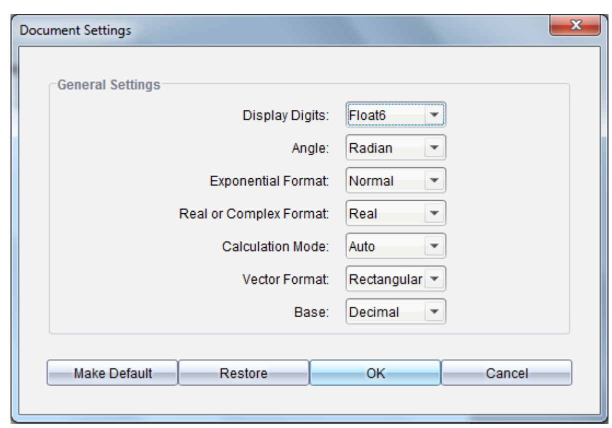
Step 11:

View the Document Properties by going to **File > Document Properties**. The Document Properties also can be viewed by going to the Status Bar and double-clicking **Page Size: Handheld** or **Page Size: Computer**. The page size displayed depends upon the type of TI-Nspire document originally opened.



Step 12:

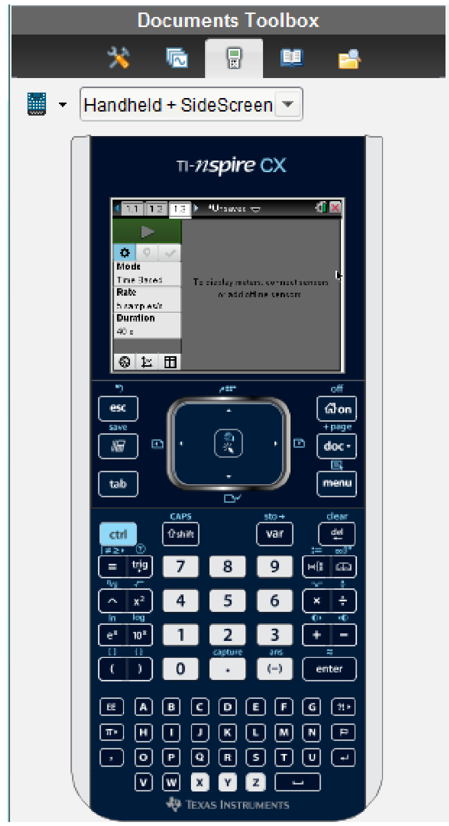
View the Document Settings by going to **File > Settings > Document Settings**. The Document Settings also can be viewed by double-clicking **Settings** in the Status Bar**.**



Note: To move across fields in the Document Settings window, press TAB. To change the setting in a given field, press the down arrow, select the desired setting, and press TAB to move to the next field. To exit the window, press ENTER.

Step 13:

Preview the document in Handheld or Computer view by clicking Document Preview .



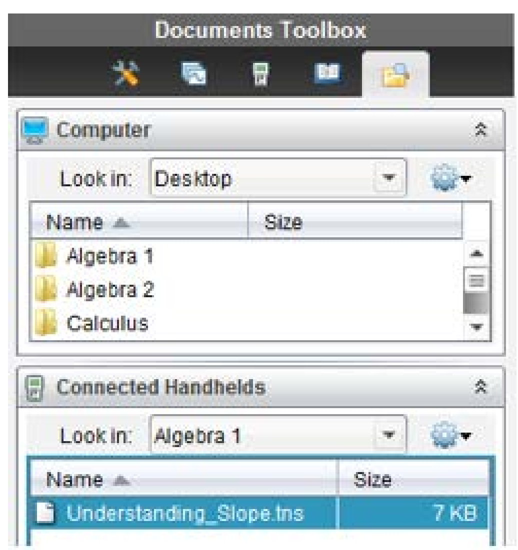
Step 14:

To access the TI-SmartView™ emulator for TI-Nspire, go to the Documents Toolbox and select the **TI-SmartView** tab.

TI-SmartView emulator has three available views: Handheld only, Keypad + SideScreen, and Handheld + Side Screen. Explore each of these views.

The keypad has three available views: Normal, High Contrast, and Outline. Click the **Keypad Options** menu and explore each keypad and view.

Note: If using the TI-Nspire™ or TI-Nspire™ CAS Navigator Teacher Software (v3.9), there are emulator keypads for TI-Nspire™ CX, TI-Nspire™ with Touchpad, and TI-Nspire™ with Clickpad.



Step 15:

Documents can be transferred between the computer and connected handhelds using the Content Explorer in the Documents Workspace. Explore the Content Explorer by clicking the **Content Explorer** tab.

To transfer a TI-Nspire™ document from the computer to the connected handheld, locate the document in the Computer panel. Click, drag, and drop it into the desired handheld or folder in the Connected Handhelds panel.

To transfer a TI-Nspire™ document from the connected handheld to the computer, locate the document in the Connected Handhelds panel. Click, drag, and drop it into the desired folder in the Computer panel.

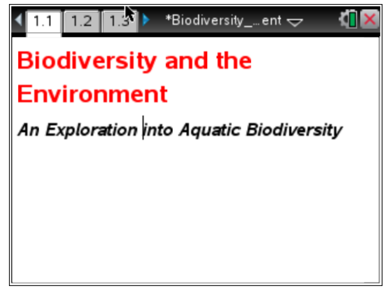
Biodiversity and the Environment
Student Activity

Name ________________

Class ________________

Open the TI-Nspire document *Biodiversity_and_the_Environment.tns.*

You may often hear of classrooms, schools, or towns having a certain amount of "diversity." Used in this way, "diversity" refers to variety within a single species: OURS!



Even though students in your classroom, school, or town might seem to be diverse on the surface, they are all human, just like you. Outside of your school's walls, there are many different species of organisms living with and among each other. The number of species and the abundance of individuals in populations are governed by the interactions between organisms and between organisms and their physical environment. Biodiversity—the variety of life forms in an ecosystem or biome—is a measure of the health of an ecosystem. Each ecosystem contains an assembly of species that are adapted to the range of conditions typically found in that environment. If conditions change dramatically, some species may not be able to survive, resulting in lower diversity. In this activity, you will examine some of the factors influencing the **biodiversity** of an ecosystem.

Move to page 1.2.

Press ctrl ▶ and ctrl ◀ to navigate through the lesson.

1. Read the background information.

<u>Background Information</u>

Organisms are impacted by the abiotic, or nonliving, factors in their environments. The actions of organisms can affect abiotic factors and other biotic factors. Abiotic factors are important drivers for biodiversity. As the variety of physical characteristics in an ecosystem increases, so does species diversity. This is because each species is adapted to tolerate a certain range of abiotic conditions.

On a global scale, there is an interesting relationship between biodiversity and temperature. Generally, species diversity increases from the poles to the equator. This is known as the *Latitudinal Diversity Gradient*. Scientists have not reached consensus on the primary mechanism for this global pattern, but the greater amount of solar energy and larger available area near the equator are thought to be important.

Move to pages 1.3 – 1.5. Answer questions 1-3 below and/or on your handheld.

Q1. Give two examples of abiotic factors in an environment.

Biodiversity and the Environment
Student Activity

Name _______________
Class _______________

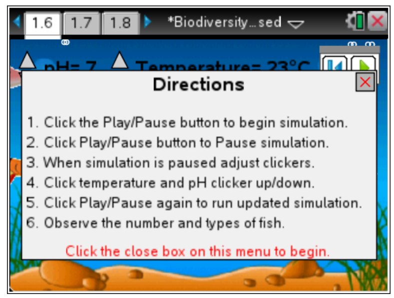
Q2. Which of the following ecosystems is likely to support the highest biodiversity?

A. Forest with three soil types and varied land features
B. Forest with one soil type and relatively flat land
C. Forest with three soil types, varied land features, and a small stream

Q3. Which of the following is an example of a biotic factor influencing another biotic factor?

A. Lower soil phosphorus concentrations decrease plant productivity.
B. Higher plant diversity increases animal diversity.
C. Concentrations of hippopotamuses in ponds increase water turbidity.
D. Accumulation of wood debris increases forest fire intensity.

Move to page 1.6.



2. On page 1.6, you will see a model of a lake ecosystem. Carefully read the directions that are covering the picture of the lake. When you understand what your task is, click ☒ and make the adjustments that the directions recommend. Pay close attention to what happens as the temperature and pH of the lake are changed. Press menu if you need to view the directions again.

Move to pages 1.7 – 1.8. Answer questions 4 and 5 below and/or on your handheld.

Q4. What are the variables that you can regulate in the simulation? (Select all that apply.)

A. pH
B. population density
C. plant diversity
D. temperature

Q5. Which of the following represent "biotic" factor(s) in the simulation? (Select all that apply.)

A. fish biomass
B. dissolved oxygen
C. plant diversity
D. water pH

Biodiversity and the Environment
Student Activity

Name _______________
Class _______________

Move to pages 1.9 – 1.10. Answer question 6 below and/or on your handheld.

3. Read the content information about pH on page 1.9.

Q6. A lake with a pH of 6.5 would be considered:

A. neutral

B. highly acidic

C. slightly acidic

D. slightly basic

Move to pages 1.11 – 1.12.

4. On page 1.11, you will read about the meaning of biodiversity. After reading the information on this page, move to page 1.12. On this page, you will be instructed to return to the simulation on page 1.6 and review what happens when the pH and temperature of the water are changed.

Move to pages 1.13 – 1.16. Answer questions 7-10 below and/or on your handheld.

Q7. How do temperature and pH affect each other?

A. As temperature goes up, pH goes up.

B. As temperature goes up, pH goes down.

C. As temperature goes down, pH goes up.

D. Temperature and pH do not affect each other.

Q8. In general, there is a greater diversity of fish when the water is warmer.

A. Agree

B. Disagree

Q9. As the water becomes more acidic, the diversity of fish decreases. Which is the best explanation?

A. The maximum sustainable number of individuals is reduced by acidic conditions.

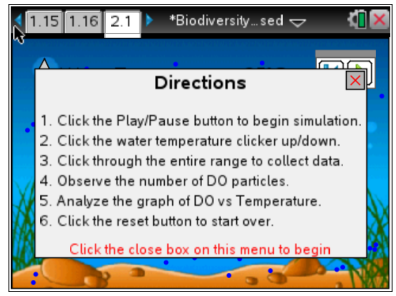
B. Only a small number of species are adapted to survive in acidic conditions.

C. Most fish prefer very basic conditions.

Acid rain from fossil fuel combustion can strongly impact the pH of aquatic ecosystems. In recent years, the U.S. has recorded acid rain with a pH as low as 4.3.

Q10. Go back to the simulation and set the temperature at 20^{o}C and the pH at 7. Note the population and species values. Now change the pH to 5 and keep the temperature at 20^{o}C. What do you observe?

Move to page 2.1 for the simulation on dissolved oxygen.



5. This next simulation deals with the relationship between water temperature and the levels of dissolved oxygen in the water. As in the first simulation, read the directions in the pop-up window. When you are ready to run the simulation, close the directions box by clicking ☒. You will then vary the water temperature and collect data on dissolved oxygen levels.

Move to pages 2.2 – 2.8. Answer questions 11-17 below and/or on your handheld.

Q11. What happened to the amount of dissolved oxygen as you increased the temperature of the water?

Q12. Which term do you think best describes the relationship between water temperature and dissolved oxygen levels?

A. Direct B. Inverse

Q13. Water has less capacity to hold dissolved oxygen as temperature increases, because gas molecules move faster and spread apart in warmer water.

A. Agree

B. Disagree

Q14. Which of the following factors do NOT contribute to higher dissolved oxygen levels?

A. photosynthesis

B. turbulence

C. decomposition of organic matter

D. low water temperature

Biodiversity and the Environment
Student Activity

Name ______________
Class ______________

Q15. Fish such as salmon and trout need a lot of oxygen to survive. Which water temperature do you think would be best for these fish?

A. 40°C

B. 30°C

C. 20°C

D. 10°C

Q16. Catfish have a lower oxygen requirement than many freshwater fish. In which aquatic habitat are they likely to be better adapted than other fish?

A. mountain stream

B. shallow tropical lake

C. deep temperate lake

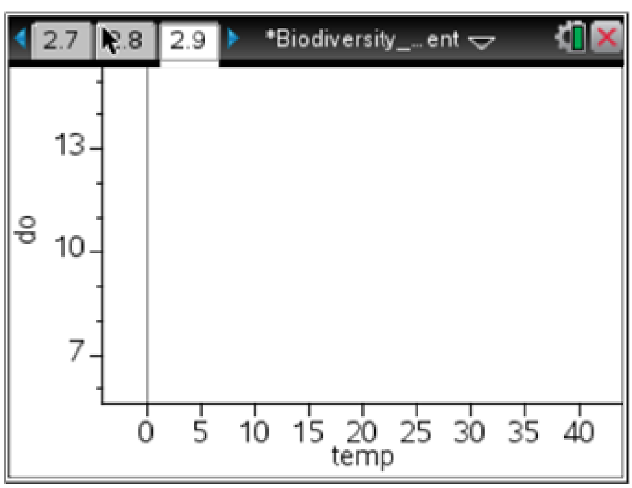
Q17. Oxygen is rarely a limiting abiotic factor in aquatic ecosystems.

A. Agree

B. Disagree

Move to page 2.9.

6. On page 2.9, there is a graph of the data that was collected automatically as you made changes to the water temperature in the simulation. Plot the data below as it appears in the graph on your handheld.



Move to pages 2.10 – 2.11. Answer questions 18 and 19 below and/or on your handheld.

Q18. Which words could be placed in the blanks below to make the statement true? (Select all that apply.)

As water temperature goes _____, the dissolved oxygen level goes _____.

A. up; up

B. up; down

C. down; up

D. down; down

Q19. Predict what would happen if the water continued to get warmer and warmer.

A. The dissolved oxygen levels would continue to drop and level off at 0 ppm.

B. The dissolved oxygen levels would level off near 6 ppm.

C. The dissolved oxygen levels would continue to drop and eventually become negative.

Move to page 2.12.

7. The final page of the activity shows you the actual data that was collected as you made changes to the temperature of the water in the dissolved oxygen simulation.

Biodiversity and the Environment

SCIENCE NSPIRED

Science Objectives

- Students will simulate adjusting the pH of a lake and draw conclusions about the relationship between pH and biodiversity.
- Students will learn the difference between biotic and abiotic factors and how abiotic factors affect biotic factors.
- Students will simulate adjusting the temperature of a lake and draw conclusions about the relationship between water temperature and dissolved oxygen levels in the lake.

Vocabulary

- pH
- biotic
- acid
- base
- abiotic
- biodiversity
- dissolved oxygen

About the Lesson

In this activity, students will observe model environments, adjust abiotic variables in those environments, observe the results of those adjustments, and then draw conclusions about the effects of the abiotic world on the biotic world.

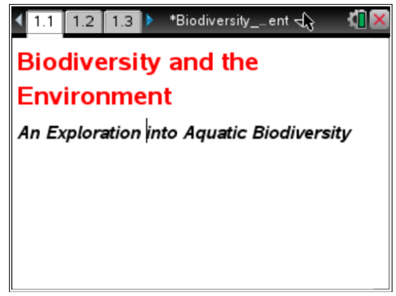
- As a result, students will:
  - Learn the fundamental meaning of "biotic" and "abiotic" factors, and how each impacts the other to determine biodiversity.
  - Form a basic understanding of pH and how it affects biodiversity of an aquatic ecosystem.
  - Develop an understanding of the relationship between water temperature and dissolved oxygen levels.

TI-Nspire™ Navigator™

- Send out the .tns file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to have students demonstrate how to negotiate the simulations and to spotlight student answers.
- Collect student responses from assessment items that are embedded throughout the document.

Activity Materials

- *Biodiversity_and_the_Environment.tns* document
- TI-Nspire™ Technology



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Manipulate sliders to adjust variables
- Answer assessment questions within a document

Tech Tips:

Make sure that students know how to move between pages by pressing ctrl ◀ (left arrow) and ctrl ▶ (right arrow).

Lesson Materials:

Student Activity

- Biodiversity_and_the_Environment_Student.doc
- Biodiversity_and_the_Environment _Student.pdf

TI-Nspire document

- Biodiversity_and_the_Environment.tns

Discussion Points and Possible Answers

Move to page 1.2.

1. After opening the document, students should read the background information on page 1.2.

Move to pages 1.3 – 1.5.

Have students answer questions 1–3 on either the handheld, on the activity sheet, or both.
These three questions assess the students' background knowledge of biotic factors, abiotic factors and biodiversity. It is recommended that these questions be used for discussion purposes after the students answer them.

Q1. Give two examples of abiotic factors in an environment.

Suggested Answers: water, air, climate, rain, snow, rocks, oxygen, carbon dioxide, etc.

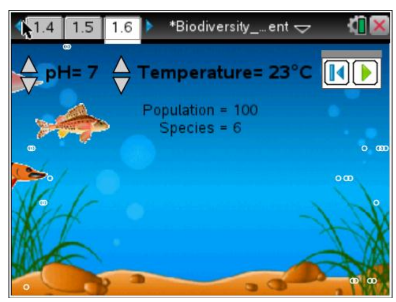
Q2. Which of the following ecosystems is likely to support the highest biodiversity?

Answer: C. Forest with three soil types, varied land features, and a small stream (This ecosystem has the greatest diversity of physical characteristics so it is likely to harbor more species uniquely adapted to each environmental condition).

Q3. Which of the following is an example of a biotic factor influencing another biotic factor?

Answer: B. Higher plant diversity increases animal diversity. (Plant diversity is a biotic factor that influences animal diversity-- another biotic factor. Hippopotamuses and wood debris are also biotic factors, but they are influencing abiotic factors in those examples.)

Move to page 1.6.



2. On page 1.6 are some instructions for the student about the simulation of the aquatic ecosystem. After reading the directions on the page that overlays the lake, the students should close the instruction window by clicking ☒. If needed at any time during the simulation, students can press menu if they would like to view the directions again.
In order to see the impact of changing pH and temperature on the biodiversity of the lake, students should only adjust ONE variable at a time. For example, guide the students to work through the entire range of the pH scale, making observations of the effects of changing the pH. Then, the pH should be reset to 7 and the temperature should be changed. Remind students that if both variables are changed at the same time, it's difficult to determine which is impacting the ecosystem.

Move to pages 1.7 – 1.8.

Have students answer questions 4 and 5 on the handheld, the activity sheet, or both.

Q4. What are the variables that you can regulate in the simulation? (Select all that apply.)

Answers: A. pH and D. Temperature

Q5. Which of the following represent "biotic" factor(s) in the simulation? (Select all that apply.)

Answers: A. fish biomass and C. plant diversity

Move to pages 1.9 – 1.10.

Have students answer question 6 on the handheld, the activity sheet, or both.

3. Have students read the content information about pH on page 1.9. The concept of pH may be new to students, so it is recommended that the teacher take some time to discuss it.

Q6. A lake with a pH of 6.5 would be considered:

Suggested Answer: C. slightly acidic

Move to pages 1.11 – 1.12.

4. On page 1.11, the students will read about the meaning of biodiversity. After reading the information on this page, they should move to page 1.12. On this page, they will be instructed to return to the simulation on page 1.6 and review what happens when the pH and temperature of the water are changed.

Move to page 1.13 – 1.16.

Have students answer questions 7–11 on the handheld, the activity sheet, or both.

Q7. How do temperature and pH affect each other?

Answer: D. Temperature and pH do not affect each other.

Q8. In general, there is a greater diversity of fish when the water is warmer.

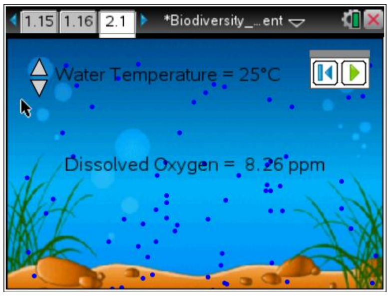
Answer: B. Disagree

Q9. As the water becomes more acidic, the diversity of fish decreases. Which is the best explanation?

Answer: B. Only a small number of species are adapted to survive in acidic conditions.

Q10. Go back to the simulation and set the temperature at 20°C and the pH at 7. Note the population and species values. Now change the pH to 5 and keep the temperature at 20°C. What do you observe?

Suggested Answer: The number of species and the number of fish has declined.



Move to page 2.1 for the simulation on dissolved oxygen.

5. After finishing the first simulation and all of the questions, the students should move to the second simulation, which deals with the relationship between water temperature and the levels of dissolved oxygen in the water. The process for the students will be the same as in the first simulation.

Move to pages 2.2 – 2.8.

Have students answer questions 11–17 on the handheld, the activity sheet, or both.

Q11. What happened to the amount of dissolved oxygen as you increased the temperature of the water?

Answer: The amount of dissolved oxygen decreased when water temperature was increased.

Q12. Which term do you think best describes the relationship between water temperature and dissolved oxygen levels?

Answer: B. Inverse

Q13. Water has less capacity to hold dissolved oxygen as temperature increases, because gas molecules move faster and spread apart in warmer water.

Answer: A. Agree

Q14. Which of the following factors do NOT contribute to higher dissolved oxygen levels?

Answer: D. Low water temperature

Q15. Fish such as salmon and trout need a lot of oxygen to survive. Which water temperature do you think would be best for these fish?

Answer: D. 10°C

Q16. Catfish have a lower oxygen requirement than many freshwater fish. In which aquatic habitat are they likely to be better adapted than other fish?

Answer: C. shallow tropical lake (this aquatic environment is expected to experience highest temperatures and will not have deeper, cooler water for refuge)

Q17. Oxygen is rarely a limiting abiotic factor in aquatic ecosystems.

Answer: B. Disagree. (Diurnal and seasonal changes in dissolved oxygen often create hypoxic conditions, which severely affects the physiology and overall productivity of many aquatic organisms)

Move to page 2.9.

6. On page 2.9, there is a graph of the data that was collected automatically as the students made changes to the water temperature in the simulation. Spend some time with the students analyzing the graph.

Move to pages 2.10 – 2.11.

Have students answer questions 18 and 19 on the handheld, the activity sheet, or both.

Q18. Which words could be placed in the blanks below to make the statement true? (Select all that apply.)

As water temperature goes _____, the dissolved oxygen level goes _____.

Answers: B. up; down and C. down; up

Q19. Predict what would happen if the water continued to get warmer and warmer.

A. **Answer:** A. The dissolved oxygen levels would continue to drop and level off at 0 ppm.

Move to page 2.12.

7. The final page of the activity shows the student the actual data that was collected as they made changes to the temperature of the water in the dissolved oxygen simulation.

TI-Nspire Navigator Opportunities

Make a student a Live Presenter to demonstrate how to negotiate the cell diagrams. The questions in the activity may be distributed as Quick Polls or used as a formative or summative assessment

Wrap Up

When students are finished with the activity, retrieve the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.

Extension

If a Vernier Dissolved Oxygen Sensor is available, you could experimentally determine that cold water is able to hold more dissolved oxygen than warm water. Half-fill a bottle with warm water and shake it for a few seconds, then test the dissolved oxygen level. Next, do the same with cold water

.

Like Moths Around a Flame

Student Activity

Name ________________

Class ________________

Open the TI-Nspire document *Like_Moths_Around_a_Flame.tns.*

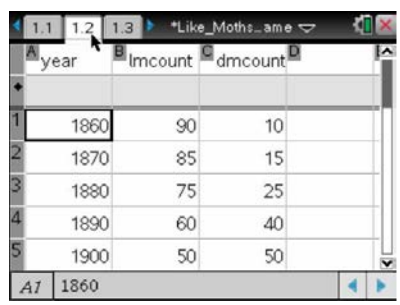
Imagine that you have a piece of red construction paper on your desk in front of you. If you wrote your name on the construction paper with a red marker and then wrote your name on the same paper with a black marker, which would be easier to read? If you showed the paper to one of your friends across the room, which do you think they would see? A similar scenario happens all the time in nature. Blending into the environment (camouflage) can help an animal avoid being seen, which may help it avoid being eaten by a predator.

In England, there is a species of insect called the peppered moth that provides us with a great example of camouflage, and this helps us understand the process of natural selection. Some of these moths are dark-colored, and some are light-colored. The color of each moth is determined by its genes for color, so a moth that is born dark stays dark, and a moth that is born light stays light.

The peppered moth is most active during the nighttime hours (nocturnal) and it spends its days resting on things like tree trunks. From the mid-1800s until the mid-1900s, people observed that the number of moths of each color changed. Why did these changes occur? In this activity you will examine data about moths, graph the data, and draw some conclusions.

Move to page 1.2.

1. Examine the data in the spreadsheet, which shows the number of moths of each color by decade. In 1860, for example, if a sample of 100 moths were counted, 90 of them would have been light (lmcount) and 10 of them would have been dark (dmcount). In this activity, you can assume that the counts for the sample accurately reflect the proportions in the entire population.



	A year	B lmcount	C dmcount	D
1	1860	90	10	
2	1870	85	15	
3	1880	75	25	
4	1890	60	40	
5	1900	50	50	

Move to pages 1.3 and 1.4. Answer the following questions here or in the .tns file.

Q1. Which of the following is an **independent** variable in this activity? (More than one response may be correct.)

A. the number of dark-colored moths
B. the number of light-colored moths
C. the year

Q2. Which of the following is a **dependent** variable in this activity? (More than one response may be correct.)

A. the number of dark-colored moths
B. the number of light-colored moths
C. the year

Like Moths Around a Flame

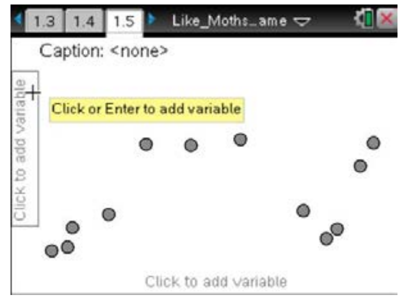
Student Activity

Name ______________

Class ______________

Move to page 1.5.

2. Select the *x*-axis to choose an independent variable(s) for the *x*-axis. Choose a dependent variable(s) for the *y*-axis. To add a second variable to the *y*-axis, select **Menu > Plot Properties > Add Y Variable**. Examine the graph and look for trends in the data.



Tech Tip: To add a second variable to the *y*-axis, select **> Plot Properties > Add Y Variable**. You may need to back-out to the main Tools Menu to see the desired menu option.

Move to page 1.6. Answer question 3 here or in the .tns file. Answer questions 4–11 here.

Q3. Describe the trend(s) you see in the numbers of light-colored moths as the decades passed. Also, describe the trend(s) you see in the numbers of dark-colored moths.

Q4. From 1950 to 1970, what was the change in the number of light-colored moths? During this time, what was the change in the number of light-colored moths per year? per decade?

Q5. From 1950 to 1970, what was the change in the number of dark-colored moths? During this time, what was the change in the number of dark-colored moths per year? per decade?

Q6. Using your answers for questions 4 and 5, predict when (after 1970) you would expect the number of each type of moth to be the same. Explain your prediction.

Like Moths Around a Flame

Student Activity

Name ______________

Class ______________

Q7. During the middle 1800s, England began what was called the Industrial Revolution. Industry increased rapidly, and with that increase came a much greater need for energy. Since nuclear power plants were still decades away, what was the source of energy that England used to power their huge increase in industry? What was the environmental impact of using this type of fuel? How do you think this impact influenced the numbers of light- and dark-colored moths?

Q8. During the middle 1900s, environmentalists really started voicing their concerns about the harmful effects that industry was having on the environment. England and other countries started paying closer attention to cleaning up the environment by reducing emissions from industrial factories. These concerns helped to promote policies like the Clean Air Act in many countries. As these policies became implemented, new forms of energy started being used, and industry was required to reduce emissions from their existing factories. What was the environmental impact of the Clean Air Act? How do you think this impact influenced the numbers of light- and dark-colored moths?

Q9. Explain how your answers to questions 7 and 8 could be used to explain the effects of natural selection on the population of peppered moths in England.

Q10. What do you think would happen to the environment and to the moth population if factories went back to using older energy sources for their power, and the Clean Air Acts were eliminated? Explain your response.

Q11. Brainstorm and then describe another example of natural selection in animals, and one in plants.

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Like Moths Around a Flame

SCIENCE NSPIRED

TEACHER NOTES

Science Objectives

- Students will determine how humans can influence natural selection by manipulating the environment.
- Students will relate two sets of data, and analyze the patterns in long-term data.
- Students will develop an understanding of the effect of the environment on natural selection.

Vocabulary

- camouflage
- dependent variable
- environmental impact
- independent variable
- natural selection
- nocturnal

About the Lesson

- In this lesson, students examine some data about moths.
- As a result, students will:
    - Understand that the environment has an effect on natural selection.
    - Graph data and compare two sets of data.
    - Find patterns in long-term data and draw conclusions.

TI-Nspire™ Navigator™

- Send out the *Like_Moths_Around_a_Flame.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Like_Moths_Around_a_Flame_Student.doc
- Like_Moths_Around_a_Flame_Student.pdf

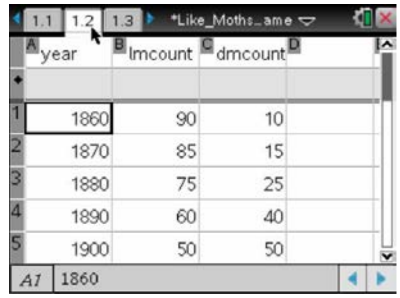
TI-Nspire document

- Like_Moths_Around_a_Flame.tns

Discussion Points and Possible Answers

Move to page 1.2.

1. Students examine the data in the spreadsheet, which shows a comparison of the number of moths of each color by decade. In 1860, for example, if 100 moths were counted, 90 of them would have been light, and 10 of them would have been dark. In this activity, students are told to assume that the counts for the sample accurately reflect the proportions in the entire population.



	A year	B lmcount	C dmcount
1	1860	90	10
2	1870	85	15
3	1880	75	25
4	1890	60	40
5	1900	50	50

Teaching Tip: In this activity, there are two sets of data that have the same independent variable. Make sure students realize that both dependent variables share the same independent variable.

Move to pages 1.3 and 1.4

Have students answer questions on either the device, on the activity sheet, or both.

Q1. Which of the following is an independent variable in this activity? (More than one response may be correct.)

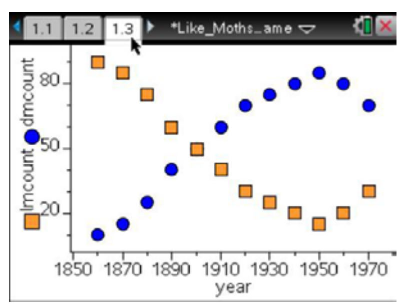
Answer: C. the year

Q2. Which of the following is a dependent variable in this activity? (More than one response may be correct.)

Answer: A. the number of dark-colored moths and B. the number of light-colored moths

Move to page 1.5.

2. Students construct a graph by choosing variables for each axis. To add a second *y*-axis variable, they will select **Menu > Plot Properties > Add Y Variable**. Their graphs should look like the graph at the right. Students then look for trends in the data.



Tech Tip: To add a second variable to the y-axis, students should select **> Plot Properties > Add Y Variable**. Students may need to back-out to the main Tools Menu to see the desired menu option.

Move to page 1.6.

Have students answer question 3 in the .tns file, on the activity sheet, or both, and questions 4–11 on the activity sheet.

Q3. Describe the trend(s) you see in the numbers of light-colored moths as the decades passed. Also describe the trend(s) you see in the numbers of dark-colored moths.

Answer: The light-colored moth population decreases until 1950, and then starts to increase. The dark-colored moth population increases until 1950, and then starts to decrease.

Q4. From 1950 to 1970, what was the change in the number of light-colored moths? During this time, what was the change in the number of light-colored moths per year? per decade?

Answer: The count of light-colored moths increased by 15. This was an increase of .75 light-colored moths per year and an increase of 7.5 light-colored moths per decade.

Q5. From 1950 to 1970, what was the change in the number of dark-colored moths? During this time, what was the change in the number of dark-colored moths per year? per decade?

Answer: The count of dark-colored moths decreased by 15. This was a decrease of .75 dark-colored moths per year, and a decrease of 7.5 dark-colored moths per decade.

Q6. Using your answers for questions 4 and 5, predict when (after 1970) you would expect the number of each type of moth to be the same. Explain your prediction.

Answer: I expect the counts of each type of moth to be equal in the 1990s. Explanations will vary.

Q7. During the middle 1800s, England began what was called the Industrial Revolution. Industry increased rapidly, and with that increase, came a much greater need for energy. Since nuclear power plants were still decades away, what source of energy did England use to power their huge increase in industry? What was the environmental impact of using this type of fuel? How do you think this impact influenced the numbers of light- and dark-colored moths?

Answer: The source of energy that England used to power their huge increase in industry was coal. The environmental impact of using this type of fuel was that there was more soot in the air, falling onto the trees and discoloring the light-colored bark. The impact on moths: Dark-colored moths would increase, and light-colored moths would decrease.

Q8. During the middle 1900s, environmentalists really started voicing their concerns about the harmful effects that industry was having on the environment. England and other countries started paying closer attention to cleaning up the environment by reducing emissions from industrial factories. These concerns helped to promote policies like the Clean Air Act in many countries. As these policies became implemented, new forms of energy started being used, and industry was required to reduce emissions from their existing factories. What was the environmental impact of the Clean Air Act? How do you think this impact influenced the numbers of light- and dark-colored moths?

Answer: The environmental impact of the Clean Air Act was that there was less soot in the air, so less fallout onto the trees. The impact on moths: Light-colored moths would increase, and dark-colored moths would decrease.

Q9. Explain how your answers to questions 7 and 8 could be used to explain the effects of natural selection on the population of peppered moths in England.

Answer: Depending on the color of the tree bark, either the light- or dark-colored moths would be selected *for* or selected *against*. Those selected *for* would be more likely to reproduce, while those selected *against* would not.

Q10. What do you think would happen to the environment and to the moth population if factories went back to using older energy sources for their power, and the Clean Air Acts were eliminated? Explain your response. (Point students back to the answer from question 7 if they need help identifying "older energy sources".)

Answer: It is likely that the population of the dark-colored moths would increase because of the darker colored bark. Dark moths would be selected *for*.

Q11. Brainstorm and then describe another example of natural selection in animals, and one in plants

Answer: Answers will vary.

TI-Nspire Navigator Opportunities

Use TI-Nspire Navigator to capture screen shots of student progress and to retrieve the file from each student at the end of the class period. The student questions can be electronically graded and added to the student portfolio.

Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show. Make sure the concept of balancing torques is firm in their understanding and not balancing forces.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.

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Arctic Wars—Lynx vs. Snowshoe Hare
Student Activity

Name ________________

Class ________________

Open the TI-Nspire document *Arctic_Wars_Lynx_vs_Snowshoe_Hare.tns.*

In this activity, you will investigate how different variables affect the dynamics of the lynx and snowshoe hare populations.

One of the most studied predator/prey relationships in nature is the lynx and snowshoe hare cycle. The lynx is a large cat about a meter in length, with an adult mass of 10–15 kg.

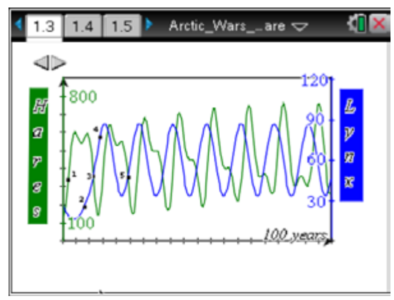
Lynx live a solitary life, which averages 10–15 years. Female lynx give birth to 2–3 kittens in the spring of each year, and the kittens remain with their mother for several months. The snowshoe hare is its favorite prey.

Snowshoe hares, which are very closely related to rabbits, reach lengths of about half a meter and a mass of 1–2 kg. During their 2–4 year lifespan, hares have 2 to 3 litters per year with 3–4 young in each litter. They have several arctic predators, including the lynx.

Move to pages 1.2–1.4. Answer Questions 1 and 2 here or in the .tns file. Answer Questions 3 and 4 here.

Press ctrl ▶ and ctrl ◀ to navigate through the lesson.

1. Analyze the graph on page 1.3.



Q1. What is happening at Point 1 on the graph?

A. The predator population is rapidly increasing.

B. The prey population is rapidly increasing.

C. Both populations are rapidly increasing.

Q2. What is happening at Point 2 on the graph?

A. The prey population is rapidly decreasing.

B. The predator population is gradually increasing.

C. The prey population is staying the same.

Q3. Describe what is happening at Point 3 on the graph.

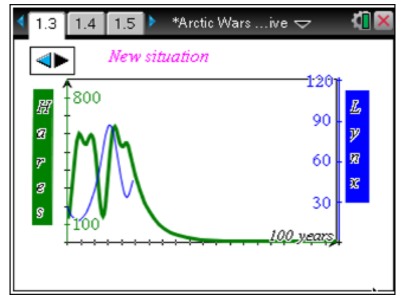
Q4. Analyze the rest of the graph. What overall pattern does the graph indicate?

Move to page 1.5. Answer Question 5 here or in the .tns file. Answer Questions 6–8 here.

Arctic Wars—Lynx vs. Snowshoe Hare
Student Activity

Name ______________
Class ______________

2. Return to page 1.3 and click the ▶ icon in the top left of the screen. Analyze the graph for the new situation.

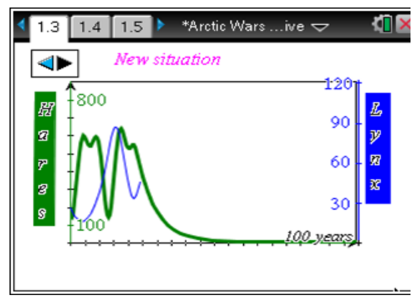


Q5. What could have caused the hare population to behave as it did in the new situation?

A. abundance of food for the hares
B. disease that affected the hares
C. excessive predation by the lynx
D. excessive hunting of the lynx

Q6. For each of the answer choices that you did not select in Question 5, explain why it is incorrect.

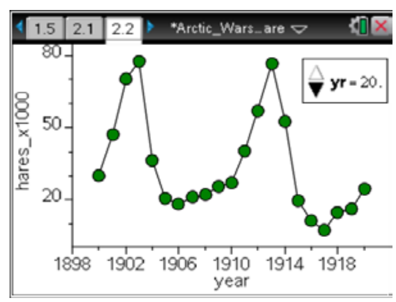
Q7. On the graph, draw a line that shows the predicted population of the lynx.



Q8. Explain your rationale for the predator graph you drew in Question 7.

Move to pages 2.1 and 2.2. Answer Question 9 here or in the .tns file.

Q9. Follow the directions on page 2.1 and draw the lynx graph below.



Move to page 2.3. Answer Question 10 on the activity sheet.

3. On page 2.2, add the lynx data by pressing **Menu > Plot Properties > Add Y Variable**.

Q10. How did your prediction match the actual data? Explain.

Arctic Wars—Lynx vs. Snowshoe Hare

SCIENCE NSPIRED

TEACHER NOTES

Science Objectives

- Students will analyze a predator prey graph that represents the population cycling of the lynx and the snowshoe hare.
- Students will hypothesize what is actually occurring at different points of the predator prey graph.
- Students will predict future trends that will occur in a predator prey population.

Vocabulary

- population cycling
- predator
- prey

About the Lesson

- This lesson *Arctic_Wars_Lynx_vs_Snowshoe_Hare.tns* involves investigating population cycling patterns that exist between a predator and its prey.
- As a result, students will:
  - Interact with a given situation to make predictions in an unknown situation.
  - Draw conclusions from graphs.
  - Predict future trends that will occur in a predator prey population.

TI-Nspire™ Navigator™

- Send out the *Arctic_Wars_Lynx_vs_Snowshoe_Hare.tns* file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- *Arctic_Wars_Lynx_vs_Snowshoe_Hare.tns* document
- TI-Nspire™ Technology

TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages

Tech Tips:

Make sure students understand how to select an answer to a question using enter

Lesson Materials:

Student Activity

- Arctic_Wars_Lynx_vs_Snowshoe_Hare_Student.doc
- Arctic_Wars_Lynx_vs_Snowshoe_Hare_Student.pdf

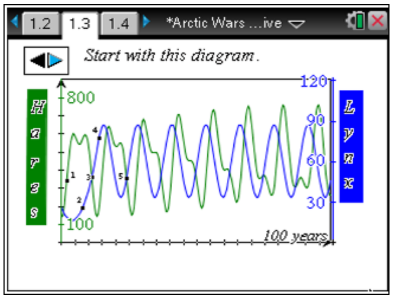
TI-Nspire document

- Actic_Wars_Lynx_vs_Snowshoe_Hare.tns

Discussion Points and Possible Answers

Move to page 1.3.

1. Have students answer Questions 1 and 2 on either the handheld, on the activity sheet, or both. Answer Questions 3 and 4 on the activity sheet.



Q1. What is happening at Point 1 on the graph?

<u>Answer</u>: B. The prey population is rapidly increasing.

TI-Nspire Navigator Opportunities
It may be helpful to display the graph for the class to see the individual points being discussed.

Q2. What is happening at Point 2 on the graph?

<u>Answer</u>: B. The predator population is gradually increasing.

Q3. Describe what is happening at Point 3 on the graph.

<u>Possible Answer</u>: The predator population is increasing because of the availability of prey (food). The prey population is decreasing because of the increased predation by the predator population.

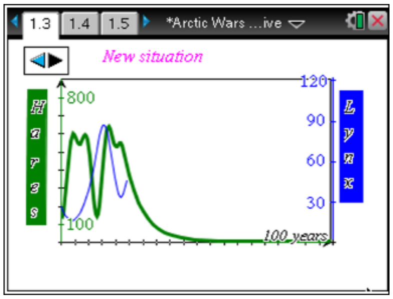
Q4. Analyze the rest of the graph. What overall pattern does the graph indicate?

<u>Possible Answer</u>: There is a repeating pattern. Whenever the prey population peaks, the predator population increases and peaks. There is a lag between the time when the prey population peaks and the predator population peaks. The two graphs are not mirror images of each other. The same pattern occurs when the prey population decreases.

Move to page 1.5.

Have students answer Question 5 on either the handheld, on the activity sheet, or both. Have students answer questions 6–8 on the activity sheet.

2. Students will return to page 1.3, choose a new situation, and analyze the graph.



Tech Tip: Students just click the ▶ or ◀ to move between situations.

Q5. What could have caused the hare population to behave as it did in the new situation?

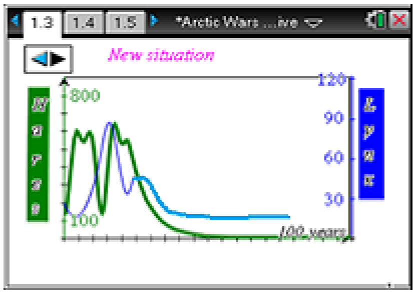
Answer: B. disease that affected the hares

Q6. For each of the answer choices that you did not select in Question 5, explain why it is incorrect.

Sample Answer: Both choices A and D would result in an increase in the hare population. Choice C would result in a decline, but not to zero.

Q7. On the graph below, draw a line that shows the predicted population of the lynx.

Sample Answer:



Q8. Explain your rationale for the predator graph you drew in Question 7.

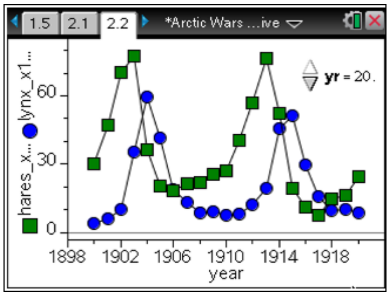
Sample Answer: Since there are other prey besides the snowshoe hare, the predator population will not decrease to zero. It will decrease sooner and to a lower point than in the previous situation. Your students might also hypothesize that another rabbit population will move in. They might also say that, because of increased habitat space, other prey populations will increase. Each scenario would depend upon the time of the year the disease outbreak occurred. Accept any answer that correctly explains the graph.

Move to pages 2.1 and 2.2.

Have students answer the question on either the handheld, on the activity sheet, or both.

Q9. Follow the directions on page 2.1 and draw the lynx graph below.

Sample Answer: Sample graph shown.



Move to page 2.3.

Have students answer Question 10 on the activity sheet.

3. Students return to page 2.2 and add the lynx data by pressing **Menu > Plot Properties > Add Y Variable**.

Q10. How did your prediction match the actual data? Explain.

Answer: Answers will vary.

TI-Nspire Navigator Opportunities

Send out actual data from a predator prey relationship for your students to graph. Capture the graphs for class analysis. Have your students change the data and watch the changes that occur on the graph.

Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Discuss with your students the variety dynamics at work in a population. Have your students form hypotheses that include additional factors that were not included in this activity. Also discuss other predator prey relationships besides the lynx and the snowshoe hare

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.

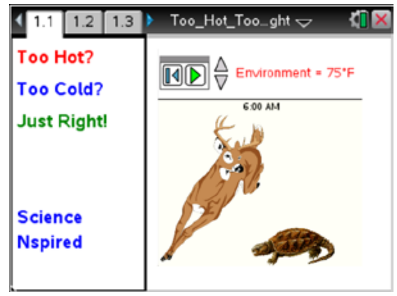
Too Hot? Too Cold? Just Right!

Student Activity

Name ______________

Class ______________

Open the TI-Nspire document *Too_Hot_Too_Cold_Just_Right.tns.*



Have you ever been in a REALLY cold environment? The coldest temperature ever recorded on Earth was –129ºF in Antarctica! How about REALLY hot places? The hottest recorded temperature on Earth was 136ºF in Libya, Africa! Both of these extremes are pretty hard to imagine, and both would be virtually impossible to live in. Thankfully, temperatures in most places are much more reasonable than that. However, people and other animals manage to live in places that we consider really cold and really hot. How do they do it? Can ALL animals live anywhere they want? Or do some have an easier time handling extreme temperatures? In this activity, you will observe the metabolic rates of two different animals in various environmental temperatures. One of these animals is an endotherm ("warm-blooded") and the other is an ectotherm ("cold-blooded").

Move to pages 1.2 and 1.3. Answer the following questions here.

On page 1.2, there are some general instructions on how to run the simulation with the deer and the turtle.

Each plot shows the environmental temperature along with the body temperatures of the animal.

1. First, run the simulation at 75ºF by selecting the Play button. The entire simulation runs for about a minute and models temperatures for two days. When the simulation is complete sketch the graphs as instructed below.

Q1. To the right, draw a sketch of the graphs that were produced when the environmental temperature was 75ºF.

Plots at 75ºF

Too Hot? Too Cold? Just Right!

Student Activity

Name ______________

Class ______________

2. Now reset the simulation by selecting . Use the down arrow to lower the environmental temperature and run the simulation again. Then raise the environmental temperature above 75°F and run the simulation again.

Q2. Draw a sketch of the graphs that were produced when the environmental temperature was ***lower*** than 75ºF.

Plots at _____ºF

Q3. Draw a sketch of the graphs that were produced when the environmental temperature was ***higher*** than 75ºF.

Plots at _____ºF

Move to pages 2.1 – 2.3. Answer questions 4 – 6 here or in the .tns file.
Answer questions 7 – 14 here.

Q4. Which animal's temperature fluctuated with the environmental temperature?

A. turtle
B. deer
C. both
D. neither

Q5. Which animal's temperature remained pretty constant, even when the environmental temperature changed?

A. turtle
B. deer
C. both
D. neither

Q6. Which variable were you able to manipulate in the simulation?

A. time
B. temperature
C. animal size
D. animal metabolism

Too Hot? Too Cold? Just Right!

Student Activity

Name ______________

Class ______________

Q7. As the sun rose and the temperature got warmer, what happened to the metabolism of the turtle? Why?

Q8. As the sun rose and the temperature got warmer, what happened to the metabolism of the deer? Why?

Q9. As the sun set and the temperature got cooler, what happened to the metabolism of the turtle? Why?

Q10. As the sun set and the temperature got cooler, what happened to the metabolism of the deer? Why?

Q11. What do you predict would be the normal body temperature of the deer?

A. It depends largely on the environmental temperature.
B. About 72°F
C. About 100°F

Q12. What do you predict would be the body temperature of the turtle?

A. It depends largely on the environmental temperature.
B. About 50°F
C. About 110°F

Q13. During cold winter months, it's common to see deer, but not common to see turtles. Why not? What happens to the turtles?

Q14. What strategies to you think deer use in the cold winter months to retain their body heat?

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Too Hot? Too Cold? Just Right!

Science Objectives

- Students will simulate environmental temperature changes and observe the effect of temperature change on the metabolic rates of two different animals.
- Students will develop an understanding of the effect of environmental temperatures on endotherms and ectotherms.
- Students will develop an understanding of the relationship between environmental temperature and animal metabolism.

Vocabulary

- circadian rhythms
- ectotherm
- endotherm
- hibernate
- homeostasis
- insulation

About the Lesson

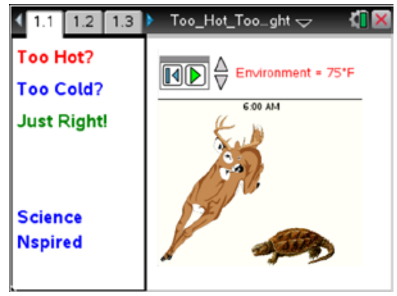
- This lesson involves students using TI-Nspire technology to simulate the effect of environmental temperature on the metabolisms of both endothermic and ectothermic animals.
- As a result, students will:
  - Differentiate between endothermic and ectothermic animals.
  - Develop an understanding of the physiological needs of endothermic and ectothermic animals.

TI-Nspire™ Navigator™

- Send out the *Too_Hot_Too_Cold_Just_Right.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI-Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software



Tech Tips:

- This activity includes class captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Too_Hot_Too_Cold_Just_Right_Student.doc
- Too_Hot_Too_Cold_Just_Right_Student.pdf
- Too_Hot_Too_Cold_Just_Right.tns

Discussion Points and Possible Answers

Regulating body temperature is one of the most critical survival mechanisms for animals. Being able to stay warm or cool can be a real challenge for animals. Although endotherms can regulate their body temperatures, they still need to make use of strategies that help them strictly maintain that temperature. Ectotherms are even more environmentally dependent for their body temperatures.

This would be a good time to brainstorm with your students about the strategic ways that various animals warm up and cool down. This may also be a good time to discuss Circadian rhythms with the students. Circadian rhythms are the daily "patterns" of animals. Some animals are nocturnal—active at night—and others are diurnal—active during the day. If all animals had the same Circadian rhythms, competition for available resources would be more intense.

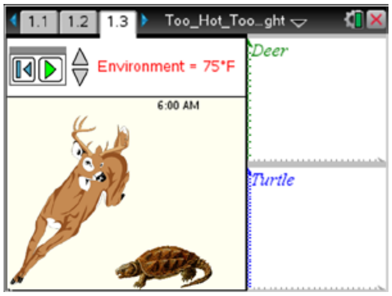
TI-Nspire Navigator Opportunities

Allow students to volunteer to be the Live Presenter and demonstrate how to adjust the environmental temperatures, start the simulation, and reset the simulation.

Move to pages 1.2 and 1.3.

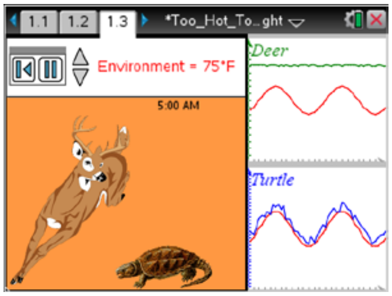
Have students answer Questions 1 – 3 on the activity sheet.

1. Students read the instructions on page 1.2 and then run the simulation on page 1.3 at 75°F. Each plot shows the animal's body temperature and the environmental temperature. The simulation, when run to completion, displays temperature and metabolism for two entire days.



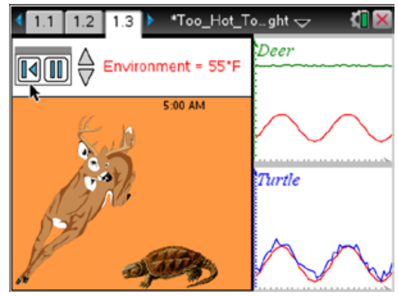
Q1. To the right, draw a sketch of the graphs that were produced when the environmental temperature was 75ºF.

Sample Answer: The simulation to the right was run at a temperature of 75ºF.



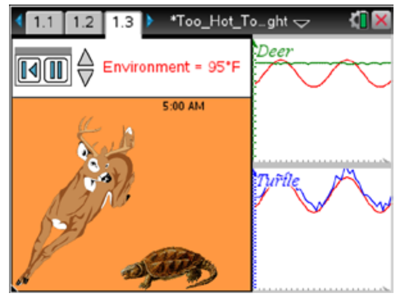
2. Students reset the simulation by selecting . They use the down arrow to lower the environmental temperature and run the simulation again. Then they raise the environmental temperature above 75°F and run the simulation again.

Q2. Draw a sketch of the graphs that were produced when the environmental temperature was ***lower*** than 75ºF.



Sample Answer: The simulation to the right was run at a temperature of 55ºF. Note the difference in position of the plots in the graph area.

Q3. Draw a sketch of the graphs that were produced when the environmental temperature was ***higher*** than 75ºF.



Sample Answer: The simulation to the right was run at a temperature of 95ºF. Again, note the positions of the plots.

Move to pages 2.1 – 2.3.

Have students answer questions 4 – 6 on either the device, on the activity sheet, or both.

Have students answer questions 7 – 14 on the activity sheet.

Q4. Which animal's temperature fluctuated with the environmental temperature?

Answer: A. turtle

Q5. Which animal's temperature remained pretty constant, even when the environmental temperature changed?

Answer: B. deer

Q6. Which variable were you able to manipulate in the simulation?

Answer: B. temperature

Q7. As the sun rose and the temperature got warmer, what happened to the metabolism of the turtle? Why?

Answer: It increased. The turtle is an ectotherm, and its body temperature depends on the environmental temperature.

Q8. As the sun rose and the temperature got warmer, what happened to the metabolism of the deer? Why?

Answer: It stayed the same. Deer are endotherms, so their body temperatures don't fluctuate very much.

Q9. As the sun set and the temperature got cooler, what happened to the metabolism of the turtle? Why?

Answer: It decreased. The turtle is an ectotherm, and its body temperature depends on the environmental temperature.

Q10. As the sun set and the temperature got cooler, what happened to the metabolism of the deer? Why?

Answer: It stayed the same. Deer are endotherms, so their body temperatures don't fluctuate very much.

Q11. What do you predict would be the normal body temperature of the deer?

Answer: About 100°F

Q12. What do you predict would be the body temperature of the turtle?

Answer: It depends largely on the environmental temperature.

Q13. During cold winter months, it's common to see deer, but not common to see turtles. Why not? What happens to the turtles?

Answer: The turtles are probably hibernating in the mud at the bottom of ponds and lakes.

Q14. What strategies to you think deer use in the cold winter months to retain their body heat?

Sample answer: Grow more and longer hair; put on body fat as winter approaches; stay out of the cold wind.

Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in student worksheet or the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.

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Need for Speed

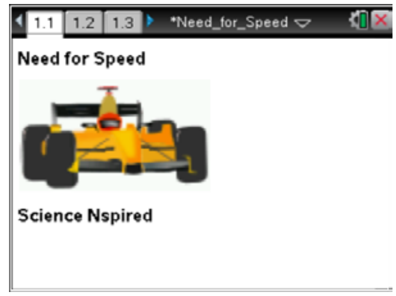
Student Activity

Name ______________

Class ______________

Open the TI-Nspire document *Need_for_Speed.tns.*

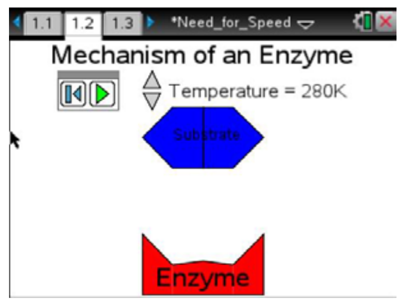
Enzymes are very important biological molecules. Their job is to speed up reactions in and around cells. Many enzymes are known as ***anabolic*** enzymes, and these build molecules. Others are ***catabolic***, and break down molecules into smaller ones. In this activity, you will be using a catabolic enzyme called catalase. Catalase helps break down hydrogen peroxide into oxygen and water.



Have you seen the effects of the reaction between hydrogen peroxide (H_2O_2) and catalase? If you have ever put H_2O_2 on a cut and seen the bubbles that form, you have witnessed this chemical reaction!

Move to page 1.2.

1. The play and reset buttons in the upper left corner stop and start the animation. Start the animation.
   <u>Note</u>: Be sure to pause the animation before you move to the next page. ( )



Tech Tip: To access the Directions again, select > **Need for Speed** > **Directions**

Tech Tip: To access the Directions again, select selecting menu or **Document Tools (** **) > Need for Speed > Directions**.

Tech Tip: Inform students that the animation on page 1.2 must be paused before moving on. This will be critical when they get to the animation on page 1.7.

Move to pages 1.3 and 1.4. Answer the following questions here or in the .tns file.

Q1. The simulation on the previous page represents a catabolic reaction. True or False?

Q2. What is the name of the region on the enzyme where the reaction took place?

Need for Speed

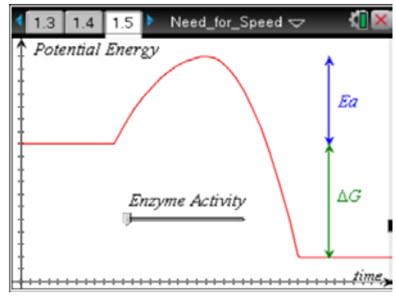
Student Activity

Name ______________

Class ______________

Move to page 1.5.

2. Grab and move the slider bar to the right and notice what changes occur.



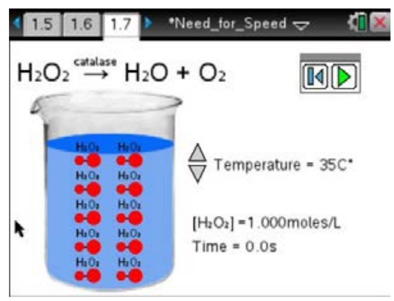
Move to page 1.6. Answer the following questions here or in the .tns file.

Q3. Which of the following changes with the use of an enzyme?

A. energy of the products B. activation energy, E_a C. free energy, ΔG

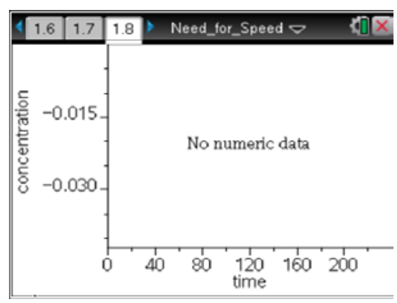
Move to page 1.7.

3. The simulation models the effect that temperature has on enzyme activity. The circles represent substrate molecules (in this case, H_2O_2). As the reaction proceeds, the concentration of substrate molecules decreases.
   Change the temperature to 30°C and click on the play button( ).
   Once all of the circles have disappeared, advance to page 1.8.



Move to page 1.8.

4. You will need to select the correct labels for the *x*- and *y*-axes to view the graph of the relationship. Select "concentration" on the left of the graph and choose concentration. The graph will appear.



Answer the following questions here or in the .tns file.

Q4. Describe the relationship between substrate concentration and time during an enzymatic reaction.

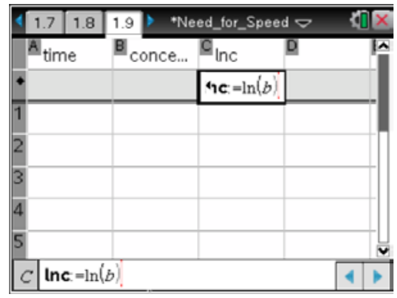
Need for Speed

Student Activity

Name ________________

Class ________________

Move to page 1.9.



5. In column A, label **time**. In column B, label **concentration**. In column C, label **lnc** (which stands for the natural log of concentration). Arrow down to the equation box in column C. Click on the natural log key (ctrl e^x). Type the letter *b* inside the ( ) and press enter. Data will now appear in column C.

Move to page 1.10.

6. Graph lnc versus time. This will generate a line that you can analyze to determine the reaction rate. Perform a linear regression on this graph by pressing **Menu > Analyze > Regression > Show Linear (mx+b)**. Record the temperature and the slope (or reaction rate) for that temperature in the table below.

	DATA TABLE	
	Temperature (°C)	**Slope of lnc Curve (Reaction Rate)**
1.	10°C	
2.	20°C	
3.	30°C	
4.	40°C	
5.	50°C	

Tech Tip: To perform a linear regression on this graph, select > **Analyze > Regression > Show Linear (mx+b)**.

Return to page 1.7.

7. Click on the reset button ( ) on the left. Select a different temperature and click on the play button ( ).

   Advance to page 1.8 and watch the graph being generated.

   When the graph is completed, advance to page 1.10. Record the slope of the ln (concentration) linear regression for the new temperature. Return to page 1.7 and repeat for three more temperatures for a total of 5 samples.

Q5. Analyze the data in the chart. Describe the pattern that is illustrated by the data.

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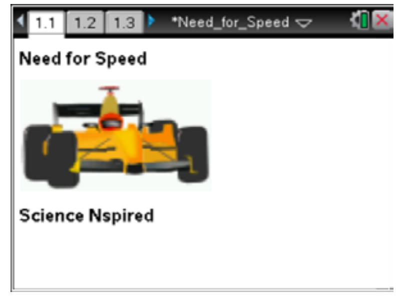
Need for Speed

SCIENCE NSPIRED

TEACHER NOTES



Science Objectives

- Students will observe the interaction between an enzyme and its substrate.
- Students will observe the effect that enzymes have on chemical reactions.
- Students will explore the effects of temperature and substrate concentration on enzymatic reactions.

Vocabulary

- anabolic
- catabolic
- catalase
- enzyme
- hydrogen peroxide
- metabolism
- substrate

About the Lesson

- This lesson investigates the properties of enzymes and how they affect reaction rates.
- As a result, students will:
  - Understand how enzymes interact with their substrates.
  - Observe the effect of enzymes on the activation energy of chemical reactions.
  - Observe the effect of temperature and substrate concentration on enzymatic reaction rates.

TI-Nspire™ Navigator™

- Send out the *Need_for_Speed.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
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- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Need_for_Speed_Student.doc
- Need_for_Speed_Student.pdf

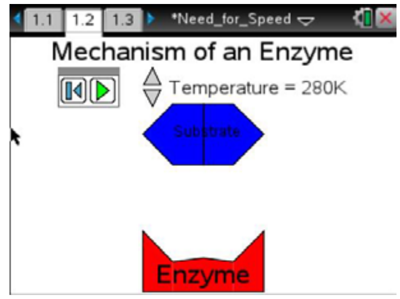
TI-Nspire document

- Need_for_Speed.tns

Discussion Points and Possible Answers

Move to page 1.2.

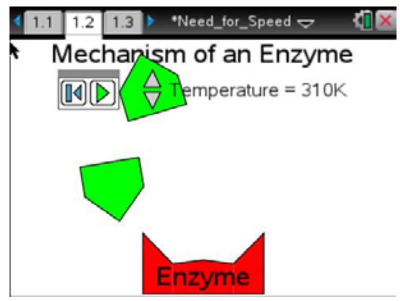
1. After reading the instructions on pages 1.2 and 1.3, students should close the directions box by selecting .



2. The play and reset buttons in the upper left corner stop and start the animation. The students will start the animation by clicking on the .

3. Students will change the temperature using the arrows until they find the temperature that produces a reaction.

   Note: Be sure your students Pause the animation before they move to the next page. ( )



Tech Tip: To access the Directions again, select > **Need for Speed** > **Directions**

Tech Tip: To access the Directions again, select selecting menu or **Document Tools ( ) > Need for Speed > Directions**.

Tech Tip: Inform students that the animation on page 1.2 must be paused before moving on. This will be critical when they get to the animation on page 1.7.

Move to pages 1.3 and 1.4.

Have students answer the questions on either the handheld, on the activity sheet, or both.

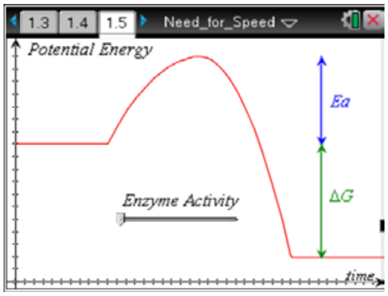
Q1. The simulation on the previous page represents a catabolic reaction. True or False?

Answer: False

Q2. What is the name of the region on the enzyme where the reaction took place?

Answer: active site

Move to page 1.5.



4. Directions are given for the next simulation. The purpose of this animation is to demonstrate how enzymes LOWER the activation energy of a reaction.

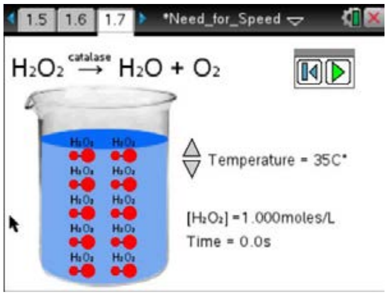
Move to page 1.6.

Have students answer the questions on either the handheld, on the activity sheet, or both.

Q3. Which of the following changes with the use of an enzyme?

<u>Answer</u>: A**.** activation energy, E_a

Move to page 1.7.



5. Directions are given for the next simulation.

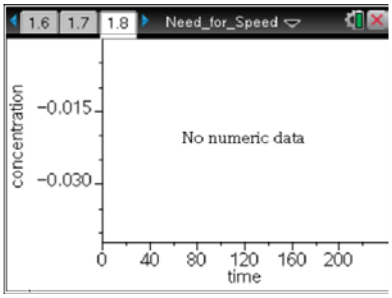
   The purpose of this simulation is to model the effect that temperature has on enzyme activity.

   Students should start with a temperature of 30°C and click on the play button ( ). The simulation at different times will take longer to run. Students will need to wait for this process to complete.

   When the simulation is complete, students advance to page 1.8.

> **Tech Tip:** The second time they run the simulation on page 1.7, students can move to page 1.8 to watch as the data is plotted. Or they can move back to page 1.7 and watch the simulation.

Move to page 1.8.



6. The first time the simulation is run, students need to choose concentration as the correct variable for the y-axis. The graph of the simulated reaction will appear.

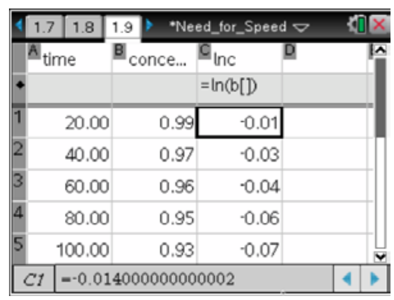
Have students answer the following question on the student activity sheet.

Q4. Describe the relationship between substrate concentration and time that occurs during an enzymatic reaction.

Answer: At the beginning, there is a steep decline because there is a large concentration of substrate. Therefore, there are multiple interactions between substrate and enzyme. As the substrate is used up, the reaction slows down because there are fewer molecules for the enzyme to encounter.

> **Teacher Tip: Check for Understanding-**
>
> There is a common misconception that the *enzyme* is being used up! Discuss with your students how detrimental it would be if an organism constantly needed to replenish enzyme concentrations.

Move to page 1.9.

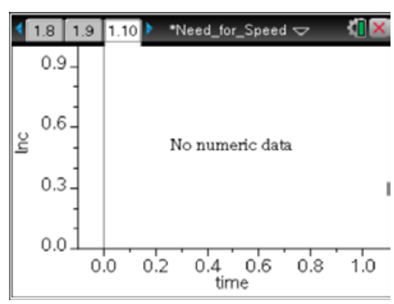


7. Students will label column A **time** and column B **concentration**. They will label column C **lnc** (which stands for natural log of concentration). They will press natural log (ctrl ex) in the equation box and type *b* in the ( ).
   Even if your students have not studied natural logs, this will teach them how a linear representation can be generated in order to determine slope (which is the ***rate*** of the reaction).

TI-Nspire Navigator Opportunities

Select a student to be the live presenter to demonstrate how to label the columns and insert the formula for Column C. This may help ensure that all students accomplish this correctly.

Move to page 1.10.



6. Here students will graph lnc versus time. This will generate a line that students will analyze to determine the rate of the simulated reaction. Students will perform a linear regression on this graph by pressing **Menu > Analyze > Regression > Show Linear (mx+b)**.

> **Tech Tip:** To perform a linear regression on this graph, select **> Analyze > Regression > Show Linear (mx+b)**.

Students will return to page 1.7 and click on the reset button ( ).

7. Students choose a different temperature and then click on the play button. ( ) Students then will advance to page 1.8.
   Once the animation is completed, students will advance to page 1.10 and record the slope of the Inc curve for the new temperature. They will repeat this step three more times to obtain data for five different temperatures.

	RESULTS	
	Temperature (°C)	**Slope of Inc Curve (Reaction Rate)**
1.	10°C	-0.000175 molecules/sec
2.	20°C	-0.00035 molecule/sec
3.	30°C	-0.0007 molecules/sec
4.	40°C	-0.0014 molecule/sec
5.	50°C	-0.0028 molecule/sec

Have students answer the following question on the student activity sheet.

Q5. Analyze the data in the chart. Describe the pattern illustrated by the data.

Answer: As the students record the data for the five different temperatures, they will see the pattern that for every 10° C increase in temperature, the reaction rate doubles. This is called a Q_{10} relationship, and commonly occurs in many other situations. For example, when Daphnia are exposed to different temperatures and heart rate is recorded, the same Q_{10} relationship is observed.

Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.

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Exploring Diffusion Lab
Student Activity

Name ________________
Class ________________

Open the TI-Nspire document *Diffusion Data Collection.tns.*

In this activity, you will explore the movement of molecules through diffusion and the effects of concentration gradient on diffusion rate.

Move to pages 1.2 through 1.6.

Q1. Riding a bike down a hill is analogous to active transport.

Q2. Why are you going to use a conductivity probe in this lab experiment?

Q3. Which of the following shows the greatest concentration gradient?

Q4. The water in a stream or river flows in a manner most similar to passive transport.

Q5. You can place a limp piece of celery in water, and it will become crisp again. Which BEST explains this?

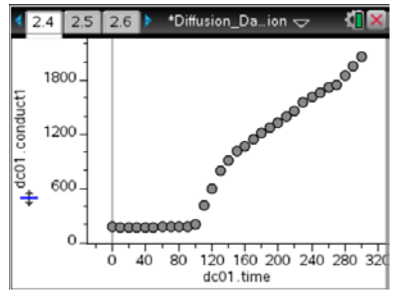
Move to pages 2.1 through 2.7.

1. To conduct the experiment and collect data, begin by pouring about 250 mL of distilled water into the beaker.
2. Tie off one end of the dialysis tube with dental floss. To tie off the dialysis tubing, twist one end of the tube, fold it over on itself, loop a knot of floss over the doubled-over tube, and tightly secure the floss.
3. Measure 15 mL of distilled water, and use a funnel to pour it into the dialysis tube.
4. Tie off the other end of the dialysis tube so you have a bag. Be careful that no liquid can leak out of the ends of the bag.
5. Plug in the conductivity probe, and set the toggle switch to the middle setting.
6. On page 2.4 set up a data collection for every 10 seconds for a total of 5 minutes.

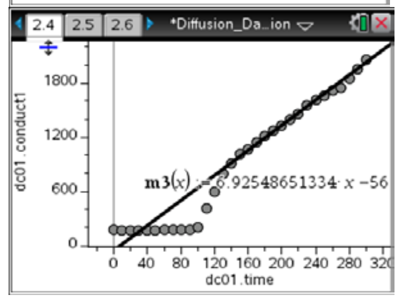
Exploring Diffusion Lab
Student Activity

Name ______________
Class ______________

7. Place the probe into the beaker of water, let the reading stabilize, click "start," and then place the dialysis bag into the beaker. The data should be displayed on Page 2.5.



8. When the data collection is over, use the **Movable Line** tool to draw a line of best fit through the linear portion of the data. The slope of the best-fit line is the diffusion rate.



9. Record the diffusion rate in the data table on Page 2.7 of the handheld.
10. Repeat the procedure three more times for each of the three remaining salt solutions, recording data on Page 2.7.
    - The water goes in the beaker, and the salt solutions go in the dialysis tubes.
    - Use a new dialysis tube and fresh beaker water each time.

Move to pages 3.1 through 3.6.

Q6. Which molarity gave the greatest rate of change?

Q7. Which molarity would you have EXPECTED to give the greatest rate of change? Which molarity would you have EXPECTED to have the least rate of change?

Q8. If you had used a 0.5 M salt solution in the tubing, how would the rate of diffusion have compared to the other rates you measured?

Q9. Other than the molarity of the salt solution, what is another experimental variable that could be applied to alter the rate of diffusion?

Q10. Predict how your results would have been different if you had put distilled water into the dialysis tube and the salt water into the beaker.

Exploring Diffusion Lab

TEACHER NOTES

SCIENCE NSPIRED

Science Objectives

- Students will explore the movement of molecules through a membrane via diffusion.
- Students will explore the effects of concentration gradient on diffusion rate.

Vocabulary

- diffusion
- concentration gradient
- molarity
- conductivity
- permeability

About the Lesson

- This activity involves students conducting 4 separate trials using 4 different molarities of a salt solution.
- As a result, students will:
    - Use a conductivity probe to help students understand diffusion rates.
    - Develop an understanding of the effect of the concentration of a solution on the rate of diffusion across a selectively permeable membrane.

TI-Nspire™ Navigator™ System

- Use Screen Capture to evaluate cooling rates obtained by the students.
- Use Live Presenter to allow students share their results and conclusions.
- Use Class Analysis for formative assessment.

Activity Materials

- TI-Nspire™ handheld
- Vernier® Conductivity Probe™
- distilled water
- 0.1 M, 0.2 M, and 0.3 M salt solutions
- 400 mL or 500 mL beaker
- 25 mL or 50 mL graduated cylinder
- funnel
- four pieces of dialysis tubing, approximately 10 cm long
- dental floss or string

TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Analyzing collected data
- Evaluating rates from a graph

Tech Tip:

Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Exploring Diffusion Lab.pdf
- Exploring Diffusion Lab.doc

TI-Nspire document

- Diffusion Data Collection.tns

Problem 1 – Prelab Questions

Move to page 1.2

Q1. Riding a bike down a hill is analogous to active transport.

Answer: False

Q2. Why are you going to use a conductivity probe in this lab experiment?

Answer: Salt is ionic and when it dissolves, the ions in the water conduct a current.

Q3. Which of the following shows the greatest concentration gradient?

Answer: 2% salt in a cell and 0.5% outside

Q4. The water in a stream or river flows in a manner most similar to passive transport.

Answer: True

Q5. You can place a limp piece of celery in water, and it will become crisp again. Which BEST explains this?

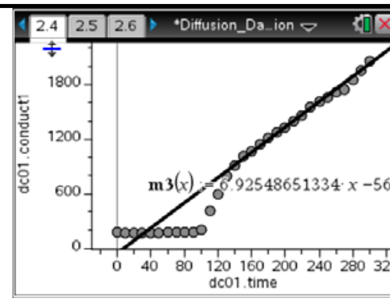
Answer: Osmosis

Move to pages 2.1 through 2.7.

1. To conduct the experiment and collect data, begin by pouring about 250 mL of distilled water into the beaker.
2. Tie off one end of the dialysis tube with dental floss. To tie off the dialysis tubing, twist one end of the tube, fold it over on itself, loop a knot of floss over the doubled-over tube, and tightly secure the floss.
3. Measure 15 mL of distilled water, and use a funnel to pour it into the dialysis tube.
4. Tie off the other end of the dialysis tube so you have a bag. Be careful that no liquid can leak out of the ends of the bag.
5. Plug in the conductivity probe, and set the toggle switch to the middle setting.
6. On page 2.4 set up a data collection for every 10 seconds for a total of 5 minutes.
7. Place the probe into the beaker of water, let the reading stabilize, click "start," and then place the dialysis bag into the beaker. The data should be displayed on Page 2.5.

TI-Nspire Navigator Opportunity

Screen Capture can be used here to ensure that students have obtained a reasonable data set. The graph should show that the conductivity of the solution is constant until the dialysis tubing is inserted. Once the tubing is placed in the beaker, the graph data points should slope upwards steadily. If student graphs do not have this form, you may need to assist groups to be sure that they have set up the experiment correctly.



8. When the data collection is over, use the **Movable Line** tool to draw a line of best fit through the linear portion of the data. The slope of the best-fit line is the diffusion rate.
9. Record the diffusion rate in the data table on Page 2.7 of the handheld.

Teacher Tip: They should fit the line to the linear, upward-sloping part of the data set, ignoring the initial flat readings. The units for the data are millisiemens per centimeter (mS/cm).

10. Repeat the procedure three more times for each of the three remaining salt solutions, recording data on Page 2.7.
    - The water goes in the beaker, and the salt solutions go in the dialysis tubes.
    - Use a new dialysis tube and fresh beaker water each time.

Teacher Tip: Make sure that students are starting with fresh distilled water for each trial. They should rinse their beakers and the conductivity probes after each trial.

Move to pages 3.1 through 3.6.

Q6. Which molarity gave the greatest rate of change?

Sample Answers: The greatest rate of change *should* have occurred for the 0.3 M solution.

Q7. a. Which molarity would you have EXPECTED to give the greatest rate of change?
b. Which molarity would you have EXPECTED to give the least rate of change?

a. Answer: 0.3 M **b. Answer:** 0.1 M

Q8. If you had used a 0.5 M salt solution in the tubing, how would the rate of diffusion have compared to the other rates you measured?

Answer: The diffusion rate would have been greater than that in the first trial, but less than those of the other trials.

Q9. Other than the molarity of the salt solution, what is another experimental variable that could be applied to alter the rate of diffusion?

Sample Answers: Examples of variable include the volume of water, the volume of salt solution, the surface area of the tube that is in contact with the water, and the temperature of the water and the salt solution.

Q10. Predict how your results would have been different if you had put distilled water into the dialysis tube and the salt water into the beaker.

Sample Answers: If the distilled water were in the dialysis tube, the water would diffuse out of the tubing into the sale solution. The solution would become more dilute over time, so its conductivity would decrease. The diffusion rate should be the same for a given concentration gradient, but the direction of diffusion would be opposite.

Wrap Up

Transport of materials into and out of the cell is one of the key ideas in Biology. Cells MUST be able to move things across their membranes. Passive transport allows materials to move across membranes without the cell having to expend ATP energy. Concentration gradients, in large part, determine the direction of movement of materials and the rates at which these materials move. This activity models these ideas.

Assessment

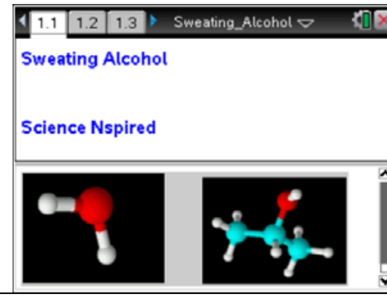
Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show can be utilized to give students immediate feedback on their assessment.

Sweating Alcohol
Student Activity

Name ________________
Class ________________

Open the TI-Nspire™ document *Sweating_Alcohol.tns.*

Everyone is familiar with the effects of perspiration on the skin. The cooling effect is very refreshing on a hot summer day. What if we perspired some liquid other than water? Would we cool off more rapidly? Would we heat up?



The goal of this activity is to help you begin to understand the "magic" of the water molecule. Without water and its incredibly unique characteristics, life as we know it would be impossible. Not only is water a really good solvent (a dissolver of things), it is a POLAR molecule, which means it is "charged" on either end; one end is positive and the other is negative. Thus, water molecules stick to each other.

This "cohesion" of water molecules makes it hard to heat it up and cool it down. This may sound bad, but it is REALLY good for us living things! Since most organisms are made mostly of water, they retain their heat really well. On a grander scale, since Earth is covered mostly with water, the overall global temperature remains pretty constant. Again, this helps make life possible here.

Move to pages 1.4 through 1.7.

Press ctrl ▶ and ctrl ◀ to navigate through the lesson.

Answer these questions on your handheld.

1. Because of its properties, most of the water on Earth is very warm. True or False.
2. In a solution of sugar-water, the sugar is called the ___, and the water is called the ___.
3. A water molecule is considered to be "polar" because it is negatively charged on both "ends" of the molecule.
4. What do you predict is the approximate percentage of water inside human beings? Express your answer as a percentage (ex: 30%).

Move to page 2.1.

5. Pour a small quantity of alcohol into the plastic cup (an inch or so).
6. Plug in the temperature probe, and place it into the alcohol.
7. Set the TI-Nspire™ handheld to collect data every second for 30 seconds.
8. Click start to begin sampling, count to 2, THEN lift the probe straight out of the alcohol, keeping the tip pointed down, until the data collection is complete.
    - The data is graphed on Page 2.2.

Sweating Alcohol
Student Activity

Name ______________
Class ______________

Move to page 2.2.

9. To determine the rate of cooling, select **MENU > Analyze > Regression > Show Linear (mx+b)**.
10. Record the equation in the data table below.
11. Move back to the *DataQuest*™ page, and run a trial with water instead of alcohol.
12. Move back to the graph, and start sampling. Store the previous run by clicking on the “filing cabinet” icon.
13. Pour a little water into a clean cup, and repeat the procedure for water.
14. Analyze the data as before, and record it in the data table to the right.

<u>Data Table</u>

Equation for Alcohol:

Equation for Water:

Move to page 3.1.

Answer the following questions on your handheld or here on this worksheet.

15. Which liquid showed a greater decrease in temperature?
16. Which liquid seemed to evaporate more slowly?
17. Which liquid “cooled” more quickly?
18. In the equation that you generated for the regression line ($y=mx+b$), what is "b"?
19. In the equation that you generated for the regression line ($y=mx+b$), what is "m"?
20. What is another name for “slope”?
21. In this activity, what data label should be included with the rate of change?
22. If, rather than perspiring water, you perspired rubbing alcohol, would you cool off more slowly or more rapidly?
23. Consider the heat that is produced and then is taken "away" by your perspiration. What is the source of this heat in your body?
24. So, if you perspired something like rubbing alcohol, rather than water, how would your lifestyle need to change?

Sweating Alcohol
Student Activity

Name ________________
Class ________________

25. Is water a polar or a nonpolar molecule?

26. Predict whether alcohol is a polar or a nonpolar molecule.

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Sweating Alcohol

SCIENCE NSPIRED

Science Objectives

- Students will collect data for the cooling rates of water and isopropyl alcohol.
- Students will compare and contrast the cooling rate data, both graphically and numerically.
- Students will predict how human homeostasis would be different if we perspired a liquid other than water.
- Students will draw conclusions about the physical and chemical characteristics of water and how those characteristics impact organisms and the ability of the Earth to sustain life.

Math Objectives

- Students will generate linear regression models and compare rates of change from those models.

Materials Needed

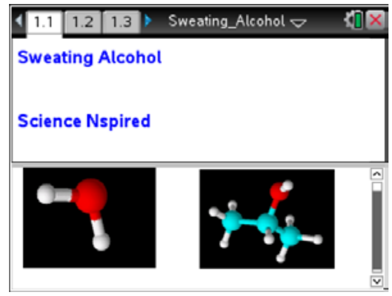
- TI-Nspire™ or TI-Nspire™ CX unit for each student
- Data collection cradle (optional)
- Vernier® EasyTemp™ probe or 2 stainless steel temperature probes
- Small plastic cups
- Bottle of rubbing (isopropyl) alcohol
- Room temperature water

Vocabulary

- polar
- nonpolar
- cohesion
- solvent
- solute
- solution
- homeostasis

About the Lesson

- This activity involves collecting data with a temperature probe as two different liquids cool via evaporation.
- As a result, students will:
  - Compare the two rates of cooling and predict the physiological and metabolic implications if we, as humans, perspired some liquid other than water.
  - Develop a deeper understanding of the properties of water and how those properties allow life to exist.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire™ document
- Open a document
- Move between pages
- Entering and graphing data using multiple applications
- Tracing, interpolating, predicting

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.
- You can hide the function entry line by pressing ctrl G.

Lesson Materials:

Student Activity

- Sweating_Alcohol_Student.pdf
- Sweating_Alcohol_Student.doc

TI-Nspire document

- Sweating_Alcohol.tns

TI-Nspire™ Navigator™ System

- Screen Capture to monitor student progress.
- Live Presenter allows students to show their graphs to the class.

Discussion Points and Possible Answers

The goal of this activity is to help you begin to understand the "magic" of the water molecule. Without water and its incredibly unique characteristics, life as we know it would be impossible. Not only is water a really good solvent (a dissolver of things), it is a POLAR molecule, which means it is "charged" on either end; one end is positive and the other is negative. Thus, water molecules stick to each other.

This "cohesion" of water molecules makes it hard to heat it up and cool it down. This may sound bad, but it is REALLY good for us living things! Since most organisms are made mostly of water, they retain their heat really well. On a grander scale, since Earth is covered mostly with water, the overall global temperature remains pretty constant. Again, this helps make life possible here.

Move to pages 1.4 through 1.7.

Answer these questions on your handheld.

1. Because of its properties, most of the water on Earth is very warm. True or False.

   Answer: False.

2. In a solution of sugar-water, the sugar is called the ___, and the water is called the ___.

   Answer: B. solute; solvent

3. A water molecule is considered to be "polar" because it is negatively charged on both "ends" of the molecule.

   Answer: Wrong.

4. What do you predict is the approximate percentage of water inside human beings? Express your answer as a percentage (ex: 30%).

   Answer: 60-65%.

Move to page 2.1.

5. Pour a small quantity of alcohol into the plastic cup (an inch or so).
6. Plug in the temperature probe, and place it into the alcohol.
7. Set the TI-Nspire handheld to collect data at a rate of 1 sample/second for 30 seconds.
8. Click start to begin sampling, count to 2, THEN lift the probe straight out of the alcohol, keeping the tip pointed down, until the data collection is complete.
    - The data is graphed on Page 2.2.

Move to page 2.2.

9. To determine the rate of cooling, select **MENU > Analyze > Regression > Show Linear (mx+b)**.
10. Record the equation in the data table below.
11. Move back to the *DataQuest*™ page, and run a trial with water instead of alcohol.
12. Move back to the graph, and start sampling. Store the previous run by clicking on the "filing cabinet" icon.
13. Pour a little water into a clean cup, and repeat the procedure for water.
14. Analyze the data as before, and record it in the data table to the right.

Data Table

Equation for Alcohol:

Answer: Answers may vary

Equation for Water:

Answer: Answers may vary

Move to page 3.1.

Answer the following questions on your handheld or here on this worksheet.

15. Which liquid showed a greater decrease in temperature?

    Answer: Alcohol

16. Which liquid seemed to evaporate more slowly?

    Answer: Water

17. Which liquid "cooled" more quickly?

    Answer: Alcohol

18. In the equation that you generated for the regression line (*y*=*mx*+*b*), what is "*b*"?

    Answer: The "*y*-intercept", which is the temperature when the data collection started.

19. In the equation that you generated for the regression line (*y*=*mx*+*b*), what is "*m*"?

    Answer: The rate of change (slope) in temperature in degrees per second.

20. What is another name for "slope"?

    Answer: Rate of change.

21. In this activity, what data label should be included with the rate of change?

    Answer: Degrees/second.

22. If, rather than perspiring water, you perspired rubbing alcohol, would you cool off more slowly or more rapidly?

    Answer: More rapidly.

23. Consider the heat that is produced and then is taken "away" by your perspiration. What is the source of this heat in your body?

    Answer: Cell respiration.

24. So, if you perspired something like rubbing alcohol, rather than water, how would your lifestyle need to change?

    Answer: You'd need to eat more.

25. Is water a polar or a nonpolar molecule?

    Answer: Polar.

26. Predict whether alcohol is a polar or a nonpolar molecule.

    Answer: Nonpolar.

TI-Nspire Navigator Opportunity: *Screen Capture*
See Note 1 at the end of this lesson.

Assessment

Formative assessment will consist of questions embedded in the TI-Nspire document. The questions will be graded when the document is retrieved. The Slide Show can be utilized to give students immediate feedback on their assessment.

TI-Nspire Navigator
Note 1 Screen Capture
Screen Capture can be used to monitor student progress.

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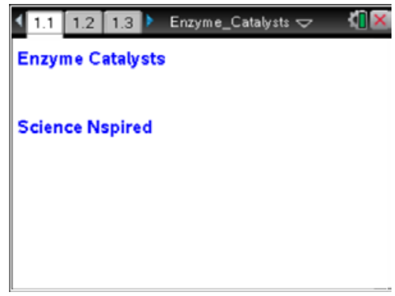
Enzyme Catalysts

Student Activity

Name ________________

Class ________________



Open the TI-Nspire document *Enzyme_Catalysts.tns.*

In this activity, you will:

- Describe the difference between anabolism and catabolism.
- Identify factors that affect the rate of chemical reactions.

Enzymes are very important biological molecules. Enzymes help speed up reactions in and around cells. Many enzymes are known as **anabolic** enzymes, and these build larger molecules from smaller ones. Others are **catabolic,** which break down larger molecules into smaller ones. You produce hundreds of different enzymes in your cells, all of which facilitate some chemical reaction in the body.

Here's an example: Hydrogen peroxide (H_2O_2) is produced naturally inside many of your cells. The trouble is that it is very toxic to us. To deal with this, we produce an enzyme called **catalase,** which serves to break down hydrogen peroxide into a couple of pretty harmless substances:

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Let's discuss some things about enzymes for a minute. Enzymes are **globular proteins** that are responsible for most of the chemical activities of living organisms. They act as **catalysts**—substances that speed up chemical reactions without being destroyed or changed during the process. Enzymes are very efficient, and they can be used over and over again. One enzyme may very well catalyze hundreds, or even thousands, of reactions every second!

Enzymes, however, can be temperamental. Most enzymes are very picky about the situations in which they will work. **Temperature** and **pH** are very important factors. If the environment is too hot or too cold, or too acidic or too basic, the enzyme may not catalyze its reaction at all. In fact, if the conditions are too extreme, the enzyme may quit working altogether because its structure may become distorted. In these cases, we say that the enzyme has become **denatured.**

Have you seen the bubbles that form when you place hydrogen peroxide (H_2O_2) on a cut? This is a reaction between hydrogen peroxide and catalase? Where is catalase found in living organisms? There is a fair amount of catalase in blood! In addition, it can be found in many different tissues in both plants and animals.

In this experiment, you will measure the rate of enzyme (catalase) activity under various conditions. To do this, you will measure the pressure of **oxygen gas** in a flask as it is released during the chemical reaction between hydrogen peroxide and catalase.

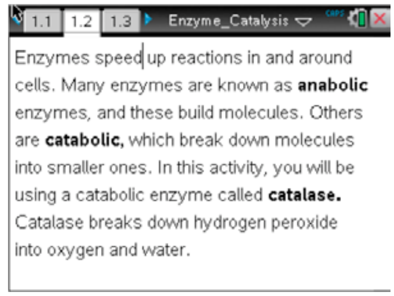
Problem 1 – Preliminary Questions

Move to page 1.2.

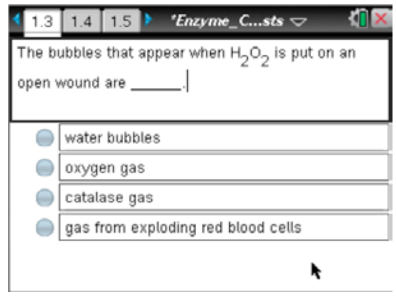
Enzyme Catalysts
Student Activity

Name ______________
Class ______________

1. Read the introduction on page 1.2.



Move to pages 1.3–1.7. Answer the following questions here or in the .tns file.



Q1. The bubbles that appear when H_2O_2 is put on an open wound are ____________.

A. water bubbles
B. oxygen gas
C. catalase gas
D. gas from exploding red blood cells

Q2. Why do you think hydrogen peroxide is stored in a brown bottle?

A. Because it is photosensitive.
B. To prevent it from being destroyed by catalase.
C. People prefer to buy chemicals in brown bottles.

Q3. The following reaction would be anabolic: $A + B \rightarrow AB$

A. True
B. False

Q4. The process of cellular respiration, which is breaking glucose into water and carbon dioxide, would be a (an) ____________ reaction.

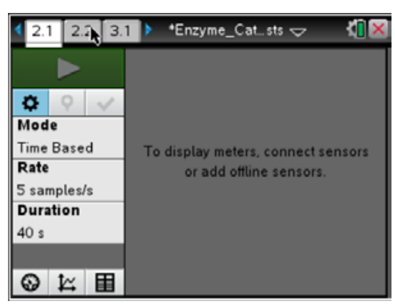
A. anabolic
B. catabolic

Q5. Photosynthesis, which builds glucose from CO_2 and H_2O, would be a (an) ____________ reaction.

A. anabolic
B. catabolic

Problem 2 – Reaction Rate Data Collection

Move to page 2.1.



2. Page 2.1 is a blank DataQuest application. Connect the EasyLink to the TI-Nspire, and then connect the Gas Pressure Sensor to the EasyLink. Set the TI-Nspire to collect data every 1 second for 30 seconds.
3. Attach the tube to the pressure sensor, and then attach the black stopper to the tube.
4. Use the graduated cylinder to measure 5 mL of hydrogen peroxide and pour it into the flask.

Enzyme Catalysts
Student Activity

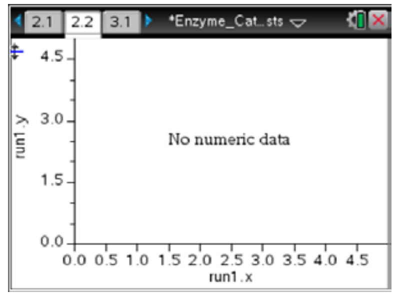
Name ______________

Class ______________

5. Draw 1 mL of the catalase suspension into the syringe.
6. Press **Start Data Collection** on the TI-Nspire, and immediately add the catalase suspension to the flask. Then, quickly put the stopper firmly in the mouth of the flask.

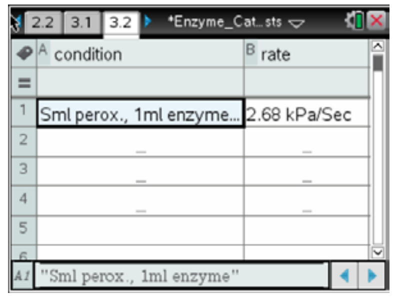
Move to page 2.2.

7. View the collected data in the Data & Statistics application on page 2.2. Use the Entry Line to set the x-axis to the variable run1.time and the y-axis to run1.pressure. Use the **Moveable Line** tool **(Menu > Analyze > Add Moveable Line)** to fit a line to the collected data. Be sure to fit the line to the data collected during the initial phase of the chemical reaction.



Move to page 3.2.

8. Observe the slope of the fitted line to determine the rate at which the pressure of the gas changes. Record these data in the *Lists & Spreadsheets* application on page 3.2.



Problem 3 – Manipulation of Reaction Variable

9. Modify a variable from the investigation in Problem 2. You may want to modify any of the following variables:
   - Amount of hydrogen peroxide in the flask
   - Amount of enzyme added to the flask
   - Temperature of flask (placed in hot or cold water)
   - Type of enzyme used (use “boiled” enzyme instead)
10. Repeat the experiment from Problem 2 with a modified variable and view the collected data on page 2.1. Be sure to rinse and dry the reaction flask between experiments.
11. For each set of newly collected data, determine the rate of reaction and record it on page 3.2.

Problem 4 – Analysis

Move to pages 4.1–4.10. Answer the following questions here or in the .tns file.

Q6. Catalase is an enzyme; it is also a protein. What are the monomers of proteins?

A. amino acids
B. monosaccharides
C. triglycerides
D. nucleotides

Q7. Since catalase is a protein, where in the cell is it probably made?

Enzyme Catalysts
Student Activity

Name _______________
Class _______________

A. in the nucleus
B. in the chloroplasts
C. on the surface of the Golgi bodies
D. on ribosomes

Q8. Because catalase is a protein, where are the instructional blueprints for making catalase?

A. on the plasma membrane
B. in the DNA in the nucleus
C. on the RNA
D. in the cytoplasm

Q9. In this activity, hydrogen peroxide was the catalyst that was used to speed up the reaction.

A. True
B. False

Q10. When you used boiled catalase, you probably noticed a very slow reaction rate. Predict why this happened.

Q11. Which trial should have had the fastest rate of reaction? The trial using the flask that had ________.

A. room temperature catalase
B. boiled catalase
C. catalase on ice
D. catalase in warm water

Q12. What was the result of increasing the amount of catalase used?

Q13. What was the result of decreasing the amount of catalase used?

Q14. What graphical evidence is there to suggest that the rate of the reaction did not stay constant throughout the data collection?

Q15. As a variation of the experiment you could increase the amount of catalase but keep the amount of peroxide the same. How would the final pressure in the flask compare to that of the initial experiment (the control)?

A. It would be higher.
B. It would be lower.
C. It would be at the same level.

Enzyme Catalysis

SCIENCE NSPIRED

Science Objectives

- Students will describe the difference between anabolism and catabolism.
- Students will identify factors that affect the rate of chemical reactions.

Vocabulary

- anabolic
- catabolic
- catalase
- catalyst
- denatured
- globular proteins

About the Lesson

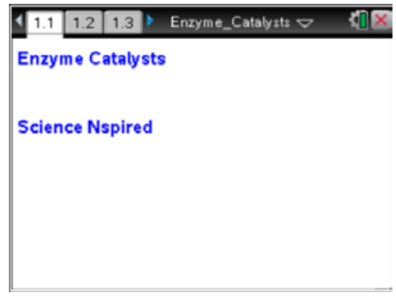
- In this activity, students will use an enzyme catalase to speed up the breakdown of hydrogen peroxide into oxygen. They will measure the pressure produced by the oxygen that is released in this reaction. Students will draw a conclusion about factors that increase or decrease the rate of this chemical reaction.
- As a result, students will:
  - Measure and graph changes in gas pressure during a chemical reaction
  - Relate the change in gas pressure to the rate of the chemical reaction
  - Draw conclusions about which variables affect the rate of reaction.

TI-Nspire™ Navigator™

- Send out the *Enzyme_Catalysts.tns* file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- *Enzyme_Catalysts.tns* document
- Vernier EasyLink™or Go!®Link interface
- Gas Pressure Sensor & Syringe
- H_2O_2
- 125 mL flask and 10 mL graduated cylinder
- Enzyme suspension
- Boiled enzyme suspension



TI-Nspire Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Collect Data with Probes

Tech Tip:

Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Enzyme_Catalysts_Student.doc
- Enzyme_Catalysts_Student.pdf

TI-Nspire document

- Enzyme_Catalysts.pdf

Teacher Preparation and Classroom Management

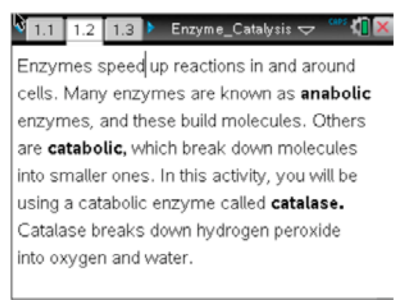
- Prepare an enzyme suspension: Place a 250 mL flask into a large beaker filled with ice so that the enzyme suspension remains cold. Place a funnel that has been lined with 2–3 layers of cheesecloth into the flask. Obtain a 2 cm cube of fresh liver (chicken, beef, or pork). Place the meat in a blender with 200 mL distilled water and blend on the highest setting for 10–15 seconds. Slowly pour the suspension through the cheesecloth and into the flask. Discard the cheesecloth with the residue. Cover the flask and keep it on ice until you are ready to use it. For best results, prepare fresh enzyme prior to each lab period.
- Prepare the boiled enzyme suspension: Pour 50–100 mL (depending on the amount needed) of the prepared suspension into a 125 mL flask, and place the flask into a boiling water bath for about 5 minutes.
- Students may record their answers to the questions on blank paper or answer in the .tns file using the Notes application.
- In some cases, these instructions are specific to those students using TI-Nspire handheld devices, but the activity can easily be done using TI-Nspire computer software.
- The following questions will guide student exploration during this activity:
  - How does the amount of pressure of the oxygen released relate to the chemical reaction rate?
  - Which variables affect the reaction rate?

Discussion Points and Possible Answers

Problem 1 – Prelab Questions

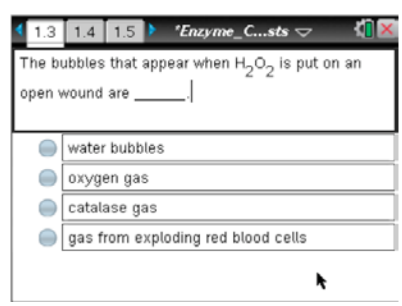
Move to page 1.2.

1. Students should open the file *Enzyme_Catalysts.tns* and read page 1.2.



Move to pages 1.3–1.7.

Have students answer the questions on either the handheld, on the activity sheet, or both.



Q1. The bubbles that appear when H_2O_2 is put on an open wound are ____________.

Answer: B. oxygen gas

Q2. Why do you think hydrogen peroxide is stored in a brown bottle?

Answer: A. Because it is photosensitive.

Q3. The following reaction would be anabolic: $A + B \rightarrow AB$

Answer: A. True

Q4. The process of cellular respiration, which is breaking glucose into water and carbon dioxide, would be a (an) ____________ reaction.

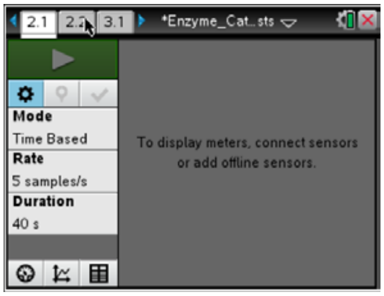
Answer: B. catabolic

Q5. Photosynthesis, which builds glucose from CO_2 and H_2O, would be a (an) ____________ reaction.

Answer: A. anabolic

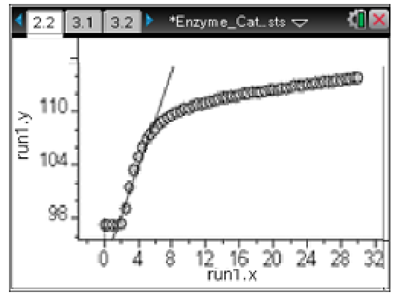
Problem 2 – Reaction Rate Data Collection

Move to page 2.1.



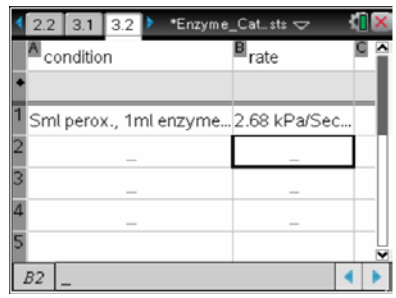
2. First students set up the experimental apparatus. They connect the EasyLink to the TI-Nspire and connect the Gas Pressure Sensor to the EasyLink. Students should set the TI-Nspire to collect data every 1 second for 30 seconds.
3. Secondly, they attach the tube to the sensor and the black stopper to the tube.
4. Next students use the graduated cylinder to measure 5 mL of hydrogen peroxide and pour it into the flask.
5. They draw 1 mL of the enzyme suspension into the syringe.
6. Then students click start on the TI-Nspire and immediately add the enzyme suspension to the flask. They should quickly put the stopper firmly in the mouth of the flask.

Move to page 2.2.



7. They should view the collected data in the Data & Statistics application on page 2.2. Use the Entry Line to set the x-axis to the variable run1.time and the y-axis to run1.pressure. Students next fit a line to the data using the **Moveable Line** tool. They should use only the initial "uphill" part of the graph for best analysis. Sometimes, this includes only 5–10 seconds of the graphed data.

Move to page 3.2.



8. Students should observe the slope of the fitted line to determine the rate of the chemical reaction. They should record these data in the *Lists & Spreadsheet* application on page 3.2.

TI-Nspire Navigator Opportunity

Quick Poll can be used here to ensure that students understand the relationships in this experiment. Ask students to explain the correlation between the rate of gas pressure changes and the rate of chemical reaction. Students should note that the rate of gas pressure change is directly proportional to the rate of the reaction.

Problem 3 – Manipulation of Reaction Variable

9. Students modify a variable in the investigation and then repeat steps 1–8. Remind students that the reaction flask should be rinsed out and dried between each experiment.
10. Each time they repeat the experiment, students should view the collected data on page 2.2.
11. For each set of newly collected data, students determine the rate of reaction and record it on page 3.2.

Problem 4 – Analysis

Q6. Catalase is an enzyme; it is also a protein. What are the monomers of proteins?

Answer: A. amino acids

Q7. Since catalase is a protein, where in the cell is it probably made?

Answer: D. on ribosomes

Q8. Because catalase is a protein, where are the instructional blueprints for making catalase?

Answer: B. in the DNA in the nucleus

Q9. In this activity, hydrogen peroxide was the catalyst that was used to speed up the reaction.

Answer: A. False

Q10. When you used boiled catalase, you probably noticed a very slow reaction rate. Predict why this happened.

Answer: The catalase was denatured by the boiling.

Q11. Which trial should have had the fastest rate of reaction? The trial using the flask that had _______.

Answer: D. catalase in warm water

Q12. What was the result of increasing the amount of catalase used?

Answer: The rate increased.

Q13. What was the result of decreasing the amount of catalase used?

Answer: The rate decreased.

Q14. What graphical evidence was there to suggest that the rate of the reaction did not stay constant throughout the data collection?

Answer: The graph was not linear.

Q15. As a variation of the experiment you could increase the amount of catalase but keep the amount of peroxide the same. How would the final pressure in the flask compare to that of the initial experiment (the control)?

Answer: C. It would be at the same level.

TI-Nspire Navigator Opportunity

Use the TI-Nspire Navigator System to collect, grade, and save the .tns file to the Portfolio. Use Slide Show to view student responses. See Note 1 at the end of this lesson.

Wrap Up

Upon completion of the lab and discussion, the teacher should ensure that students are able to understand:

- The difference between anabolism and catabolism.
- Factors that affect the rate of chemical reactions.

Assessment

The students should collect data and can complete the embedded multiple choice questions in the *Enzyme_Catalysts.tns* file. In addition, students can answer questions on the student activity sheet.

T^3 Ticket Outta Here

Day Two

I have learned …

My question is …

T^3 Ticket Outta Here

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