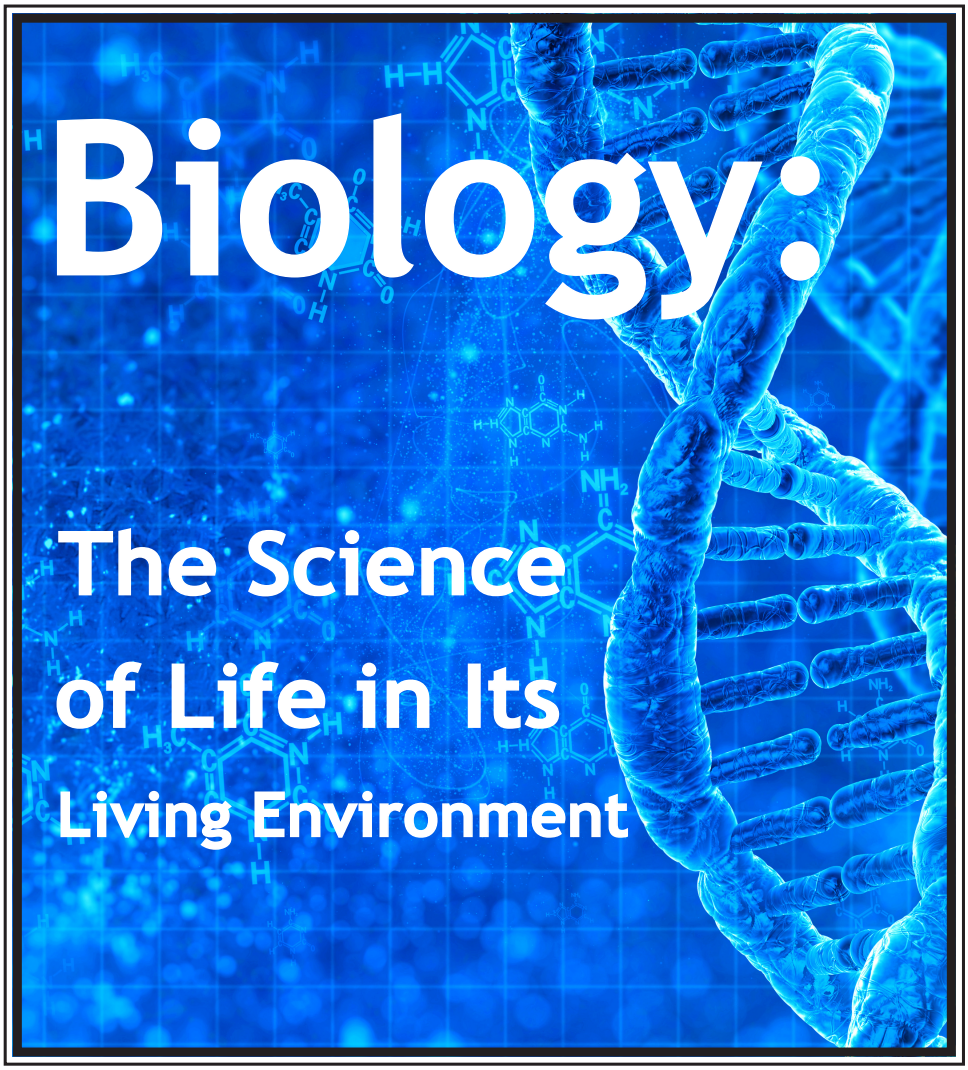
Teacher Manual
&
Answer Key
for



Aligned with Next Generation Science Standards

and

NYS Science Learning Standards

TOPICAL REVIEW BOOK COMPANY

Teacher Manual & Answer Key
for
BIOLOGY
The Science of Life in Its Living Environment

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Table of Contents

Science Engineering Practices:

Phenomenon: Human eyes have evolved to see the light given off by the Sun.

human eye Visible spectrum as colors of the rainbow

Problem: Not all people can see all colors.

Science Engineering Practices: (with illustrations)

Student must ask a question. Questions may include, but are not limited to:

– How do human eyes interpret color?

– How can I see color?

Ask a Question - Testability - Variable - Labels - Predicted Outcome

Color Vision Perception (Circles 1 – 6) Chart

Students cannot see colors if they have color deficiency. Squinting does not help. Allow students to record their own information.

1) Might be 21 as seen by an individual with red / green deficiency
2) 12, a demonstration plate, seen by all individuals
3) Might be seen 4 or 2 in a red / green color deficiency, depending on the type of red/green color deficiency.
4) Might be seen as 2 in red / green color deficiency.
5) Will not see anything or it will not look right, red-green deficiency
6) Might be seen as 3 by an individual with red / green deficiency

Histogram of Students' Perception of the Ishihara Chart

Number of Students	True Image	Reported Image	True Image	Reported Image	True Image	Reported Image	True Image	Reported Image	True Image	Reported Image	True Image	Reported Image
35 - 36												
33 - 34												
31 - 32												
29 - 30												
27 - 28												
25 - 26												
23 - 24												
21 - 22												
19 - 20												
17 - 18												
15 - 16												
13 - 14												
11 - 12												
9 - 10												
7 - 8												
5 - 6												
3 - 4												
1 - 2												
	Circle # 1		Circle # 2		Circle # 3		Circle # 4		Circle # 5		Circle # 6	

Clarifying Questions:

1. Circle 2, the image 12 was easiest to decipher.
2. If the person has normal vision, no plates were difficult. I person with red / green color deficiency will have difficulty with circle 5, image of 16. Student might report not seeing anything at all.
3. Difficulty might be reported as not seeing an image. Squinting will not help the person see color.
4. Yes, (student might consider color deficiency) *or* No, (student might infer normal vision)
5. Student elaborates on vision
6. Yes, Circle 2, image 12.
7. Most likely circle 5, image 16. Students who cannot see image will interpolate and image. Circle 3, image 42 where some students will see 42 or 4 or 2.
8. A trend might be that more people can see full color.
9. Students may find out that they have full color vision.
   or Some students may find out that they have some color issues. Follow up with doctor is recommended.
10. Students might reference the Science of Engineering Practices; modeling and phenomenon.
    or Students might reference the Crosscutting Concepts; claim after experimentation, sketching a model

Crosscutting Concepts:

Claim: Not all people can see all of the colors of visible light. *or* There were no differences in the way our class saw the images.

Patterns

Are there patterns with ...
- ***repeats** in the data?*
- *cycles or events?*
- ***correlation** in variables?*

Answers may include, but are not limited to:
- There was no pattern to the differences in the way the students viewed the images
- All students saw all of the images correctly.
- Students who could not see all of the colors had problems with the same image.
- Only boys had difficulty with seeing all of the images correctly.
  (Side note: Girls may have color deficit, it is just less common)

Illustrations may include, but are not limited to:
- eyes looking at dots in a circle
- rough graphs

sketch a model – illustrate patterns – describe patterns – explain correlations

Conclusion: After testing color vision and class discussion, it is determined that not all people can see all of the colors.

Lab Investigation 1: Laboratory Safety

Objective: Students will be able to do the following:

- Follow safety rules in the laboratory
- Select and use correct instruments
- Use a balance to measure mass
- Use a graduated cylinder to measure volume
- Use a metric ruler to measure length
- Use a thermometer to measure temperature

TEKS (b) [2 A, B], [3 A, B], [4A, B], 6, 7
(c) [1C, D, H]

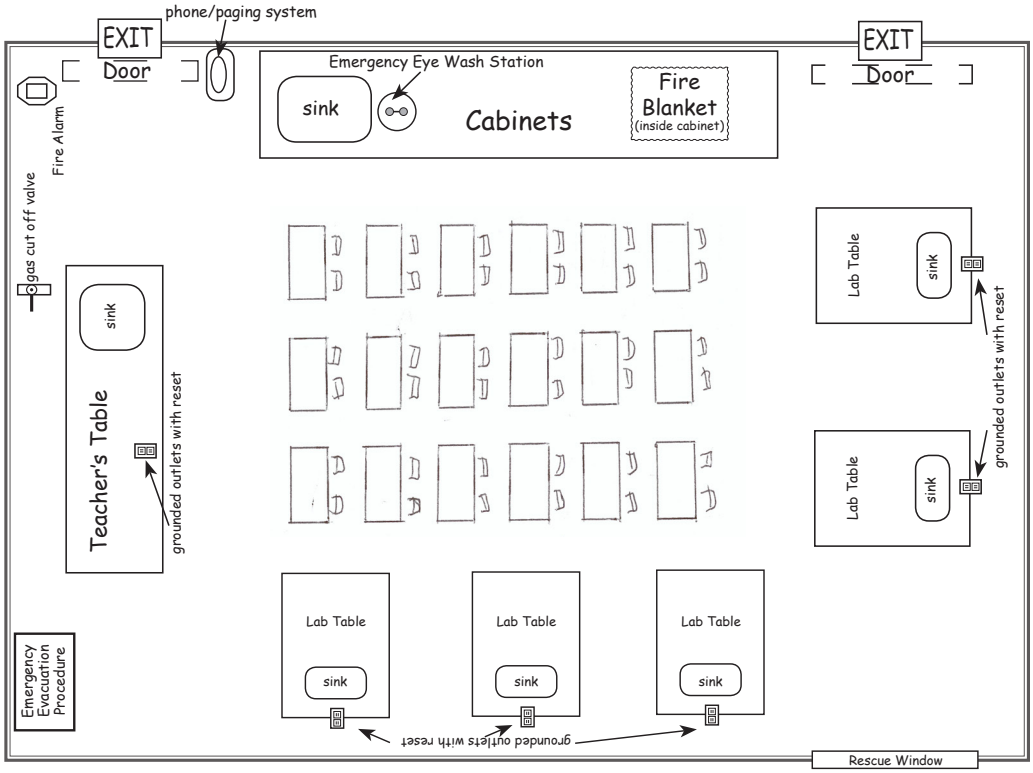
Items found in Laboratory – Name, Uses and Possible Hazards:

1. **Graduated Cylinder**: A long narrow piece glassware that has small markers on the side.
   Usage: measure volume. Hazards: Glass breaking. Glass does not change appearance when heated.
2. **Test Tube**: Long narrow piece glassware that has no marks on the side. Usage: experiment, or test, liquids.
   Hazards: Glass breaking. Glass does not change appearance when heated.
3. **Metric Ruler**: A device, which may be made of plastic, metal or wood. Usage: Measure length.
4. **Beaker**: A wide mouthed piece glassware that has markers on the side. Usage: Measure volume.
   Hazards: Glass breaking. Glass does not change appearance when heated.
5. **Slides**: Small, thin, rectangular sheet of glass.
   Usage: Holds material which is being viewed under a microscope. Hazards: Glass breaking.
6. **Heat Lamp**: An electrical appliance used to heat materials. Hazards: Glass breaking. Glass does not change appearance when heated. May have electrical issues if wires are frayed, can have burning hazard.
7. **Erlenmeyer Flask**: A tapered flask, has a wide bottom but is narrow-mouthed piece glassware* that has markers on the side.
   Usage: Measure volume. Hazards: Glass breaking. Glass does not change appearance when heated.

Describe the objects and have your teacher initial that they have been located.

1. **Emergency Eye Wash Station:** A water fountain station that has two sprinkler head nozzles for the eyes.
2. **Gas Cut Off Valve**: A lever that is at the teacher's desk.
3. **Fire Blanket**: A gray blanket that is usually housed in a bright red metal box.
4. **Fire Alarm (visual/auditory)**: A small box mounted to the wall with both a speaker and a flashing device.
5. **Rescue Window**: A window that readily opens so that people can exit in the event of emergency.
6. **Phone – Paging System**: Either a phone, or is a push button paging system that is located near the classroom speaker.
7. **Emergency Evacuation Procedures**: Information about evacuation that is posted near the door.
8. **Exit Signs**: 6-inch-tall illuminated letters near every exit.
9. **Grounded outlets with Reset**: Outlets with three prongs and a red reset button in it
10. **First Aid Procedures**: A notice of how to prepare and react to a medial emergency.

The **"My Lab Room Layout"** should reflect the layout of the student's class lab room. **ALL** 10 objects, defined from previous exercise, should be **drawn** in layout and **labeled.** ***Answers will vary but may similar to the example:***



Conclusion: It is important to understand how to properly read directions and to understand the basic safety issues in a biology laboratory because one can get hurt or ruin the experiment.

Lab Investigation 2: Variables

Objective: The objective of the laboratory activity is to understand how variables interact.

SCIENCE AND ENGINEERING PRACTICES

Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)

DISCIPLINARY CORE IDEAS

1. ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (Secondary to MS-PS1-6)

CROSSCUTTING CONCEPTS

Patterns

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)

TEKS (b) 2, [3 A, B], [4 A, B]
(c) [1A, B, C, D, E, F], [2A, B], [4 A]

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** Science experiments include different variables that are have a relationship to each other.

Asking Questions

ask questions
- each other
- the texts
- the phenomena
- observations

Answers may include, but are not limited to:

Students talk to each other, may read texts, discuss phenomenon, may discuss observations.

Sketch Your Model

Vocabulary:

Independent Variable: The independent variable is the component of the experiment that is being tested.

Dependent Variable: The dependent variable is a change that happens as a result of the experiment of the independent variable, it is also measured.

Controlled Variable: The control variable is there to know that the independent variable did affect a change, it is not tested.

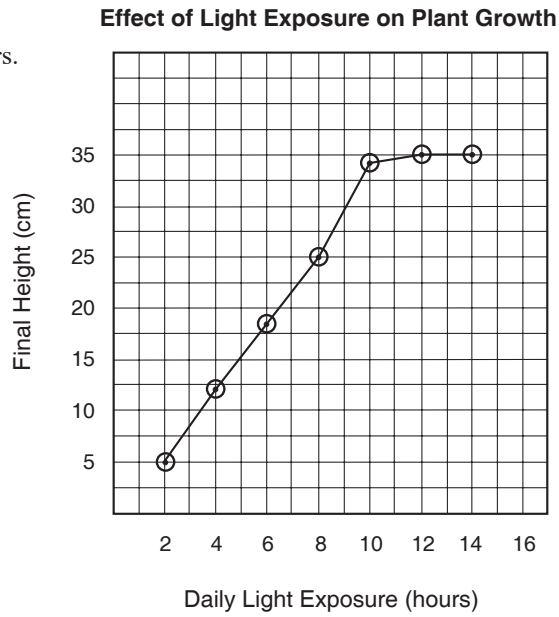
Hypothesis: The hypothesis is the suggested relationship of two variables.

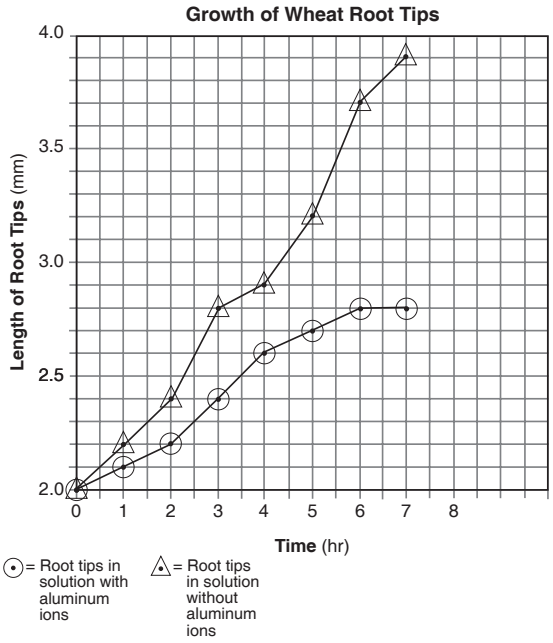
Investigative Statement: Investigative statement is more than a hypothesis in that it not only is a suggested relationship of the two variables, but it includes an illustrated prediction as well as the inclusion of the current state. It consists of a small box with the terms; "variables", model", "prediction", explanation", "labels", and "arrows", written along the bottom of the box.

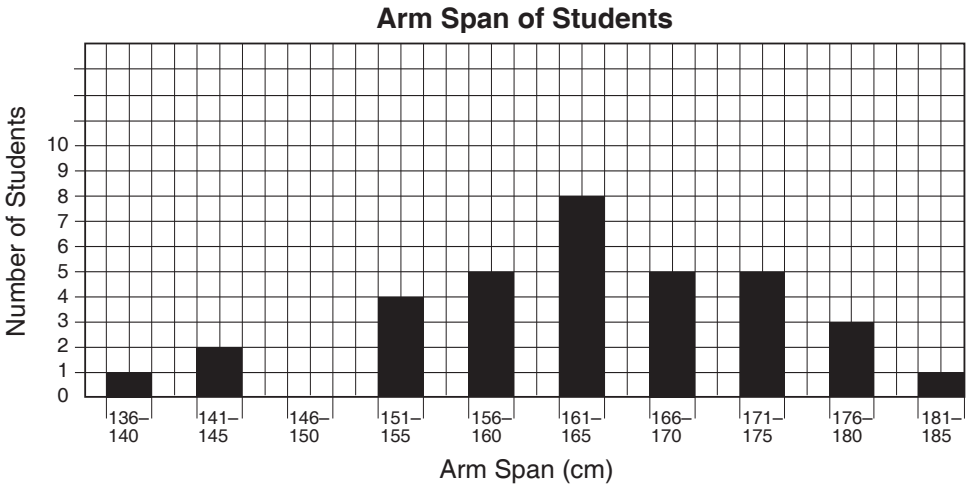
Effect of Light Exposure on Plant Growth Data Table	
Daily Light Exposure (hours) 2	Final Height (cm) 5
4	12
6	18
8	25
10	34
12	35
14	35

Clarifying Questions:

1. **Independent Variable:** The independent variable is daily light exposure in hours.
2. **Dependent Variable:** The dependent variable is height in centimeters (cm).
3. **If** – plants are exposed to light for different time in hours,
   then – there would be a difference in plant height
   because – plants generate nourishment from light. (more light = taller)
4. **Independent Variable:** The independent variable is time in hours.
5. **Dependent Variable:** The dependent variable length of root tips in millimeters.
6. **Control Variable:** The control variable is of root tips in solution without aluminum ions.
7. **Hypothesis:** **If** – aluminum ions were put in solution on wheat root tips,
   then – growth would be stimulated
   because – aluminum ions stimulate cell division.
8. The rate of change is not steady because it is not a straight line.







9. No. The variables cannot be predicted for data not shown on this graph because the relationship is random.
10. Study could be improved by: – grouping all physical attributes per person. – comparing body proportions.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:*** Variables, when tested can answer scientific questions.

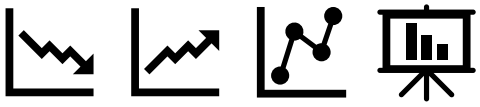
Patterns

Are there patterns with ...
- ***repeats*** *in the data?*
- *cycles or events?*
- ***correlation*** *in variables?*

Answers may include, but are not limited to:

– As one variable increased in value, the other variable increased in value.

Illustrations may include, but are not limited to:



sketch a model – illustrate patterns – describe patterns – explain correlations

Conclusion: Variables, when tested provide patterns that can easily be plotted to illustrate relationships.

Lab Investigation 3: Experimentation

Objective: The objective of this lab is to understand the steps of the scientific method so that students can replicate findings of other scientists and know how to create work that, also, can be duplicated

SCIENCE AND ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)

DISCIPLINARY CORE IDEAS

ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

CROSSCUTTING CONCEPTS

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

TEKS (b) 2, 3B, [4 A, B], 6, 7
(c) [1A, B, C, D, E], 4A

Science, Technology, and Engineering Practices:

Phenomenon: ***Answers may include, but are not limited to:***

Science experiments are considered valid if they can be replicated with similar results.

Constructing Explanations

- *construct explanations*
- *designing solutions*
- *design, evaluate, and refine a solution*

Illustrations may include, but are not limited to:

Scientist perform experiments and take careful notes so the work can be replicated.

Sketch Your Model

Experiment Notes: Experiment requires Petri dishes and grass seed. Grass seed grows quickly; seed should be barely covered by soil. It is recommended to begin on a Friday, allow some growth over the weekend then spend Monday – Friday with observations.

The independent variable is: water *or* sunlight *or* temperature *or* plant food

Record all information about the independent variable relating to what changes will be done to Petri Dish *B*.

Answers will very based on students should notes taken on their daily implementation of the care of the plants.

Example: Petri dish B is receiving 50 ml of water

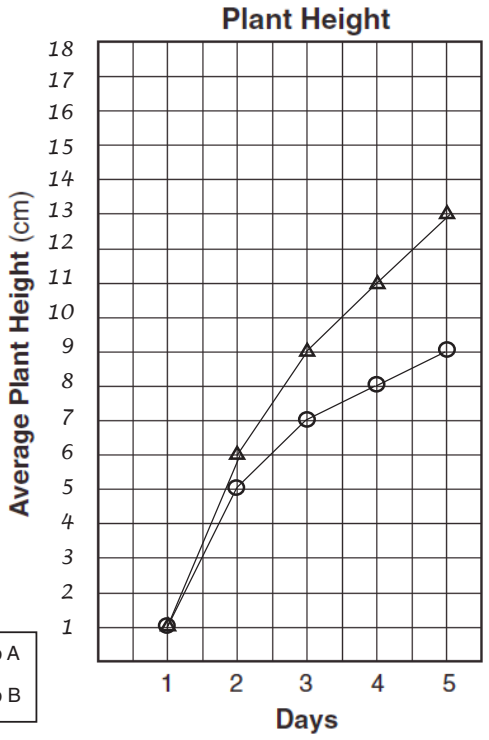
Answers will vary but may similar to the example below:

Plant Growth Over 5 Days					
Petri Dish	Day 1	Day 2	Day 3	Day 4	Day 5
A	seeds sprout	seedlings grow	7 mm	8 mm	9 mm
B	seeds sprout	6 mm	9 mm	11 mm	13 mm

Predict: Students should make a reasonable prediction related to their variable.

Answers will vary but should be based on the data from the Plant Growth chart.

- *Petri Dish A should have* ***each point with a circle and connect the dots.***
- *Petri Dish B should have* ***each point with a triangle and connect the dots***



Clarifying Questions:

1. The independent variable in this experiment is (whatever is being performed in petri dish *B*).
2. The dependent variable in this experiment is plant growth.
3. The control variable is dish *A*.
4. The change in [water / sunlight / temperature / plant food] caused a change in plant growth.
5. Yes or no
6. Yes: outcome similar to prediction No: outcome different than prediction
7. Difficulties may be that changes introduced to dish *B* to far from needs of grass to grow, too much water / not enough / too little light
8. Students must reflect on changes to Dish *B*
9. Groups with positive plant growth, can pool their ideas as to what makes plants grow best.
10. The information could relate to horticulturists in that you could find out how plants grow.

Crosscutting Concepts:

Claim: ***Answers may include, but are not limited to:***

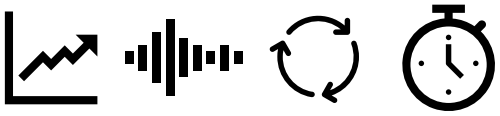
Independent variable influences the dependent variable.

Scale, Proportion, and Quantity

Simple tests can determine a phenomenon is dependent on
- scale
- proportion
- quantity

Images may include relationship graphs, time, repeats, or patterns.

Illustrations may include, but are not limited to:



sketch a model – use boxes to show proportion – use labels

Conclusion: ***Answers may include, but are not limited to:***

– An important part of science is to be able to have an experiment that can be replicated with similar results.
– Scientists follow a methodology in their experimentation.
– Students can create their own repeatable experiments using the same methodology.

Lab Investigation 4: Using A Microscope

Objective: This investigation is to learn appropriate handling and use of a microscope.

SCIENCE AND ENGINEERING PRACTICES

Asking Questions and Defining Problems

Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

DISCIPLINARY CORE IDEAS

The use of the microscope is essential to the study of the biological sciences. No discrete Disciplinary Core Idea is written sole for the purpose of using a microscope.

CROSSCUTTING CONCEPTS

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

TEKS (b) 2, [3A, B], 6, 7
(c) [1A, B, C, D, E

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** Microscopes are tools that enable scientists to view very small objects.

Asking Questions

ask questions
- each other
- the texts
- the phenomena
- observations

Ask a question - May include, but are not limited to:

- How are microscopes useful?
- What is the proper usage of a microscope?
- How can microscopes help in science?

Illustrations may include, but are not limited to:

Sketch Your Model

Pre-Lab:

a. *Both* A and C
b. E
c. Responses may include, but are not limited to: enlarged – upside down – backward – more detail

Compound Magnification Calculation Chart

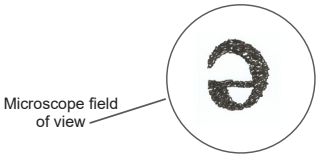
Answers will vary based on the objectives on the microscopes used in your classroom. The chart should be filled in for reference.

TEACHER LAB NOTE

If a student sees spiders through the microscope lens, they are seeing their own eyelashes.

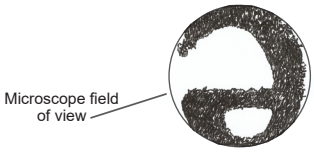
Low Power Magnification

Record Observations: The e upside down and larger.



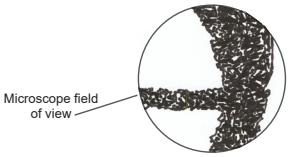
Medium Power Magnification

Record Observations: It looks the same as low power but include paper easier to see, e ink not smooth.



High Power Magnification

Record Observations: It looks the same as medium power but add e too big for view.



Clarifying Questions:

1. Microscopes are used to magnify objects too small to be seen with the naked eye or with the aid of a magnifying lens.
2. Microscopes help biologists study cells by making microscopic organisms visible.
3. *The magnification of the low power lens is whatever is written on the specific microscope in the classroom.*
4. The low power compound magnification is the product of the low power lens and the eyepiece lens which is 10.
5. *Responses may include, but are not limited to:* – enlarged – upside down – backward – more detail
6. *Responses may include, but are not limited to:* – Surprised to see that letter is upside down / backwards.
   – Mention of spiders, they are eyelashes.
7. *Responses may include, but are not limited to:* – "e" larger than field of view, fibers of paper visible
8. Carefully place a cover slip on the material to be examined and the slide. Use the pipette to put a drop of water on one edge of the cover slip and use a small piece of paper towel on the opposite side of the cover slip to draw the water through from under the cover slip.
9. The average length of a single cell is 200 micrometers (μm). If one millimeter (mm) equals 1000 micrometers (μm), divide 100 by 5.
10. Microscopes are useful in the biological sciences by study of the biological sciences by allowing students to properly use the equipment so that further investigations can be made.

Crosscutting Concepts:
Claim: ***May include, but are not limited to:*** The function of a cell determines its shape.

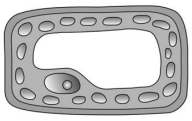
Structure and Function

How is the object:
- shaped
- structured
- properties and functions
How do structures play a role in the function of the system?

Sketch a Model:
- All Microscope should be labeled, animal cells are round to create tissues that can be flexible, plants cells have rigid cell wall to add to plants' upright structure.

Sketches may include, but are not limited to:





sketch a model – what are the shapes – how does it work – variables – use labels

Conclusion: ***May include, but are not limited to:*** A microscope is an essential tool in the biology lab. One can see very tiny pieces of tissue or entire cells. It is important to know the parts and the function of the microscope to achieve best results.

Lab Investigation 5: Viewing Animal & Plant Cells

Objective: In this lab, animal and plant cells will be compared and contrasted.

SCIENCE AND ENGINEERING PRACTICES
Asking Questions and Defining Problems
Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
- Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

DISCIPLINARY CORE IDEAS
LS1.A: Structure and Function
All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)

CROSSCUTTING CONCEPTS
Structure and Function
Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)

TEKS (b) 2, [3A, B], [4A, B], 7
(c) [1A, B, G], [2A, D], 3A, [5B, C], [12A, B]

Science, Technology, and Engineering Practices:
Phenomenon: ***May include, but are not limited to:***
- Cells are the basic unit of life.
- All life functions ca be carried out be a single cell.
- With a microscope, we can compare and contrast animal and plant cells..

Planning and Carrying Out Investigations

- plan investigation
- gather data
- produce evidence
- include measurements
- consider limitations on the precision

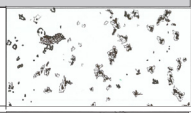
May include, but are not limited to:
Using a microscope, we can see cells.

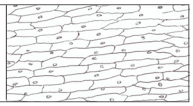
Sketches below may include, but are not limited to:

Sketch Your Model

Animal the cells come from that you are viewing? Student needs to fill in properly

Name of tissue are you viewing? Student needs to fill in properly

Animal Cells	
Low Magnification	
Medium Magnification	
High Magnification	

Plant Cells	
Low Magnification	
Medium Magnification	
High Magnification	

Clarifying Questions:

1. The cell theory states that:
   - All organisms are composed of one or more cells, that vital functions of an organism occur within cells
   - All cells come from preexisting cells,
   - All cells contain the hereditary information necessary for regulating cell functions and for transmitting information to the next generation of cells.
2. *Answers may vary, but are not limited too:* (***Note:*** *Do* ***not*** *accept answers without explanation.*)
   – If a student states the plant cell was easier to view, the student must give clear statements as to why. Statements may include cell wall, large central vacuole.
   – If a student states the animal cell was easier to view, the student must give clear statements as to why. Statements may include the stain enhanced the view, the organelles were more clear.
3. The small parts in a cell called organelles.
4. Answers vary, most include *two* parts of the cell and their functions:
   Nucleus: Holds genetic material
   Membrane/Cell wall: Provides support and protects the cell
   Ribosomes: Make protein
   Lysosome: Contains digestive enzymes to help break food down
   Vacuole: Stores material
   Golgi Apparatus: Make, process and package proteins
   Centriole: Helps in division
5. *Answers may vary, but are not limited too:* nucleus, vacuole, membrane
6. *Answers may vary, but are not limited too:* nucleus, vacuole, cell wall, chloroplasts
7. *Answers may vary, but are not limited too:* both cells have nucleus, vacuole that are visible under a microscope, they also perform all of the functions of life.
8. *Answers may vary, but are not limited too:*
   – Plant cells have a single large and proinent vacuoles, liquid-filled organelles. Animal cells may or may not contain one or many smaller vacuoles.
   – Plant cells have but animal cells do not: rigid cell wall, chloroplasts, lysosomes.
   – Animal cells have but plant cells do not: centriols.
   – Plant cells are usually larger and rectangular in shape. Animal cells are spherical in shape.
9. This is an individualized answer. Students should explain why it surprised them.
10. Students should explain Cell Theory and describe what was viewed under a microscope.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:*** Cells have different organelles based on the different functions of the cell.

Structure and Function

How is the object:
- shaped?
- structured?

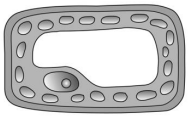
What is the objects:
- properties?
- functions?

How do structures play a role in the function of the system?

Sketch a Model - ***May include, but are not limited to:***
- All sketches must be labeled and description of how form precedes function

Sketches may include, but are not limited to:





sketch a model – what are the shapes – how does it work – variables - use labels

Conclusion: ***May include, but are not limited to:*** Animal cells only have a membrane that gives flexibility.
or Plant cells have a rigid cell wall that gives support. *or* Plant cells have chloroplasts that support photosynthesis.

Lab Investigation 6: Cell City

Objective: The objective of this lab is to understand the functions of a cell by illustrating it as a city or a farm.

SCIENCE AND ENGINEERING PRACTICES

Asking Questions and Defining Problems

Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

DISCIPLINARY CORE IDEAS

LS1.A: Structure and Function

All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)

CROSSCUTTING CONCEPTS

Structure and Function

Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)

TEKS (b) 2, [3A, B], 4A
(c) [1A, B, G] [2A, D], [5A, B, C], [12A, B]

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:***

- All organisms are composed of one or more cells, and vital functions of an organism occur within cells.
- All cells come from pre-existing cells.
- All cells contain the hereditary information necessary for regulating cell functions and for transmitting information to the next generation of cells.

Developing and Using Models

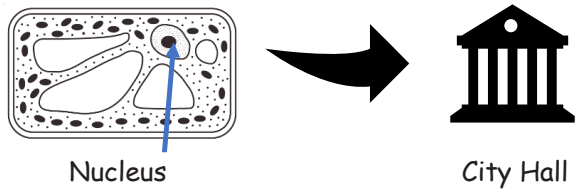
- *identify variables*
- *develop models to predict outcomes*
- *illustrate relationships*

May include, but are not limited to:

– Image of cell, organelles defined

– Image of city, correlating buildings defined.

Sketches may include, but are not limited to:



Sketch Your Model

Organelles	Functions	Animal Cell	Plant Cell
Cytoskeleton	give shape, act as tracks for the movement of organelles, aid division, give strength, aid movement *nucleus*: stores and protects the DNA	X	X
Endoplasmic Reticulum	production of proteins and lipids, breakdown of drugs and alcohol	X	X
Ribosome	link amino acids together to form proteins	X	X
Vacuole	sac used for storage of materials, typically quite large in plant cells	X	X
Lysosome	sacs containing enzymes that defend a cell from invaders and break down worn-out cell parts	X	X
Golgi Apparatus	processes, sorts, and delivers proteins	X	X
Chloroplast	carry out photosynthesis to convert solar energy into energy-rich molecules		X
Mitochondria	supply energy to the cell by converting molecules from food into usable energy	X	X
Cell Wall	rigid layer surrounding the cell membrane in plant, algae, fungi, and most bacteria cells; provides protection, support, and shape		X
Nucleus	regulate protein synthesis and the production of hormones, often referred to as the control center of the cell	X	X

City Cell and Farm Cell - After deciding which cell digram to draw, the proper organelle should be written in the chart that the student will use to draw from.

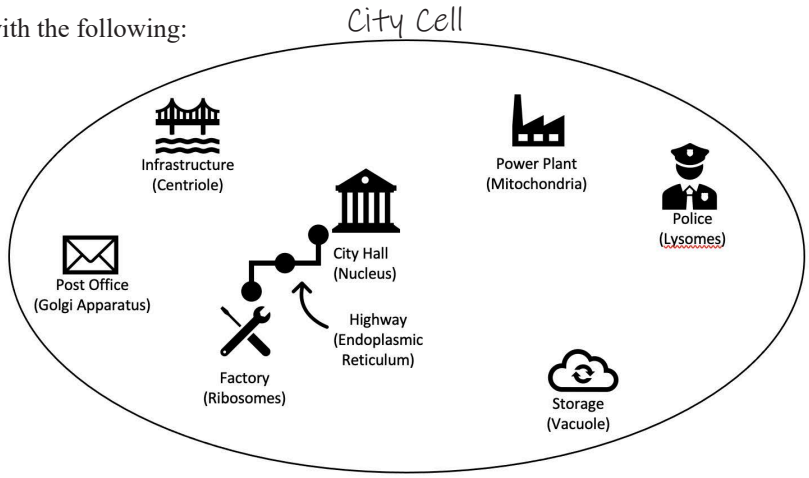
City Chart:

Municipal Function:	**Organelle**
Highway Department: roads and bridges in town	Endoplasmic Reticulum
Police Department: protects against bad materials	Lysome
City Hall: Government seat; runs the city / town	Nucleous
Factory: manufactures material for use of the city	Ribosome
Power Station: supplies energy	Mitochondria
Shipping: packages materials for export out of the city	Golgi Apparatus
Storage: keeps materials for a later time	Vaculole
Port: Imports and exports products	Cell Membrane

Farm Chart:

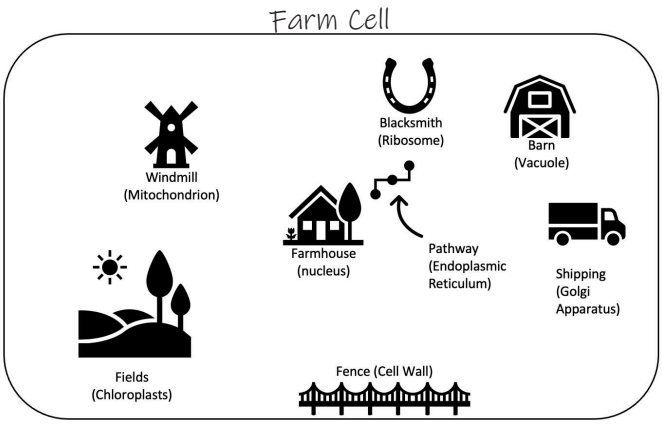
Agricultural Function:	**Organelle**
Highway Department: roads and bridges in town	Endoplasmic Reticulum
Compost Heap: stores unused material	Vacuole
Farm House: Runs the farm	Nucleous
Blacksmith: manufactures material for use of the farm	Ribosome
Windmill: supplies energy	Mitochondria
Shipping: packages materials for export out of the city	Golgi Apparatus
Barn: keeps materials for a later time	Vaculole
Field: where food is grown	Chloroplast
Fence: defines the farm, keeps unwanted animals out of farm	Cell Wall

Cell Diagram - The chosen cell diagram should be drawn with the following:
Drawings will vary but may similar to the diagrams below:



City Cell:
1) oval frame
2) title "City Cell" written
3) All functions must be drawn according to the City Chart
4) All organelles need to be properly labeled.

Farm Cell:
1) Rounded rectangular frame
2) title "Farm Cell" written
3) All functions must be drawn according to the Farm Chart
4) All organelles need to be properly labeled.



Clarifying Questions:
1. Answer: city *or* farm, with a written explanation why the group choose the city or farm. (**Note:** *Be sure that city correlates with an animal cell, farm correlates with a plant cell.)*
2. Organelles should match city or farm function.
3. Even single celled organism came from another cell through mitosis.
4. A single celled organism can perform the life functions of a multi-cellular organism.
5. Two waste products given off by the mitochondrion are water, H_2O a[illegible] CO_2.
6. The mitochondrion produces adenosine triphosphate or ATP.
7. The ribosome synthesized the protein that the cell exported.
8. The golgi body exported the protein that the cell synthesized.
9. A single celled organism can perform all of the life functions that a multi-cellular organism can.
10. **Respiration:** a multicellular organism utilizes a respiratory system to exchange gases, a single celled organism utilizes a cell membrane to exchange gases.
    Locomotion: a multicellular organism, animals utilizes limbs to move plants use phototropism, single celled organisms utilize cilia, flagella or pseudopods.
    Respiration: a multicellular organism utilizes a respiratory system to exchange gases, a single celled organism utilizes a cell membrane to exchange gases.
    Digestion: a multicellular organism utilizes a digestive/excretory system breaks down food, a single celled organism uses a process called phagocytosis.
    No reaction to stimuli.

Crosscutting Concepts:
Claim: ***May include, but are not limited to:*** Different activities are dependent upon one another.

Scale, Proportion, and Quantity

Simple tests can determine a phenomenon is dependent on:
- scale
- proportion
- quantity

Students would discuss the functions of a larger system, either a city or a farm.

Sketches may include, but are not limited to:

sketch a model – use boxes to show proportion - use labels

Conclusion: ***May include, but are not limited to:*** Organelles are parts of a cell that make the cell function. Each organelle has a function to contribute to the life of the cell. In constructing a model, using an analogy of a farm or a city, we can see how cells function.

Lab Investigation 7: Body Systems

Objective: The objective of this investigation is to investigate organ systems as they relate to life functions.

SCIENCE AND ENGINEERING PRACTICES
Planning and Carrying Out Investigations
Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)

DISCIPLINARY CORE IDEAS
HS-LS1-2.

- Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

CROSSCUTTING CONCEPTS
Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

TEKS (b) 2, [3A, B], [4A, B], 7
(c) [1A, G], 4A, 5C, 11A, [12A, B]

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** Organ systems are groups or organs with a similar function.
or The body is made of different organ system that relate to organelles of a single cell.

Planing and Carrying Out Investigations

- plan investigation
- gather data
- produce evidence
- include measurements
- consider limitations on the precision

Sketches may include an organelle and organ system with an explanation.
– How do body systems interact with one another?
– How does [a specific body system] work?
– What happens if a body system breaks down?

Sketch Your Model

Student's recordings at rest: ***Answers will vary but be similar to the diagram below:***

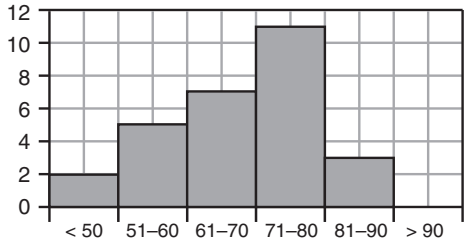
Breathing	Heart Rate	Skin Condition
-normal -calm -relaxed	average teen at rest: 60 - 100 pr/min* (If an athlete it may be slightly slower at rest.)	-normal -healthy color (should ***not*** be flushed or moist at rest)

Student's recordings after 25 Jumping Jacks: ***Answers will vary but be similar to the diagram below:***

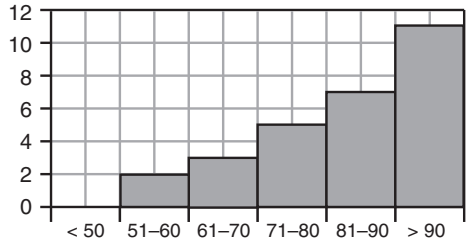
Breathing	Heart Rate	Skin Condition
-more rapid -labored -faster -heavier	student's heart rate should be slightly elevated from the heart rate recorded when at rest.*	-slightly warmer -slightly pink/red in color -slightly flush -slightly moist

**** You may use the histogram to help determine how Heart Rate at rest and after activity, may very among a classroom of students.***

Resting Pulse Rate



Pulse Rate After Activity



A. Muscular; moving muscles, Respiratory; in breathing, Excretory; sweating (if they broke a sweat), Nervous; to make your muscles move, then to respond to stimuli, Skeletal; to hold muscles that move, Circulatory; to increase the blood flow to muscles that need more oxygen.

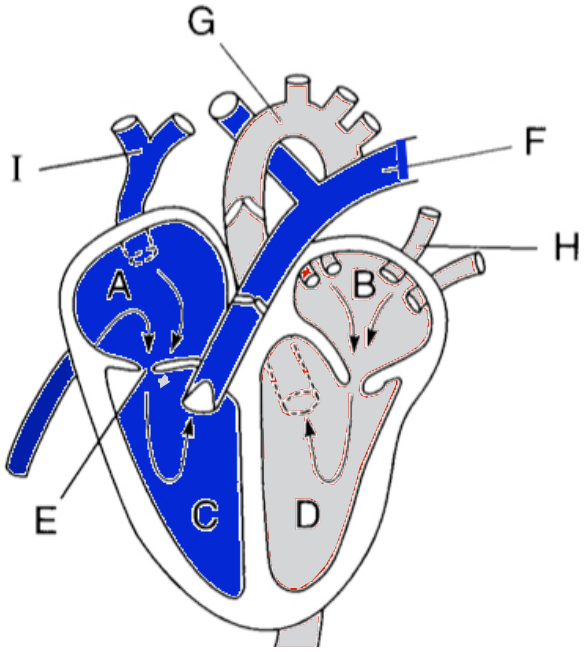
B. The exercise would not be able to occur.

Pulmonary refers to which body system? The respiratory system

Color the areas that are low oxygen blue. blue

Color the areas that are high oxygen red. red

A – Right atrium
B – Left Atrium
C – Right Ventricle
D – Left Ventricle
E – Tricuspid Valve
F – Pulmonary Artery
G – Aorta
H – Pulmonary Vein
I – Vena Cava



Comparison of Organelles and Organ Systems:

Organelles:	**Organ System:**
• Cell Membrane	• Circulatory System
• Vacuoles	• Digestive System
• Golgi bodies	• Excretory System
• Flagella, cillia, pseudopodia	• Muscular System
• Nucleus	• Nervous System
• Cell membrane	• Respiratory System
• Cell wall, cytoskeleton	• Skeletal System
• Binary fission	• Reproductive System

Overall function that organelles and organ systems have in common: They both maintain homeostasis for the organism.

Clarifying Questions:

1. Circulatory system, digestive system, excretory system, nervous system, respiratory system, skeletal system, and reproductive system were correlated.
2. No, there is no organelle for reproduction in single cellular organisms.
3. The only organs system that is not necessary for the life of an individual is the reproductive system.
4. "B" belongs to the muscular system.
5. "D" belongs to the skeletal system.
6. The individual would have difficulty moving the arm if there were a problem with any one of the body systems in the image. The individual might also be in tremendous pain.
7. The structure that uses both chemical and mechanical means to digest food is the mouth.
8. (a) If a substance is resistant to an acid environment, then a basic environment would be digested in the intestines.
   (b) If a foreign substance is resistant to an acid environment, then a basic environment would dissolve the material.
9. Refer to the outline of the body systems, be sure that all three parts of the question is answered.
   Digestive system malfunction may include and possible causes:
   – *Indigestion:* It may occur by eating too quickly or too much.
   – *Gastritis*: Insufficient mucosal production / stomach acid burning stomach lining
   – *gall bladder inflammation*: Overproduction of gall stones can cause this condition.
   – *Cirrhosis of the liver*: Possible causes could be: hepatitis, excessive alcohol consumption.
   – *Peritonitis*: Inflammation of the intestines. Possible causes could be: pH imbalance, parasites, gastritis
   – *Appendicitis:* Inflammation of the appendix.
   • Problems with the digestive system can reduce required nutrients for the other body systems

Circulatory system malfunction may include and possible causes:

- thrombosis: blood clots that form in the veins caused by excessive sitting or genetics
- hemophilia: body's inability to properly clot blood genetic predisposition autoimmune diseases can cause a form of hemophilia
- blocked arteries: plaque build-up in the arteries insufficient exercise.
- cardiac arrest: heart stops a regular beat without immediate care results in death
- Problems with the circulatory system can reduce transport or oxygen and nutrients for the other body systems

Respiratory system malfunction may include and possible causes:

- asthma: Inflammation of bronchioles and lungs can be autoimmune or environmental.
- bronchitis: Inflammation of the tubes leading to the lungs. Results in coughing. It may be caused by influenza.
- emphysema: Shortness of breath caused by damaged alveoli (lung air sacks) due to smoking.
- chronic obstructive pulmonary disease: emphysema and chronic bronchitis together due to smoking
- spontaneous pneumothorax: lung collapse due to air outside of the lung inside the chest

• Problems with the circulatory system can reduce required oxygen for the other body systems

Excretory system malfunction may include and possible causes:

- *Constipation:* The inability to defecate for some time. Possible causes could be: stress, a lack of drinking water, some medications. Over-the-counter medications can ease symptoms.
- *Diarrhea:* sudden, almost explosive expulsion of fecal matter. Possible causes could be: eating bad food, drinking foul water, or parasites.
- *Kidney failure:* Kidneys can no longer filter toxins out of the blood, dialysis is often required. Diabetes is a common cause of kidney failure.
- *Obstructive bowels:* It can be caused by peritonitis.

• Problems with the excretory system can reduce the removal of toxins for the other body systems

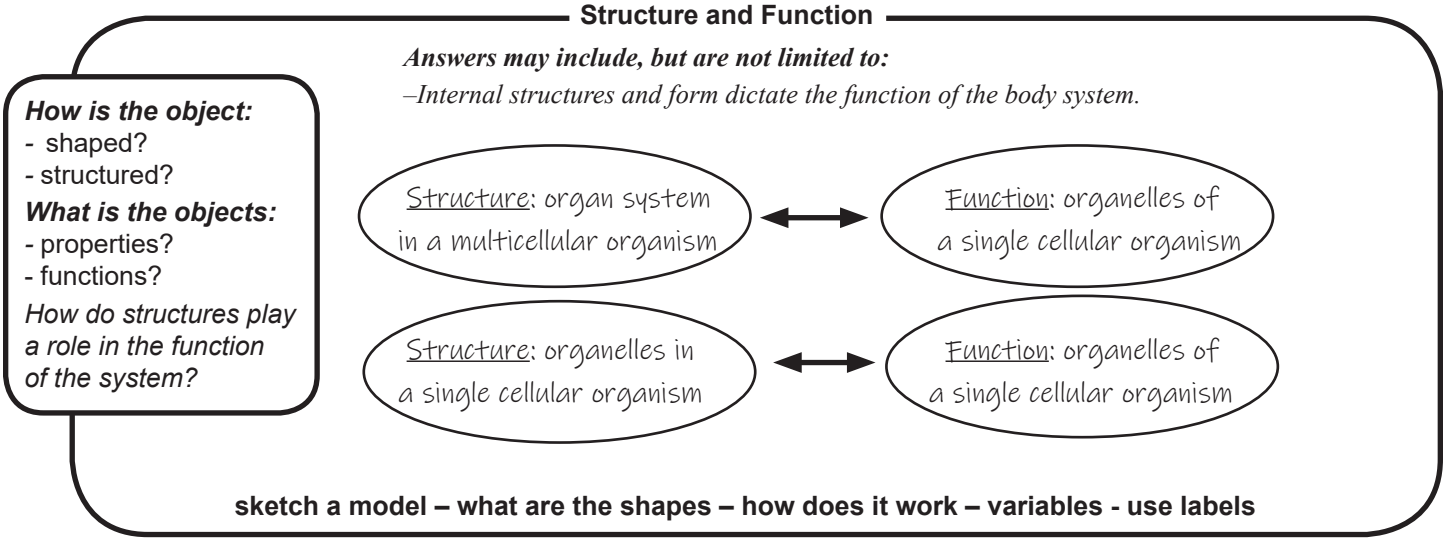
Nervous system malfunction may include and possible causes:

- *Headache* is pain in the head caused by fatigue or stress.
- *Migraine* is an intense form of headache that is associated with serotonin levels.
- *Radiculopathy* is loss of sensation of feeling on extremities caused by nerve impingement (pinching)
- *Stroke* is when artery to the brain is blocked results in loss of neurological ability .
- Problems with the nervous system can reduce the body's ability to communicate with the other body systems

10. The organism as a whole have organ systems that work together to maintain the heath of the organism.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:*** The organ systems of a multicellular organism functions similarly to that of the organelles of a single celled organism



Conclusion: ***May include, but are not limited to:*** The organ systems in a multicellular organism are very much like the organelles in the cell. The organ systems are necessary for the function of the organism. Failure of one organ system can cause grave health issues to the entire system.

Lab Investigation 8: Measuring Photosynthesis

Objective: The objective of this investigation is to measure the output of photosynthesis by measuring the amount of oxygen produced.

SCIENCE AND ENGINEERING PRACTICES

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

DISCIPLINARY CORE IDEAS

LS1.C: Organization for Matter and Energy Flow in Organisms

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
- (NYSED) Sugar molecules contain carbon, hydrogen, and oxygen. Their hydrocarbon backbones combine with other elements to make amino acids and other carbon-based molecules that can be assembled into larger molecules, such as proteins or DNA. (HS-LS1-6)

CROSSCUTTING CONCEPTS

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6)

TEKS (b) 2, [3A, B], [4 A, B], [5], [6]
(c) [1A, B, D], [11 A, B]

Vocabulary:

Chloroplasts: structures found in plants that photosynthesis takes place.
Grana: the structures in the chloroplast where the light reaction takes place.
Thylakoids: the surface of the chloroplast where the light reactions occur.

Pre-lab: Photosynthesis: $\underline{6}\ CO_2 + \underline{6}\ H_2O \rightarrow light \rightarrow C_6H_{12}O_6 + \underline{6}\ O_2$

Cellular Respiration: $C_6H_{12}O_6 + \underline{6}\ O_2 \rightarrow \underline{6}\ CO_2 + \underline{6}\ H_2O$

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** Plants use sunlight to produce its food.

- *sketch representatives*
- *mathematical modeling*
- *computational thinking*
- *analyze*
- *design solutions*

Using Mathematics and Computational Thinking

Answers may include, but are not limited to:

– Plants make food from sunlight
– Plants make glucose from atmospheric carbon dioxide.
– The amount of oxygen a plant produces is measurable.

Example sketch of a model may include, but are not limited to:

Sketch Your Model

Clarifying Questions:

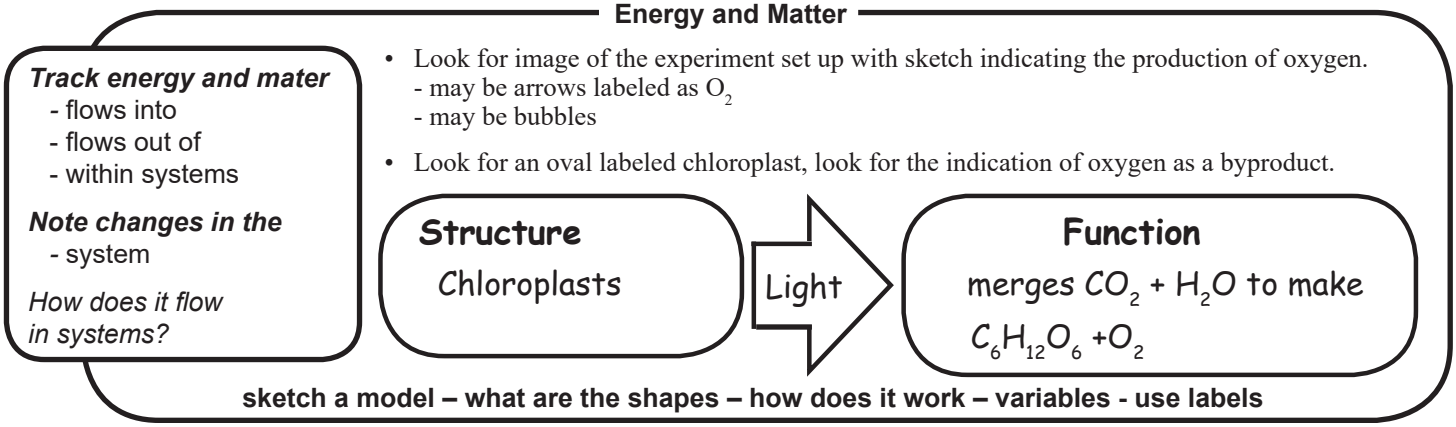
1. Much of the atmospheric carbon dioxide is the result of cellular respiration, from animals exhaling.
2. *Answers will vary.*
3. *While answers may vary, but it **must** agree with the answer to question 2.*
4. For every 6 molecules of oxygen produced, there is 1 molecule of glucose produced.
5. Structure **X** represents grana, stacks of thylokoids.
6. The organic compound created as a result of photosynthesis is glucose, $C_6H_{12}O_6$
7. Oxygen is the gas that is exiting the chloroplast and is a waste product, carbon dioxide is the gas being used and entering the chloroplast.
8. *Some answers may include but are not limited to:*
   - Temperature of the water may influence reaction rate
   - Intensity of the light source (wattage of bulb)
   - Condition of the elodea
   - Proximity to a light source
   - Amount of elodea in the beaker

9. Global atmospheric oxygen rate is maintained at 20%, while carbon dioxide is maintained at 1% because of the interaction of photosynthesis and respiration. Excessive Carbon dioxide is absorbed by the oceans and in carbonates.
10. Although students should be answering in an essay format, look for these key points:
    - Oxygen cycle would have a reduced output
    - Carbon dioxide would increase because the plant life in the rainforest would not be there to absorb and convert the CO_2.
    - This could amplify the greenhouse effect, intensifying climate change.
    - Communities can work toward sustainability

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***
The amount of CO_2 and H_2O can equal glucose and oxygen.

or If the oxygen given off by a plant is measurable, then the amount of glucose is measurable.



Conclusion: ***May include, but are not limited to:*** Photosynthesis is a process by which organelles in plants use atmospheric carbon dioxide to create glucose. A byproduct of this chemical reaction is oxygen. Without photosynthesis life itself would not exist. This chemical reaction is measurable.

Lab Investigation 9: Maintaining Homeostasis

Objective: The objective of this investigation is to determine if immediate changes to the environment affect a body's function.

SCIENCE AND ENGINEERING PRACTICES

Planning and Carrying Out Investigations

Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)

DISCIPLINARY CORE IDEAS

HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis

[Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]

CROSSCUTTING CONCEPTS

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system. (HS LS1-3)

TEKS (b) 2, [3 A, B], [4 A, B]
(c) [1A, B, E], [2B, C], [5B, C], [12A, B]

Vocabulary:

Deviation: any change from the standard.

Equilibrium: a balance in systems.

Perceived: as one observes or interprets information.

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** Find out how changes to the immediate environment affect your body's function.

Planning and Carrying Out Investigations

- plan investigation
- gather data
- produce evidence
- include measurements
- consider limitations on the precision

Answers may include, but are not limited to:
– How can homeostasis be measured?
– How can we tell the difference between positive and negative feedback?

Example sketch of a model may include, but are not limited to:
- a sketch of a body system with a corresponding organelle.

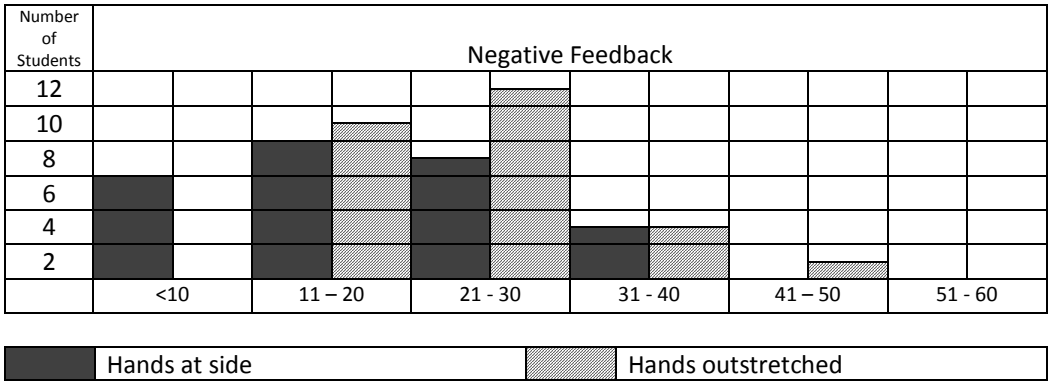
Sketch Your Model

PART 1 – NEGATIVE FEEDBACK

Example – student may enter for activity:

Negative Feedback Sample Histogram						
seconds	< 10	11 – 20	21 – 30	31 – 49	41 – 50	51 - 60
at side	6	8	7	3	0	0
outstretched	0	9	11	3	1	

Example Histogram - Answers will vary but should be based on the data from the activity chart above.

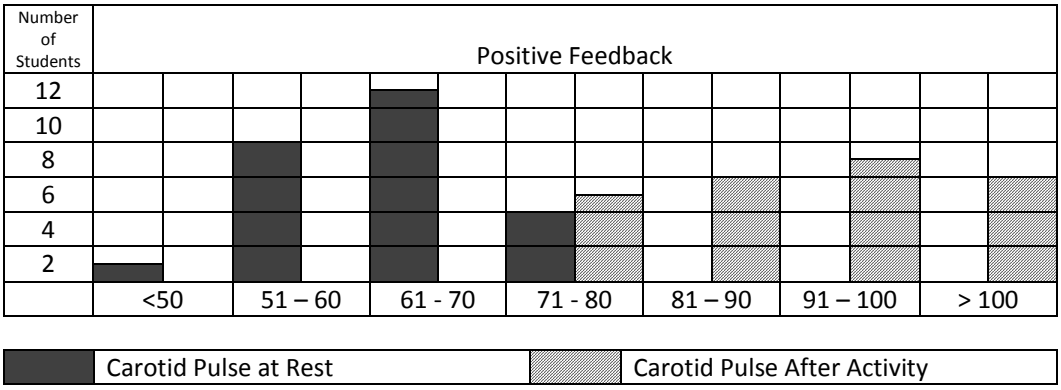


PART 2 – POSITIVE FEEDBACK

Example – student may enter for activity:

Positive Feedback Sample Histogram							
seconds	<50	51 – 60	61 - 70	71 - 80	81 – 90	91 – 100	> 100
at side	1	8	11	4	0	0	0
outstretched	0	0	0	5	6	7	6

Example Histogram - Answers will vary but should be based on the data from the activity chart above.



Clarifying Questions:

1. Homeostasis is the means by which your body maintains equilibrium.
2. Most students will state that it is easier to stand with hands outstretched.
3. Closing the eyes would make it more difficult to maintain balance because vision also aids to maintaining balance.
4. The generalized pattern should show that most students find it is easier to stand with hands outstretched.
5. Toes spread more, muscles worked to maintain balance. These are in response to input and to correct the "out-of-balance"
6. There was an increase in pulse after exercise.
7. The pulse would increase.
8. Most students had an increase in pulse rate after aerobic activity.
9. Instead of correcting to a "normal", the body reacted with an increase in the activity of body systems because the environment was out of a "normal".
10. Respiratory: Body reacts to increase in CO_2 of in blood stream by exhaling then inhaling.
    Circulatory: Body reacts to use of ATP in cells and body transport more O_2 to cells.
    Blood sugar: Body reacts to increase of glucose in blood stream by releasing insulin.
    Shivering: Body reacts to decrease in ambient temperature by flexing micro-muscles to increase circulation.
    Sweating: Body reacts to increase in ambient temperature by excreting urea through pores in the skin.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

– A healthy body regulates itself through a system known as negative feedback.
– When a body cannot maintain homeostasis, disease is the result.

Stability and Change

- How does the system operate effectively?

- What changes causes changes in its operation?

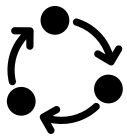
- What changes could cause the system to fail?

- Describe the feedback mechanisms

Answers may include, but are not limited to:

– When each part of the feedback mechanism works, the system operates properly.
– An introduction of a new material to the system can cause a sudden reaction, such as a sneeze. That is an example of a positive feedback.
– Pathogens, poor diet, lack of exercise and/or harmful chemicals can cause a disruption to the process.
– If the body is failing in homeostasis, positive feedback reactions can correct for the imbalance.

Example sketch of a model may include, but are not limited to:



Sketch a model

Conclusion: ***Answers may include, but are not limited to:***

The body is designed to function in a narrow environment. There are checks to ensure good health.

Lab Investigation 10: Reproduction

Objective: Determine the roles have in human reproduction organs. The objective of this lab is to determine the roles have in human reproduction organs.

SCIENCE AND ENGINEERING PRACTICES

Analyzing and Interpreting Data

Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

DISCIPLINARY CORE IDEAS

LS1.A: Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)
- (NYSED) The structures and functions of the human female reproductive system produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn. The structures and functions of the human male reproductive system produce gametes in testes and make possible the delivery of these gametes for fertilization. (HS-LS1-8)

CROSSCUTTING CONCEPTS

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1),(HS-LS3-2)

TEKS (b) 2, [3 A, B], [6 A, B]
(c) [1A, B, G], [3A, B], [4 A, B, C] 5A, [10 A, C], [5A, D], 10A

Science, Technology, and Engineering Practices:

Phenomenon: ***Answers may include, but are not limited to:***

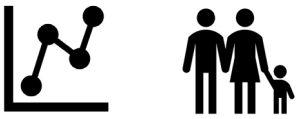
- Hormones trigger ovulation.
- Hormones trigger the release of other hormones.
- Male reproductive system is steady and not controlled by a series of hormones.

Analyzing and Interpreting Data

- organize data
- relationships in data sets
- variables
- distinguish between correlation and causation

Example sketch of a model may include, but are not limited to:

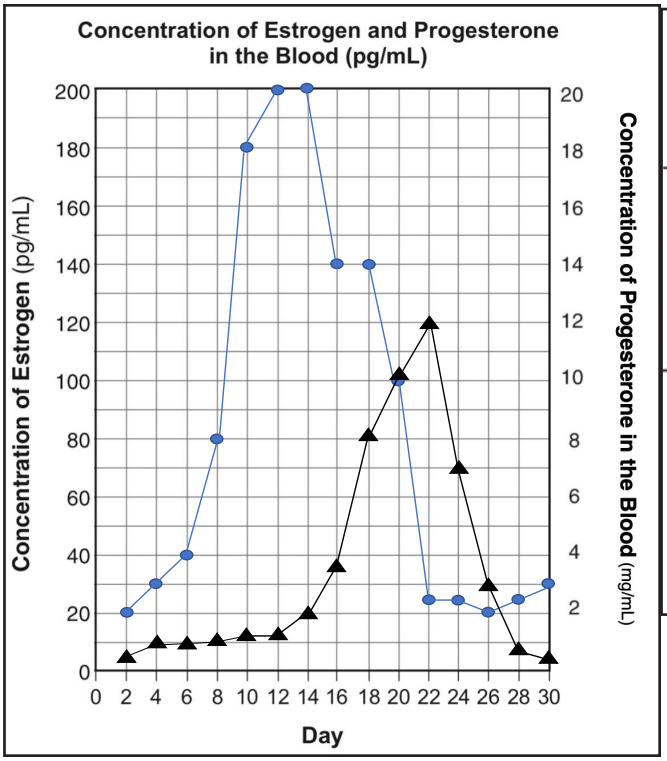
- graphs labeled with hormones.

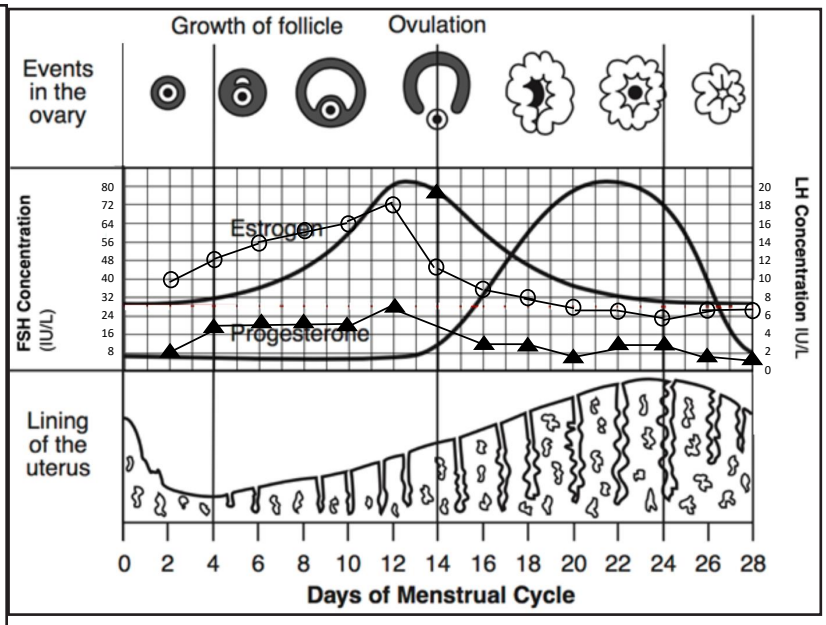


Sketch Your Model

Male Reproductive System	
A	Testes
B	Vas deferens
C	Bladder
D	Penis

Female Reproductive System	
A	Fallopian Tube
B	Ovary
C	Vagina
D	Uterus





Clarifying Questions:

1. The hormones associated with the menstrual cycle are estrogen, progesterone, luteinizing hormone, and follicle-stimulating hormone.
2. The hormones secreted in the ovaries are estrogen and progesterone.
3. The hormones secreted in the pituitary gland are luteinizing hormone, and follicle-stimulating hormone.
4. Male hormones secreted in the testes.
5. The hormones which are predominantly female are estrogen, progesterone, luteinizing hormone, and follicle-stimulating hormone.
6. The estrogen peaks in the menstrual cycle near day 14.
7. When estrogen peaks, ovulation occurs.
8. Progesterone peaks near day 22.
9. When progesterone peaks, the uterine lining is at its thickest.
10. • The cycle is dependent on the peaks and valleys of the hormones.
    • One hormone's level triggers the release of other hormones.
    • Ovulation is suppressed.
    • The hormones build a thin uterine lining then works to shed the lining.

Crosscutting Concepts:

Claim: ***Answers may include, but are not limited to:***

Female reproduction is controlled by hormones.

Cause and Effect

Simple tests can be designed to:
- gather evidence
- argue about idea causes
- explain relationship
- explain causes

Student should identify and correlate as one hormone increases, it triggers other hormones to increase or decrease and triggers the body to action

Example sketch of a model may include, but are not limited to:

Cause:
- Estrogen, LH, FSH, peak
- Progesterone peaks
- All hormone levels drop

→

Effect:
- Ovulation occurs
- Uterine lining thickens
- Menstruation occurs

sketch a model – use arrows to show relationships - use labels

Conclusion: ***Answers may include, but are not limited to:***

In reproduction in animals, specifically humans, there is a delicate balance of hormones that come into play in both the male and the female of the species. The female has more hormones involved in the release of the egg and the maintaining of the pregnancy in order for successful reproduction.

Lab Investigation 11: Microbes Around Me

Objective: The objective of this investigation is to explore microbes in the environment.

SCIENCE AND ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)

DISCIPLINARY CORE IDEAS

LS2.A: Interdependent Relationships in Ecosystems

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2 1),(HS-LS2-2)
- (NYSED) Carrying capacity results from the availability of biotic and abiotic factors and from challenges such as predation, competition, and disease. (HS-LS2-1),(HS LS2-2)

CROSSCUTTING CONCEPTS

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6),(HS LS2-7)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, G], [3A, B], [4 A, B, C] [5 A], [10 A, C], [5A, D], [10A]

TEACHER LAB NOTE

Time:

Performance: Part one: allow 60 minutes. Includes, brainstorming hypothesis, and Petri dish prep as will as predictions.
Part Two: Allow 120 minutes: includes observations, sketch and notes, prep of slides, using microscope and observations.

Agar Recipe:

- 40 grams agar/agar powder
- 5 liters of water
- Add water and agar powder in a small saucepan.
- Whisk the mixture together and bring it to a hard boil on medium-high heat, being careful not to let the liquid boil over.
- After the mixture has boiled and agar powder is dissolved, add sugar and cook on low heat for 2 minutes. If you add sugar before boiling, agar powder may not be dissolved.
- Allow mixture to cool slightly.
- Pour mixture into base of Petri dish, just enough to cover the base.

Yields for 24 Petri dishes.

Science, Technology, and Engineering Practices:

Phenomenon: ***Answers may include, but are not limited to:***

– Microbes are found everywhere
– Microbes can be helpful to human existence
– Microbes may disrupt homeostasis

Constructing Explanations

- construct explanations
- designing solutions
- design evaluate, and refine a solution

Example sketch of a model may include, but are not limited to:

- Microbes in the digestive tract
- Microbes and food products
- Microbes and illness

Sketch Your Model

Predictions 1 – 4

Answers may include but are not limited to:

– germs will grow all over the agar
– the agar will be infected by different bacteria
– one dish [may be specified or not] will have more colonies than others.

Microbe Observations 1 – 4

Answers may include but are not limited to:

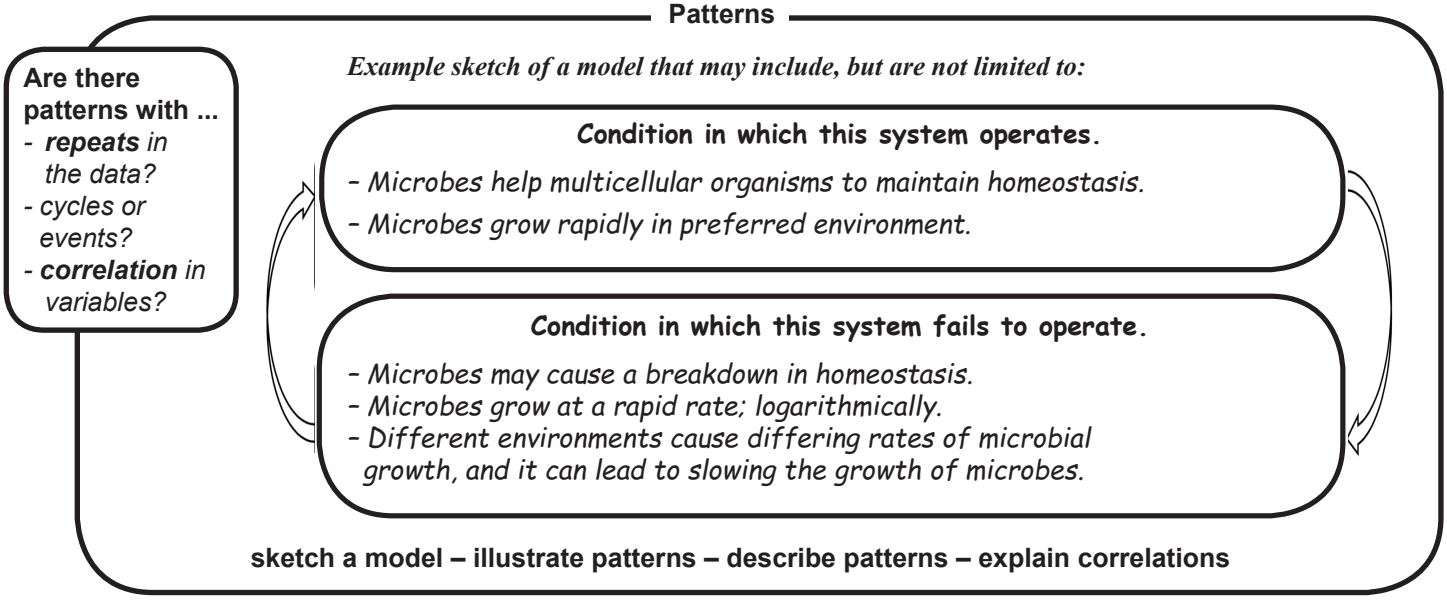
– germs grew all over the agar
– the agar is infected by different bacteria
– one dish [may be specified or not] has more colonies than others.

Clarifying Questions:

1. *Answers will vary, but the answer **must** include a description.*
2. *Answers will vary, but the answer **must** include a description.*
3. Dish number 4 is the control group.
4. Control groups are not impacted by the experiment itself, therefore is a check on the development of the other groups in the experiment.
5. *Answer will vary.* The life function that is allowed for the growth in the Petri dish is the ability to reproduce / reproduction / mitosis while not preferred, is acceptable.
6. *Answers will vary, but the answer **must** include a description.*
7. Washing hands will destroy microbes on the hands.
8. In order to prevent infection: *Answers will vary. Answers can include but not limited to* cooking food, refrigeration of food, not sharing food / drink, covering when sneezing or coughing.
9. To fight infection, one might use penicillin or a penicillin derivative.
10. Not all of the bacteria is killed by penicillin. When the bacterial level is reduced by penicillin, the body's defenses can fight the infection. Of the bacteria that lived, it reproduced more bacteria that is now resistant to the penicillin.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:*** Microscopic organisms exist throughout the environment. Some of these microbes are beneficial to our existence, some are quite harmful.



Conclusion: ***May include, but are not limited to:*** Microbes are found in abundance in most environments.

Lab Investigation 12: Enzymes

Objective: The objective of this lab is to determine if enzymes' effectiveness are affected by conditions that are outside of normal conditions.

SCIENCE AND ENGINEERING PRACTICES

Planning and Carrying Out Investigations

Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)

DISCIPLINARY CORE IDEAS

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)
- (NYSED) Disease is a failure of homeostasis. Organisms have a variety of mechanisms to prevent and combat disease. Technological advances including vaccinations and antibiotics have contributed to the prevention and treatment of disease. (HS-LS1-2, HS-LS!-3)

CROSSCUTTING CONCEPTS

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B], [3 A, C], [4A], [5A]

Vocabulary:

Catalyst: Biological chemicals that affect the rates of chemical change.
Enzyme: Enzymes are molecules that are made of amino acids that are a specific shape.
Substrate: Material that an enzyme reacts with.
Product: The result of an enzyme on a substrate.
Synthesis: The combination of two materials to create a new substance.

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:***

– Enzymes will act differently when they undergo differing treatments.
– Enzymes act best when in the environment best suited for them.
– Enzymes work best in a narrow band of temperature.
– Enzymes work best in a narrow band of pH.
– Enzymes are designed to work only with certain molecules because of their shape.

Planing and Carrying Out Investigations

- plan investigation
- gather data
- produce evidence
- include measurements
- consider limitations on the precision

Students should have filled this space with drawings, and written thoughts in relationship to the bullets to the left of the sketch box. Examples below that may include, but are not limited to:


Food prep often destroys enzymes


Enzymes work best in the best suited environment

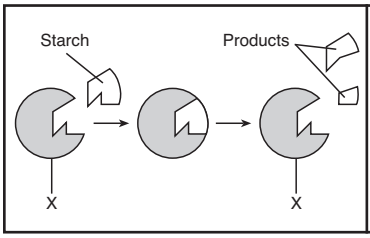

Enzymes have a narrow band of efficiency, heating or cooling enzymes can damage them.


If pH is manipulated, then the enzymes could be denatured.

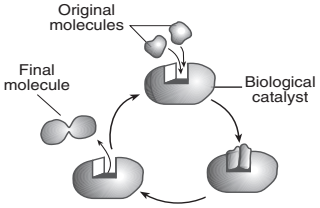

If the shape of the enzyme is changed, its ability to work with its substrate will be affected.

Sketch Your Model

Describe the process in each picture, include if it is synthesis or breakdown.



What is "X"?
- An enzyme
- The process is breakdown

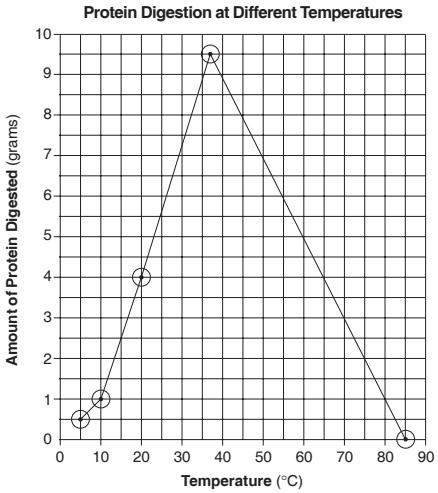


- The process is synthesis

DAY 1

Control: Students should indicate that there should be some sort of disruption in the gelatin form.
Fresh: Students should indicate that there should be some sort of disruption in the gelatin form.
Canned: Students could indicate that there should be some sort of disruption in the gelatin form, but it is related to the mass of the pineapple, not the enzymes.

1–3. Completing the graph:



4. If a sixth test tube identical to the other tubes was kept at a temperature of 30°C for 24 hours, the amount of protein that would be digested would most likely be between 7.0 and 7.5 grams. (Students would derive the answers by reading the completed chart.)
5. No starch was digested because the enzyme in stomach fluid will not digest starch
   or The enzyme in the stomach fluid is specific for protein digestion.

DAY 2

Control: Students should indicate that the gelatin form collapsed, unable to retain its form.
Fresh: Students should indicate that the gelatin form collapsed, unable to retain its form.
Canned: Students could indicate that there was some sort of disruption in the gelatin form, but it is related to the mass of the pineapple, not the enzymes.

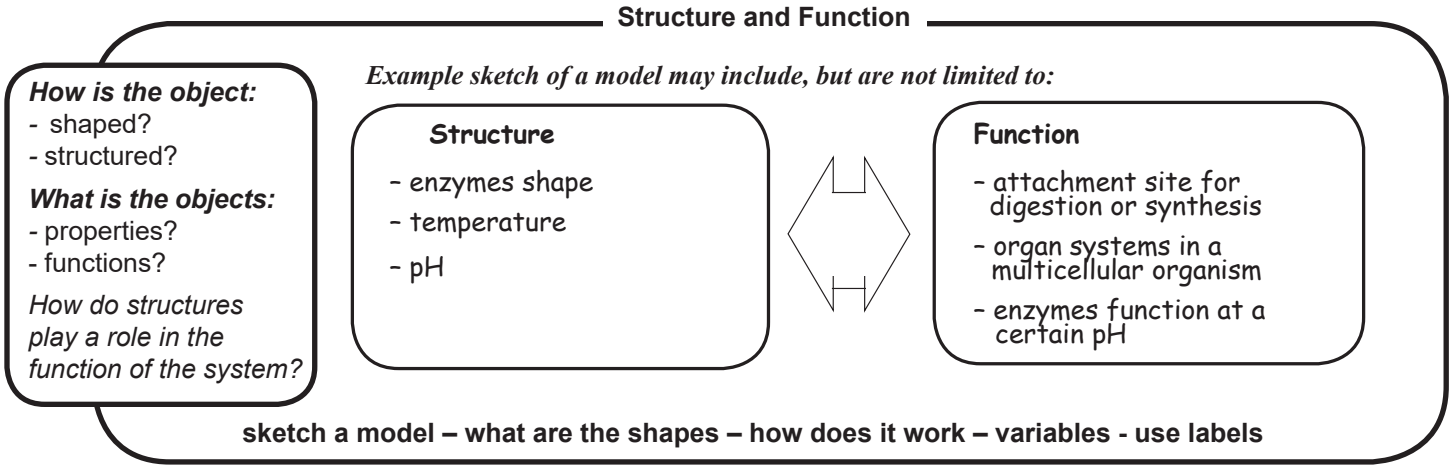
CLARIFYING QUESTIONS: 1–6

1. Data was accurate, information was gathered from enzyme chart to make predictions. Prediction was inaccurate, inferences were made that were inconsistent with outcome, such as: fresh / frozen / control would have similar outcomes.
   Frozen would not impact the gelatin structure / canned would impact the gelatin structure.
2. Differences may include a difference in the rates digestion of collagen by the fresh and frozen pineapple.
3. There may be differences in the rates of digestion of the collagen due to the processing of the pineapple.
4. The substance that affected a difference in the dishes was bromelain, it is an enzyme.
5. The difference, if any, of the fruit filled dishes is that the canning process denatured the enzyme that is naturally found in the fruit. The freezing process did not affect the enzyme.
6. The variable that would cause the difference between the two difference types of fruit was the process in which it was preserved.
7. The stomach is acidic, with a pH of 1.0 – 3.0 while the small intestine is very basic, with a pH of 7.5 – 9.0.
8. The pepsin will become neutralized as it moves from its acidic environment to a basic environment.
9. A fever of 40°C would most likely affect the activity of these enzymes, notice, in the chart where the peak function is about at body temperature (37°C). It's effectiveness drops off quickly.
10. The enzymes are designed to work in a specific pH environment. Although both of these are designed to break down proteins the specific shape of the enzyme, means that it will attach to the molecules at different sites.

Crosscutting Concepts: *:*

Claim: ***May include, but are not limited to:***

– The structure of the enzymes is to work best in certain environments.
– Enzymes are designed to work best in a certain temperature.
– Enzymes work best in the correct pH.



Conclusion: Enzymes are biological molecules that work within a relatively narrow environment of temperature, and pH. This affects the shape of the enzyme and therefore its efficacy.

Lab Investigation 13: Replication DNA

Objective: The objective of this lab is to understand the structure of DNA as a double helix using the base pairing rules.

SCIENCE AND ENGINEERING PRACTICES

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)

DISCIPLINARY CORE IDEAS

LS1.A: Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)

CROSSCUTTING CONCEPTS

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

TEKS **(b) 2, [3A, B], [4 A, B], 5, 6, 7**
(c) 2A, 3B, 4A, 5A, [7A, B, D]

Vocabulary:

Base Paring Rules: The base paring rules state that adenine and thymine bond only to each other and cytosine and guanine bond only to each other.

Double Helix: A double helix looks like a twisted ladder of the nucleotides.

Nucleotide: Subunit of DNA

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** DNA is a double stranded molecule that is constructed with specific rules for the nucleotides that are the subunits of this macromolecule.

Developing and Using Models

- *identify variables*
- *develop models to tpredict outcomes*
- *illustrate relationships*

Example Answer and sketch of a model may include, but are not limited to:

Using the base paring rules, adenine bonds to thymine and guanine bonds to cytosine.

Sketch Your Model

Lab Group 1				
DNA	ATG	GGG	CTC	TGG

Lab Group 2				
DNA	GTA	ATA	CTA	TAT

Lab Group 3				
DNA	AAA	GCC	CTT	TGA

Lab Group 4				
DNA	ATG	GCT	CTG	TAC

Lab Group 5				
DNA	CTA	ATA	TTA	TGC

Lab Group 6				
DNA	CGA	GTG	TTG	TAA

Clarifying Question:

1. The bases of DNA are adenine, thymine, guanine and cytosine.
2. The structure of a nucleotide is a ribose, a phosphate group, and a base.
3. The nucleotides are bonded with hydrogen bonds.
4. The ribose - phosphate "backbone" of DNA is strong because of the covalent bonding.
5. The ribose - phosphate "backbone" of DNA is broken using enzymes.
6. In order to complete a DNA segment, the phosphorous section needed to be attached to the ribose on the next nucleotide.
7. DNA is stable because the phosphate groups and ribose are connected through covalent bonds and the bases are connected by multiple hydrogen bonds.
8. The open DNA strand would correctly attach to the complimentary nucleotides in the nucleus using DNA polymerase because of the base pairing rules that use the hydrogen bonding of the different bases.
9. ***Answers should include:*** DNA stores genetic information effectively because it is double stranded and DNA polymerase works as a "proofreader".
10. ***Answers should include:*** Replication is necessary because cellular division in mitosis requires each of the daughter cells require its own DNA in its nucleus.

Crosscutting Concepts: ***Answers may include, but are not limited to:***

Claim: ***May include, but are not limited to:*** DNA is a double stranded macromolecule.

Structure and Function

How is the object:
- shaped?
- structured?

What is the objects:
- properties?
- functions?

How do structures play a role in the function of the system?

Example sketch of a model may include, but are not limited to:

Structure
- DNA is a double helix.
- *A* + T and *C* + *G* base pairing.
- Helicase unzips and exposes both strands.

Function
- A two stranded molecule maintains integrity.
- reduce errors
- Both strands create two new molecules.

sketch a model – what are the shapes – how does it work – variables - use labels

Conclusion: ***May include, but are not limited to:*** DNA is a double stranded molecule. The molecule is stable because it is double stranded, the two sides help to maintain the structure and sequence of the molecule.

Lab Investigation 14: Transcription RNA

Objective: The objective of this lab is to understand how RNA is constructed from DNA.

SCIENCE AND ENGINEERING PRACTICES

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)

DISCIPLINARY CORE IDEAS

LS1.A: Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)

CROSSCUTTING CONCEPTS

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2)

TEKS **(b) 2, [3A, B], [4 A, B], 5, 6, 7**
(c) 2A, 3B, 4A, 5A, [7A, B]

Vocabulary:

RNA: RNA is a single sided chain of nucleotides

Transcription: mRNA is transcribed from DNA

RNA Polymerase: an enzyme that binds RNA nucleotides together

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** RNA is a molecule created by instructions from DNA.

Developing and Using Models

- *identify variables*
- *develop models to predict outcomes*
- *illustrate relationships*

Identification of variables needs to be included. Variables may include:
– the DNA sequence, connection of nucleotides
– DNA dictates the order of RNA

A sketch should be drawn. It may include:
– illustrating the creation of an RNA molecule.

Illustrating relationships should be established. It may include:
– that RNA is dependent of DNA for information of sequencing.

Example sketch of a model may include, but are not limited to:
– DNA strand unzipping, RNA being formed.

Sketch Your Model

TEACHER LAB NOTE:

Setup: Students will receive four card stock pages with each of the nucleotides. Students will cut out each of the nucleotides and arrange them in order as per the strand. After checked and glued, students will be given another set of nucleotides; the complimentary strand. Advise students to glue each base pair not by complimentary strand.

Lab Group

mRNA:

Lab Group 1				
DNA	ATG	GGG	CTC	TGG
mRNA	UAC	CCC	GAG	ACC

Lab Group 2				
DNA	GTA	ATA	CTA	TAT
mRNA	CAU	UAU	GAU	AUA

Lab Group 3				
DNA	AAA	GCC	CTT	TGA
mRNA	UUU	CGG	GAA	ACU

Lab Group 4				
DNA	ATG	GCT	CTG	TAC
mRNA	UAC	CGA	GAC	AUG

Lab Group 5				
DNA	CTA	ATA	TTA	TGC
mRNA	GAU	UAU	AAU	ACG

Lab Group 6				
DNA	CGA	GTG	TTG	TAA
mRNA	GCU	CAC	AAC	AUU

Clarifying Questions:

1. The bases of RNA are Adenine, uracil, cytosine, guanine.
2. RNA's has a phosphate backbone, ribose, and base.
3. Messenger RNA, mRNA, forms from the DNA template to transfer genetic information from the DNA to the ribosomes.
4. Ribosomal RNA, rRNA, is part of the ribosome, an organelle that builds proteins and enzymes.
5. The role of transcription RNA, tRNA, is to bind amino acids together to make a peptide.
6. *Answers may include, but are not limited to:*
   - DNA and RNA both have phosphate backbones
   - DNA and RNA both have a sugar like-structure
   - DNA and RNA both have a bases.
7. mRNA is a strand that uses the ribosomes to create proteins.
8. RNA nucleotides come from the DNA transcription process.
9. RNA is a single strand molecule. DNA has base pair molecules that hold it together.
10. DNA is a stable molecule because it has a complimentary strand that can serve as a placeholder. Genetic information. Can be passed down from one generation to the next. RNA is a single stranded molecule and therefore, does not have the complimentary strand to serve as a place holder for the nucleotides. It would take generations to create a mutation, since protist have such short life spans, the mutation is more readily apparent.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

DNA structure dictates the structure and sequence of the mRNA strand.

Structure and Function

How is the object:
- shaped?
- structured?

What is the objects:
- properties?
- functions?

How do structures play a role in the function of the system?

A sketch should be drawn. It should include:

– DNA strand

– arrow indicating the creation of corresponding RNA strand

– labels on all drawings

sketch a model – what are the shapes – how does it work – variables - use labels

Conclusion: ***May include, but are not limited to:***

RNA is constructed based on the DNA sequence, using similar base pair sequencing.

Lab Investigation 15: Translation Protein Synthesis

Objective: The objective of this investigation is to understand the relationship of the RNA sequence and resulting polypeptide.

SCIENCE AND ENGINEERING PRACTICES

Asking Questions and Defining Problems

Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

DISCIPLINARY CORE IDEAS

LS1.A: Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.

LS3.A: Inheritance of Traits

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)

CROSSCUTTING CONCEPTS

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-4),(HS-LS1-8)

TEKS (b) 2, [3A, B], [4 A, B], 5, 6, 7
(c) [1A, B, G], [2A, D], 3B, 4A, 5A, [7A, B, C]

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:***

– RNA will code for proteins
– RNA can code for proteins using sets of three.
– Protein synthesis is dependent on the correct code from RNA.

Asking Questions

ask questions
- each other
- the texts
- the phenomena
- observations

A sketch should be drawn. It should include:

– RNA attaching to a ribosome, tRNA introducing amino acids.

Sketch Your Model

Codon: – A sequence of three nucleotides that codes for an amino acid.

Polypeptide: – A long string of amino acids that would begin to make up a protein.

TEACHER LAB NOTE:

Setup: Using the RNA strand from the Lab 14 – RNA. Students will be given "amino acids" based upon request. The amino acid cards should already have holes punched in at either end. Paper clips will be used to attach them.

Amino Acid Sequence:

Lab Group 1				
mRNA	UAC	CCC	GAG	ACC
CODON	AUG	GGG	CUC	UGG
Amino Acid	METHIONINE / START	GLYCINE (Gly)	LEUCINE (Leu)	TRYPTOPHAN (Try)

Lab Group 2				
mRNA	CAU	UAU	GAU	AUA
CODON	GUA	AUA	CUA	UAU
Amino Acid	VALINE (Val)	ISOLEUCINE (Ily)	LEUCINE (Leu)	TYROSINE (Tyr)

Lab Group 3				
mRNA	UUU	CGG	GAA	ACU
CODON	AAA	GCC	CUU	UGA
Amino Acid	LYSINE (Lys)	ALANINE (Ala)	LEUCINE (Leu)	STOP

Lab Group 4				
mRNA	UAC	CGA	GAC	AUG
CODON	AUG	GCU	CUG	UAC
Amino Acid	METHIONINE / START	ALANINE (Ala)	LEUCINE (Leu)	TYROSINE (Tyr)

Lab Group 5				
mRNA	GAU	UAU	AAU	ACG
CODON	CUA	AUA	UUA	UGC
Amino Acid	LEUCINE (Leu)	ISOLEUCINE (Ile)	LEUCINE (Leu)	CYSTEINIE (Cys)

Lab Group 6				
mRNA	GCU	CAC	AAC	AUU
CODON	CGA	GUG	UUG	UAA
Amino Acid	ARGININE (Arg)	VALINE (Val)	LEUCINE (Leu)	STOP

Clarifying Questions:

1. Three RNA nucleotides make up a codon
2. The newly formed molecule is a (protein, polypeptide, amino acid chain).
3. The RNA entering the ribosome is mRNA. It is bringing code from the DNA in the nucleus.
4. The amino acid being added by the tRNA is THR, Threonine.
5. ***Answers may include but are not limited to:*** difficulty with coding for RNA - creating codons - finding the amino acids from code
6. Without the proofreading of polymerase, there could be miscoding, nucleotides dropped, inverted or deleted.
7. The mRNA code for DNA, AGG would be UCC, which codes for serine, but a switch to AGC would code for the mRNA, UCG which also codes for serine. No change would be evident.
8. The mRNA code for DNA, ACG would be UGC, which codes for cysteinine, but a switch to ACC would code for the mRNA UGG which codes for tryptophan. This change may very well alter the polypeptide.
9. The mRNA code for DNA for ATG would be UAC, which codes for tyrosine, but a switch to ATC would code for the mRNA UAG which codes for STOP, the protein would be shortened.
10. To avoid environmental triggered mutagens, avoid environmental hazards.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

– The sequence of RNA codons is the template for amino acid sequencing in the construction of proteins.
– A single error in the coding of mRNA can result in a different amino acid or possibly a difference protein.

Structure and Function

How is the object:
- shaped? - structured?

What is the objects:
- properties? - functions?

How do structures play a role in the function of the system?

Sketches may include, but are not limited to:
- RNA strand as instructions for the sequence of amino acids
- RNA entering a ribosome, amino acid chain exiting ribosome

Sketches should be labeled properly.

sketch a model – what are the shapes – how does it work – variables - use labels

Conclusion: ***May include, but are not limited to:***

– DNA molecule is a double helix molecule. The nature of the structure of the molecule serves to maintain its integrity of the molecule. The enzymes that promote replication of this molecule work to ensure the correct duplication of the molecule as to prevent severe changes. sometimes there are mistakes in replication. If the mistake is severe it can cause illness. If the mistake is in a germ cell it can cause a mutation.

– Amino acid's are linked to gather to create a polypeptide because of the information provided to the ribosomes from the messenger RNA. Sometimes there are mistakes in the RNA and the protein is not created properly.

Lab Investigation 16: Peas Please

Objective: The objective of this investigation is to understand the probability of certain dominant – recessive traits in offspring.

SCIENCE AND ENGINEERING PRACTICES

Analyzing and Interpreting Data

Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3)

DISCIPLINARY CORE IDEAS

LS3.B: Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. (HS-LS3-2)
- (NYSED) Environmental factors can cause mutations in genes. Only mutations in sex cells can be inherited. (HS-LS3-2)

CROSSCUTTING CONCEPTS

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-4),(HS-LS1-8)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, F], [2A, B, C, D], [8A, B]

Vocabulary:

Allele: – An allele is one of the two versions of a gene that can be tested for hybridization.
Example: One person has brown eyes and the other parent has blue eyes.

Dihybrid Cross: A cross of two genes.

Monohybrid Cross: A cross of one gene.

Test Cross: A test of an organism of unknown genotype with a pure breed of recessive genotype to determine the genotype

Law of Independent Segregation: Each gene has two copies; one from each parent, and each parent passes only one copy down to its offspring.

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** – Flowers of the same plant have different appearance.
– Organisms of the same kind of plant have different appearances.
– A monohybrid cross will show changes in just one trait.

Analyzing and Interpreting Data

- organize data
- relationships in data sets
- variables
- interpret data
- distinguish between correlation and causation

Images may include, but are not limited to:

– a grid, flowers indicating inheritance, labels identifying variables.

Pink/White Flowering Plants

Pink is the dominant flower color; white is the recessive color for this plant.

P Generation: The genotype for Pink (P) pure breed plants: – **PP**

P Generation: The genotype for white (p) pure breed plants: – **Pp**

F_1 Generation: Illustrate a cross for the P generation you defined above.

	P	P
p	Pp	Pp
p	Pp	Pp

F_2 Generation: Illustrate a cross for the hybrids produced above.

	P	p
P	PP	Pp
p	Pp	pp

Test Cross: Cross a hybrid from F_2 generation with a recessive pure breed.

	P	p
p	Pp	pp
p	Pp	pp

Dihybrid Cross for pea plant appearance:

The phenotype for the genotype is RrYy: Round Yellow Pea

Phenotype:

	RY	Ry	rY	ry
RY	RRYY 1. Round Yellow	RRYy 5. Round Yellow	RrYY 9. Round Yellow	RrYy 13. Round Yellow
Ry	RRYy 2. Round Yellow	RRyy 6. Round green	RrYy 10. Round Yellow	Rryy 14. Round green
rY	RrYY 3. Round Yellow	RrYy 7. Round Yellow	rrYY 11. wrinkled Yellow	rrYy 15. wrinkled Yellow
ry	RrYy 4. Round Yellow	Rryy 8. Round green	rrYy 12. wrinkled Yellow	rryy 16. wrinkled green

Dihybrid Cross for plant appearance:

What is the genotype for a tall hybrid plant? Tt

What is the genotype for a plant with hybrid pink flowers? Pp

Define the genotype for a hybrid tall plant with pink flowers. TtPp

	TP	Tp	tP	tp
TP	TTPP Tall Pink	TTPp Tall Pink	TtPP Tall Pink	TtPp Tall Pink
Tp	TTPp Tall Pink	TTpp Tall White	TtPp Tall Pink	Ttpp Tall White
tP	TtPP Tall Pink	TtPp Tall Pink	ttPP Short Pink	ttPP Short Pink
tp	TtPp Tall Pink	Ttpp Tall White	ttPp Short Pink	ttpp Short White

Clarifying Questions:

1. 100% of the crosses are hybrid.
2. 50% of the crosses are hybrid.
3. 75% of the plants had a dominant phenotype in the F_2 generation?
4. In the dihybrid cross, the probability of peas being round are 12 out of 16.
5. 75%
6. 2 plants
7. 12.5%
8. rarely if ever
9. Farmers must breed recessive green plants to ensure peas are green
10. Most peas are round, they should make sure none of the parents are wrinkled.

Crosscutting Concepts: ***Answers may include, but are not limited to:***

Claim: ***May include, but are not limited to:***

- Flowers have different appearances because of a different combination of genes.
- Organisms of the same kind will have different appearances because of genetic crosses.
- Monohybrid crosses will show changes in that one trait because of dominance and recessive genes.

Patterns

Are there patterns with ...
- ***repeats*** *in the data?*
- *cycles or events?*
- ***correlation*** *in variables?*

Images should include:

– a more accurate image of Punnett Squares, or images of inheritance.

sketch a model – illustrate patterns – describe patterns – explain correlations

Conclusion: ***May include, but are not limited to:*** When Gregor Mendel experimented with P plants, he worked with simple genes. There is a probability as to which genes would be expressed when crossbreeding. These rates of probability are easy to define, therefore desired traits can be selected in breeding organisms.

Lab Investigation 17: Human Family

Objective: Students will investigate genetic disorders.

SCIENCE AND ENGINEERING PRACTICES

Analyzing and Interpreting Data

Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3)

DISCIPLINARY CORE IDEAS

LS3.B: Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and re markably accurate, errors do occur and result in mutations, which are also a source of genetic variation. (HS-LS3-2)
- (NYSED) Environmental factors can cause mutations in genes. Only mutations in sex cells can be inherited. (HS-LS3-2)

CROSSCUTTING CONCEPTS

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-4),(HS-LS1-8)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, F], [2A, B, C, D], 7C, [8A, B]

Vocabulary:

Carrier: A carrier carries one recessive allele.
Co-dominance: Co-dominance is when a heterozygous genome has both alleles expressed.
Pedigree: A pedigree is a map that finds out the phenotypes or traits and genotypes in a family to determine if the child is a carrier of the trait

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:***

– Humans inherit traits from both parents.
– Some traits are hidden and express themselves when there are two copies.

Analyzing and Interpreting Data

- organize data
- relationships in data sets
- variables
- interpret data
- distinguish between correlation and causation

STEM

Images may include, but are not limited to:

– parents with a child.

Investigation # 1 – Recessive – Tay Sach's Disease

Scenario 1

	T	t
T	TT	Tt
T	TT	Tt

Scenario 2

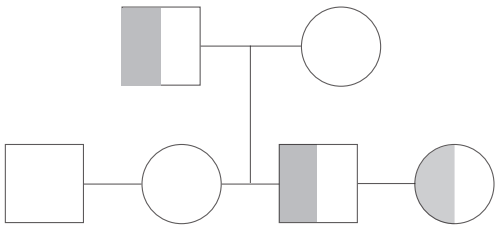
	T	t
T	TT	Tt
t	Tt	tt

Probability of the children are not afflicted?
Scenario 1 100 % Scenario 2 75 %

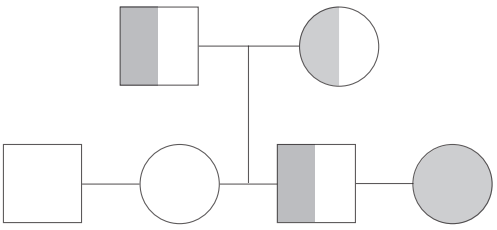
Probability of the children are carriers?
Scenario 1 50 % Scenario 2 50 %

Probability of the children are afflicted?
Scenario 1 0 % Scenario 2 25 %

Pedigree of the Punnett Square - Scenario 1



Pedigree of the Punnett Square - Scenario 2



Investigation # 2 – Dominance – Huntington's disease

Scenario 1

	H	h
h	Hh	hh
h	Hh	hh

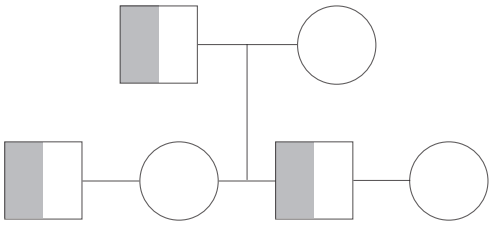
Scenario 2

	H	h
H	HH	Hh
h	Hh	hh

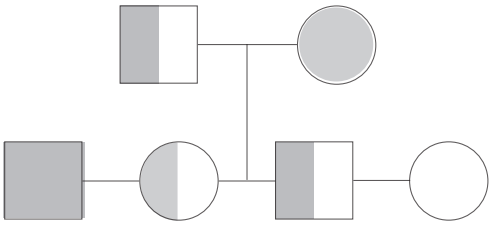
Probability of the children are not afflicted?
Scenario 1 **50** % Scenario 2 **25** %

Probability of the children are afflicted?
Scenario 1 **50** % Scenario 2 **75** %

Pedigree of the Punnett Square - Scenario 1



Pedigree of the Punnett Square - Scenario 2



Investigation #3: Co-Dominance Sickle Cell Disease.
Put an X in the box of the correct answer.

1. Their oldest child, #1 ☐ male ☒ female

The child has ☐ Sickle Cell Disease ☐ Sickle Cell Trait ☒ Not affected

The child is resistant to malaria ☐ Yes ☒ No

The genome is ☐ SS ☐ Ss ☒ ss

---

2. Their middle child, #2 ☒ male ☐ female

The child has ☐ Sickle Cell Disease ☒ Sickle Cell Trait ☐ Not affected

The child is resistant to malaria ☒ Yes ☐ No

The genome is ☐ SS ☒ Ss ☐ ss

---

3. Their youngest child, #3 ☐ male ☒ female

The child has ☒ Sickle Cell Disease ☐ Sickle Cell Trait ☐ Not affected

The child is resistant to malaria ☒ Yes ☐ No

The genome is ☒ SS ☐ Ss ☐ ss

Punnett Square for the probability of their children having the disease of the trait.

	S	s
S	SS	Ss
s	Ss	ss

What is the probability of their children having sickle cell disease? **25%**

What is the probability of their children having sickle cell trait? **50%**

What is the probability of their children not being affected? **25%**

Punnett Square for the probability of the children's expression of vision.

	X^m	Y
X^M	$X^M X^m$	$X^M Y$
X^m	$X^M X^m$	$X^m Y$

What is the probability the daughters will have color deficiency? **50%**

What is the probability the sons will have color deficiency? **50%**

Clarifying Questions:

1. Tay Sachs is a disease that is found in specific populations; Ashkenazi Jews and Cajuns. Cajuns are a population of descendants of French Canadians found in Louisiana. French Canadians also have a variant of this disease.
2. Individuals with Tay Sachs disease have a breakdown of the nervous system. It includes blindness, loss of muscle tone, loss of mental ability. When the disease manifests at infancy, the life expectancy is 4 or 5 years.
3. Tay Sachs is a recessive gene; the carrier might not know that they have this gene. Those with this mutation, survived illness to pass this gene on.
4. An individual with Huntington's Disease may show loss of muscular control as well as possible dementia.
5. Huntington's Disease is referred to as a genetic time bomb because it often manifests itself after one already has had children. Being a dominant pattern of inheritance, there is a high likelihood that their children might get it.
6. Although sickle cell trait is extremely painful, it is an evolutionary advantage because those with the trait are resistant to malaria.
7. Sickle cell trait expresses both of the traits of having normal hemoglobin and rigid malformed hemoglobin because some of the red blood cells are normal and some are rigid.
8. A sex-linked trait is a condition that has the variant of the gene on the X chromosome
9. Color deficiency is more likely found in boys, not girls because it is sex-linked.
10. In order for a girl to have color deficiency, her the mother would have to be a carrier and the father would have to be color deficient.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

– Traits are inherited from parents.
– Some traits that are inherited are recessive that parents might know they have.

Patterns

Are there patterns with ...
- ***repeats*** *in the data?*
- *cycles or events?*
- ***correlation*** *in variables?*

Sketches may include, but are not limited to:

– pedigrees, and or images of people.

sketch a model – illustrate patterns – describe patterns – explain correlations

Conclusion: ***May include, but are not limited to:***

Sometimes mistakes in the genetic code can cause serious genetic illnesses. Some illnesses are dominant genetically in nature, some are recessive in nature, some are a sex linked traits.

Lab Investigation 18: Blood

Objective: The objective of this lab is to determine how objects change in shape due to weathering.

SCIENCE AND ENGINEERING PRACTICES

Analyzing and Interpreting Data

Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3)

DISCIPLINARY CORE IDEAS

LS3.B: Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. (HS-LS3-2)
- (NYSED) Environmental factors can cause mutations in genes. Only mutations in sex cells can be inherited. (HS-LS3-2)

CROSSCUTTING CONCEPTS

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows —within and between systems at different scales. (HS-LS1-4),(HS-LS1-8)

TEKS (b) 2, [3A, B], [4A, B], 5, 6, 7
(c) [1A, B, F], [2A, B, C, D], [3A, B, C], [4A, B, C], 7C, [8A, B], [10D]

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** – Blood is made of many components.
– Blood has types because of the markers on the cells.
– Hemophilia is a genetic disorder that causes delay in clotting.

Analyzing and Interpreting Data

- organize data
- relationships in data sets
- variables
- interpret data
- distinguish between correlation and causation

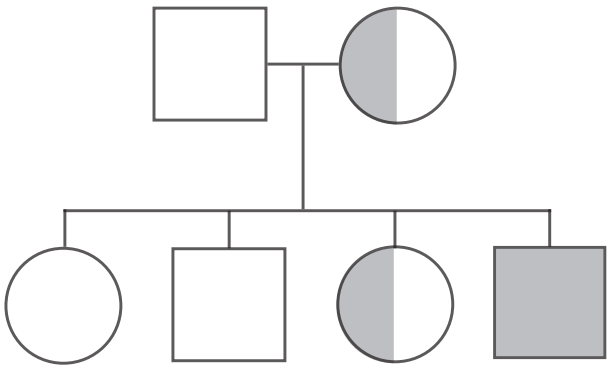
Sketches should be labeled correctly.

Sketches may include but not limited too:

– data tables and/or graphs. Relationships are indicated.

Investigation #1 – Sex-linked Hemophilia Type A

	X^M	Y
X^M	$X^M X^M$ 1	$X^M Y$ 2
X^m	$X^M X^m$ 3	$X^m Y$ 4



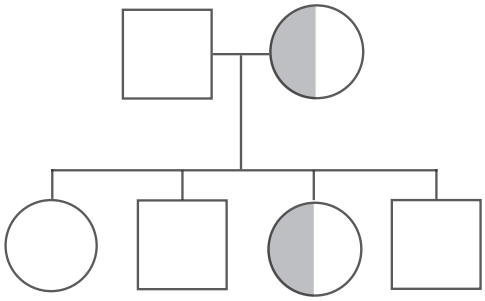
1. The probability of the daughters will be a carrier is **50%**, although it is one in four, the probability is looking for the outcome of one sex.
2. The probability of the sons will have hemophilia is **50%**, although it is one in four, the probability is looking for the outcome of one sex.

Investigation #2 – Sex Linked Hemophilia Type B - the European Royal Family

3. We know that Beatrice and Alice are carriers because their sons were afflicted with the disease.
4. Alice had __7__ children
5. Alexandra's family were all killed during the Russian revolution. Notice that Alexandra and Alexis died at the same time. Her daughters did not have children.

Investigation #3 – Von Willebrand Disease Types I and II

	V	V
V	V V 1	V V 2
v	Vv 3	Vv 4



Investigation #4 – Von Willebrand Disease Type III

	V	v
V	V V 1	Vv 2
v	Vv 3	v v 4

6. The missing von Willebrand factor affects clotting because the protein coded to make the platelets stick to each other and to the walls of the blood vessels are missing.
7. If one parent is affected with the defective gene, then there is a 50% chance that the child will be affected.
8. There is a twenty-five percent chance of VWD III in scenario 4.
9. Women inherit VWD as frequently as men because it is on the 12 chromosome. Both men and women have the 12 chromosome, therefore it is not sex-linked.
10. As determined in of the scenarios, all types of hemophilia either have spontaneous mutations. As many as 30% of Type A and Type B hemophilia are spontaneous mutations while VWD can be the result of autoimmune disease.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

– Blood is made of many components, such as plasma, red blood cells, and white blood cells.
– Blood types are derived from markers on the cells. This must be paid attention to because different blood types cannot donate to one another.
– Certain heritable diseases can affect the clotting of blood.

Patterns

Are there patterns with ...
- ***repeats*** *in the data?*
- *cycles or events?*
- ***correlation*** *in variables?*

Sketches may include but not limited too:

sketch a model – illustrate patterns – describe patterns – explain correlations

Conclusion: ***May include, but are not limited to:*** Sometimes mutations cause and if a deficiency is in the clotting of blood. Some of these mutations are sex linked, but not all of them.

ADDITION RESOURCES FOR BLOOD: "Hemophilia" Edward Willett
Enslow Pub Incorporated, Apr 1, 2001 - Juvenile Nonfiction - 128 pages

Lab Investigation 19: Unity & Diversity of Life

Objective: The purpose of this investigation is to observe the internal structures of vertebrates to determine if similarities exist.

SCIENCE AND ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS4-2), (HS-LS4-4)

DISCIPLINARY CORE IDEAS

LS4.C: Adaptation

- Evolution is a consequence of the interaction of four factors:
  (1) the potential for a species to increase in number,
  (2) the genetic variation of individuals in a species due to mutation and sexual reproduction,
  (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce,
  (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)
- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3), (HS-LS4-4)
- Adaptation also means that the distribution of traits in a population can change when conditions change.

(HS-LS4-3)

- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5)
- Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5)

CROSSCUTTING CONCEPTS

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS LS4-1), (HS-LS4-3)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, G, H], [4A, B, C], [9A, B] [10A, C]

Vocabulary:

Analogous Structure: Structures that although have a similar function are not similarly structured. Examples are butterfly and bird wings.

Homologous Structures: Structures that are similar in build and ancestry. Examples are the forelimbs of vertebrates.

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:***

- Organisms were grouped by body structure.
- Organisms are grouped by homologous structures.
- Organisms are grouped using the fossil record.

Constructing Explanations

- construct explanations
- designing solutions
- design, evaluate, and refine a solution

Sketches may include, but are not limited to:

- Organisms "evolving"
- Procession of organisms from simple to complex

Sketch Your Model

Part I - Analogous structures

a. Both animals have wings.

b. Yes, hawks have an internal bone structure.

c. No, moths do not have an internal bone structure.

d. No, they are not related

e. **Analogous Structure:** Wings	
Organisms: Hawk and Moth	
Similarities	**Differences**
• wings • flight • pairs	• Hawk is a bird • Moth is an insect • Hawk has an internal skeleton

Part II – Homologous Structures

Clarifying Questions:

1. Charles Darwin based his observations of the similarities and differences of the finches and the tortoises on the islands he visited.
2. The finches varied from island to island.
3. The bones in the forelimbs of vertebrates are the humorous, the radius and ulna, and the metacarpals.
4. The bone structures of the limbs of vertebrates reveal that these organisms descended from a common ancestor.
5. "A" represents the humorous in vertebrates.
6. The similarities of the humorous provide evidence of a common ancestor and therefore evolution.
7. Whales hind legs have become vestigial because whales do not use them for swimming, an ancestral whale that "lost" the legs where better adapted to the watery world and therefore able to reproduce.
8. In studying the skeletal structures of these organisms, they appear to be dinosaurs.
9. "Columba" is a bird.
10. The first organism is the Archaeopteryx was the most ancient organism. The Dromaesaurus descended from the Archaeopteryx. These were dinosaurs. The Columba is a bird. It is descended from the dinosaurs. It is clear that it is a bird because the bone structure is similar to the bird from the previous pages.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

– There are a variety of life forms on Earth because the life forms adapted to their environments.

– Organisms appear to have similar structures because they have a common ancestor.

Patterns

Are there patterns with ...
- ***repeats*** *in the data?*
- *cycles or events?*
- ***correlation*** *in variables*

Sketches may include:

– more refined images from previous sketches.

Check for exclusion of growth (seed to plant / embryo to animal)

sketch a model – illustrate patterns – describe patterns – explain correlations

Conclusion: ***May include, but are not limited to:*** Some mutations create new traits that are advantageous to a new environment. When organisms are in different environments does that adapt can pass on these new trades to their offspring eventually creating a new species. This process of evolution has been recorded in the fossil record.

Lab Investigation 20: Classification & Cladograms

Objective: The objective of this investigation is to correlate relationships between organisms by examining the taxa and constructing resulting cladograms.

SCIENCE AND ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS4-2), (HS-LS4-4)

DISCIPLINARY CORE IDEAS

LS4.A: Evidence of Common Ancestry and Diversity

- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)

LS4.B: Natural Selection

- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation —that leads to differences in performance among individuals. (HS-LS4-2), (HS-LS4-3)
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

CROSSCUTTING CONCEPTS

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS LS4-1), (HS-LS4-3)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, F, G], [2A, B], [9A]

Vocabulary:

Binomial Nomenclature: A system that includes the *Genus* and *species*, like *Homo sapiens*, which means, "man, the wise"

Linnaean Classification: A system developed by Carl Linnaeus to sort organisms by ancestry, not morphology.

Morphology: The shape of the body.

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** – Means of classification has been purely by body shape.
– Modern classification is based on ancestry.

Constructing Explanations

- construct explanations
- designing solutions
- design evaluate, and refine a solution

Sketches may include, but are not limited to:

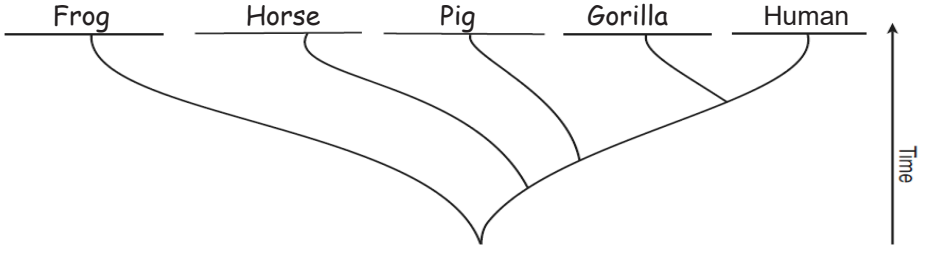
- cladogram of organisms
- listing the hierarchy of classification; Kingdom, Phylum…

Sketch Your Model

Procedure: Activity 1

a. These animals were able to adapt to the changes in the environment.
b. Plohippus is an ancestor to the zebra, donkey, horse, and any other animal that is in the genus Equus.

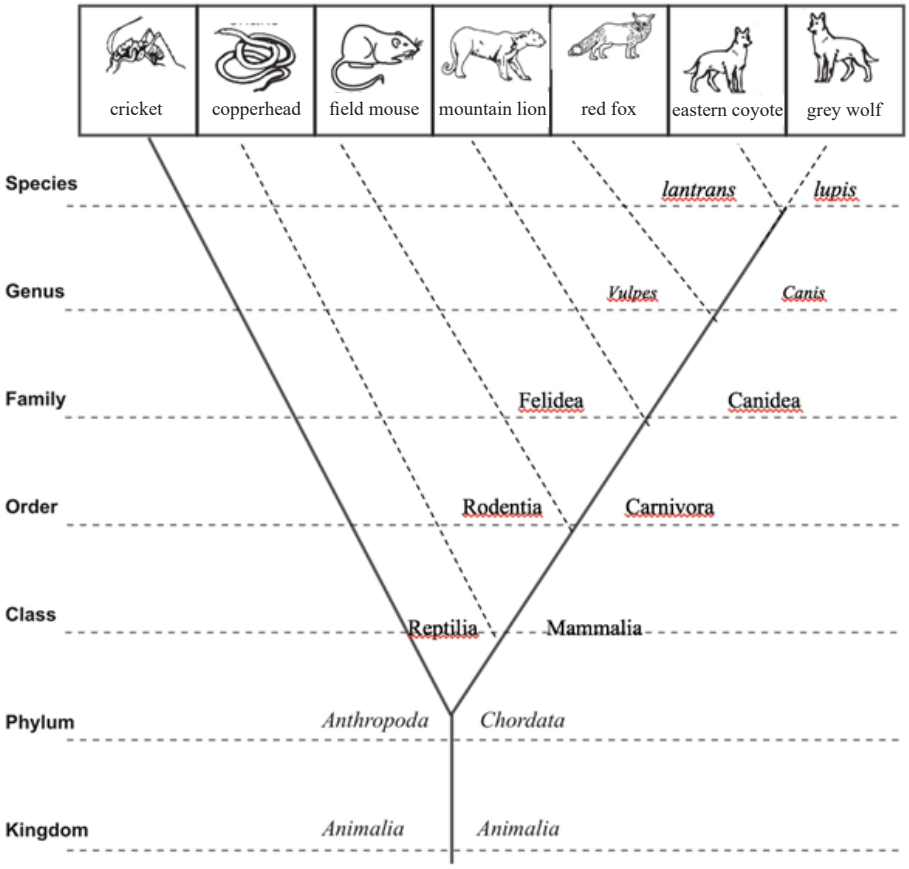
Procedure: Activity 2



Clarifying Questions:

1. The various taxa in the classification system include kingdom, phylum, class, order, family, genus and species.
2. The different groups in the "Domain" taxa are bacteria, archaea, and eukarya.
3. Scientists use binomial nomenclature to classify organisms by genus and species.
4. Binomial nomenclature a more accurate way to describe organisms because
   - there is only one amino difference between the two organisms.
   - it is closest on the cladogram
   - it is highest on the cladogram.
5. The animal is most closely related to humans is the gorilla, because it is closest on the cladogram and is higher on the cladogram.
6. The cause of differences in the DNA that cause organisms to drift apart, biologically, are mutations that might spontaneously arise and giving advantage to that organism to survive and reproduce.
7. The animals are least related are the frog and the human. This is evidenced by
   - separation on the cladogram.
   - separation on the node.
   - the differing taxa.
8. The animals are most closely related are the gray wolf and the eastern coyote because they are in the same genus; Canis.

Classification of Species of a United States Forest Biome



9. *Answers may include deciding*:
   • where the separations may occur • where the the nodes should be placed • pasting the animals in place
10. The cricket differs from the other animals in the eastern forest because
    - it has a different phylum. - Arthropoda and it has an exoskeleton, as opposed to the other animals which are chordates.
    - the cricket is an insect. - is not in the phylum Chordata

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

– Organisms are classified based on structure and genetics.
– Organisms adapt to their environment, those who could not, [died] [became extinct].
– Looking at a cladogram, the diversity of life branches out from a source.

Stability and Change

- How does the system operate effectively?
- What changes causes changes in its operation?
- What changes could cause the system to fail?
- Describe the feedback mechanisms

Sketch may include, but are not limited to:

– a cladogram (must have sketch labeled properly. It should include description of cladogram, and pattern of branching)

Examples should answer all 4 questions in box to the left.

sketch a model

Conclusion: The diversity of life is the result of organisms as a population responding to changes resulting in new species, different and unique from their ancestors and separate from other groups that branched off from the same common ancestor.

Lab Investigation 21: Biotic & Abiotic Factors

Objective: The objective of this lab is to explore on the interrelationships of biotic and abiotic features of any given space.

SCIENCE AND ENGINEERING PRACTICES

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS LS2-1)
- Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2)
- Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS2-7)

DISCIPLINARY CORE IDEAS

LS2.A: Interdependent Relationships in Ecosystems

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2 1), (HS-LS2-2)
- (NYSED) Carrying capacity results from the availability of biotic and abiotic factors and from challenges such as predation, competition, and disease. (HS-LS2-1), (HS LS2-2)

CROSSCUTTING CONCEPTS

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6), (HS LS2-7)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, 13B

Define the following:

Abiotic: Non-living things in an ecosystem; air, rocks, clouds, weather

Biotic: Living organisms in an ecosystem; animals, bacteria and plants

Ecosystem: Collection of organisms and non-living things in a given area

Environment: The area where an ecosystem exists

Pre-Lab:

Abiotic	Biotic		
1. Rocks	1. Tree	6. Lily pads	11. Dragon flies
2. Air	2. Grass	7. Seagull	12. Rabbits
3. Water	3. Beaver	8. Fishes	13. Frog
4. Dirt	4. Turtle	9. Algae	
	5. Cattails	10. Eel	

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:***

– The environment is full of biotic [living] and abiotic [non-living] things.
– The environment is dependent on biotic [living] and abiotic [non-living] things.
– In an environment of biotic [living] and abiotic [non-living] things, some abiotic items are man-made.

Using Mathematics and Computational Thinking

- sketch representatives
- mathematical modeling
- computational thinking
- analyze
- design solutions

STEM
Images may include, but are not limited to:
– rocks, trees, and animals.

(Using a small space as a representation of a larger system.)

Sketch Your Model

TEACHER LAB NOTE:

4 m string with 3 knots. Each knot at 1 m increments
- Lay a meter stick on a table.
- Grasp the string and lay it along a meter stick. Grasping the end in one hand, pinch the end that extends to one meter.
- Carefully tie it in a simple knot
- Repeat this until three knots have been tied.
- The students will stretch out the string to a knot, make a right angle and repeat until they have made a square on the ground.

Clarifying Questions:

1. *Answers vary but may include:*
   The most common biotic factors found in my inventory include a reflection of local area, most likely grasses, dirt, bugs, and others
2. The most common abiotic factors found in my inventory included, dirt/sand/gravel, etc
   - do not mark incorrect if air is mentioned
3. My inventory surprise me because I did not expect…(answer should make sense for your campus and/or weather conditions)
4. *Two views of this answer:*
   - No, this one-meter square is not reflective of a larger ecosystem because there are more organisms in the environment.
   - Yes, this one-meter square is reflective of a larger ecosystem because it is part of a larger environment
5. If the object was a cube not a square, we could include air, pollen and insects.
6. The aspects of the square that were anthropogenic include
   - The trash in our square was anthropogenic.
   - There were no anthropogenic objects in our square
7. How do these anthropogenic objects effect the environment?
   - Some anthropogenic objects might be eaten by organisms. Paved areas would affect drainage.
   - The anthropogenic objects pollute the environment by animals eating the garbage, or attracted to garbage.
   - Some material can go into the soil damaging plant life, causing a reduction in animals.
   - Anthropogenic objects can affect water distribution by disturbing the infiltration of water.
8. *Answers vary but may include:*
   - If another class goes at a later time, the temperature would be different so there would be a change in the amount insects at the time.
   - The observation can be different because of differing temperatures / amount of sunlight.
9. *Answers vary but may include:*
   - Oak trees and maple trees are keystone organisms.
   - The most significant organism in this environment of the square was grass.
10. *Answers vary but may include:*
    - Changing the amount of pavement could affect the drainage in an area. If the drainage is affected, it could affect the plant life in the area.
    - These plants could be food or shelter for local organisms.
    - Paving an area reduces amount of area in which plants can grow.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:***

– The 1-meter square contained a diverse amount of biotic and abiotic factors.
– 1-meter square represents a larger ecosystem.

Stability and Change

- How does the system operate effectively?
- What changes causes changes in its operation?
- What changes could cause the system to fail?
- Describe the feedback mechanisms

Sketch may include, but are not limited to:

– a square illustrated; students represented exploring the area.

Examples of how system operates, but are not limited to:

– System operates in its own response to the external factors such as weather and climate.

– System fails to operate by sudden changes to ecosystem; influx of invasive species, anthropogenic interference, sudden catastrophe like hurricanes, floods, and or wild fires.

sketch a model

Conclusion: Living things depend on the nonliving portions of the environment. Living organisms can influence the non-living. There is an interdependence.

Lab Investigation 22: Food Web

Objective: The objective of this investigation is to explore how trophic interactions of species in an ecosystem are illustrated.

SCIENCE AND ENGINEERING PRACTICES

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS LS1-5), (HS-LS1-7)
- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5)

DISCIPLINARY CORE IDEAS

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS LS2-3)
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)
- (NYSED) When matter is cycled through organisms and ecosystems, some of the matter reacts to release energy for life functions, some is stored in newly made structures, and some is eliminated as waste. (HS-LS2-4)
- (NYSED) Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, hydrosphere, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)

CROSSCUTTING CONCEPTS

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6)
- Energy can be transferred between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7), (HS-LS2-4)
- Energy drives the cycling of matter within and between systems. (HS-LS2 3)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, [13A, B, C]

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:***

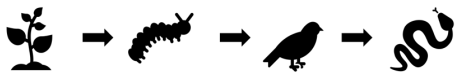
– Living things [biotic factors] are interdependent.
– As one examines the hierarchy of a food pyramid, one sees that not all energy is transferred up the pyramid.
– Organisms depend on one another for [food, nutrients. nourishment]

Developing and Using Models

- *identify variables*
- *develop models to predict outcomes*
- *illustrate relationships*

Sketch may include, but are not limited to:

– a food chain

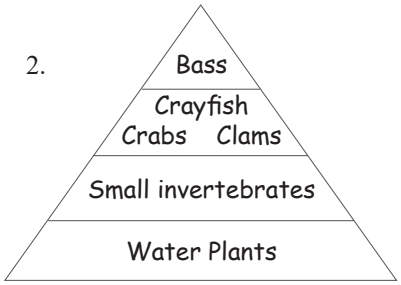


Sketch Your Model

Procedure 1: Tropic Pyramid

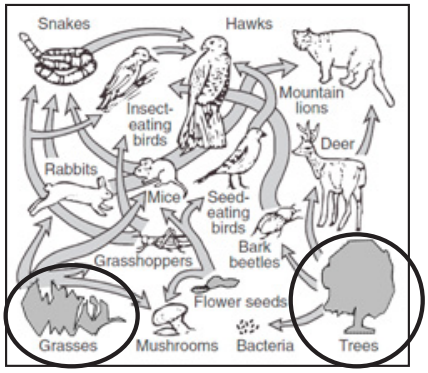
1. A: Tertiary Consumers
   B: Secondary Consumers
   C: Primary Consumers
   D: Producers

2.

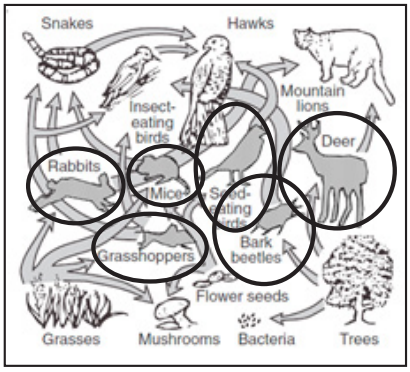


Procedure 2: Food Web

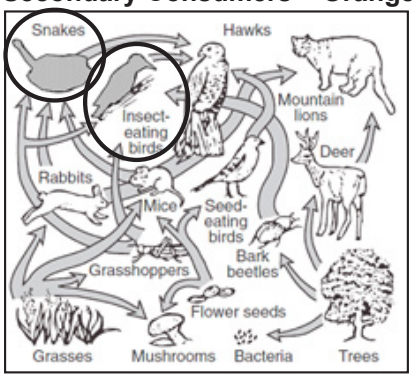
Producers – Green



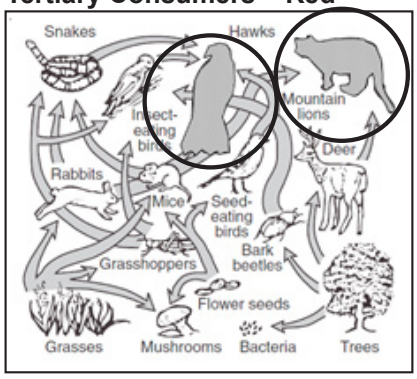
Primary Consumers – Yellow



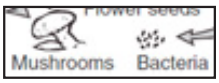
Secondary Consumers – Orange



Tertiary Consumers – Red



Decomposers include *mushrooms* and *bacteria*. – Brown



Clarifying Questions:

1. The role of producers is to provide fuel for the environment.
2. Decomposers consume dead, shed materials or waste remains of other living things. Decomposers complete the cycle by returning much of the raw material to the environments. (Nitrogen cycle, carbon cycle)
3. Producers, as the name suggests, make food by synthesizing materials from the environment using energy from the sun.
4. Rabbits consume producers as a primary consumer and coyotes consume rabbits as secondary producers. Both are heterotrophs and cannot produce their own food.
5. A consumer consumes about 10% of the energy at eat trophic level as 90% is lost as heat.
6. An ecosystem must have more producers than consumers because the energy lost at each trophic level.
7. Trophic levels are depicted as a pyramid because most of the energy and biomass is on the lowest trophic level.
8. The level that receives the least nutrient energy from the Sun is the tertiary level.
9. The organisms that are the top are: - the tertiary level. - top predators. - hawk.
10. Insecticides sprayed in trees would effect the food by:
    - killing the insects that organisms feed on. - poisoning the insects that organisms feed on.

Crosscutting Concepts:

Claim: With each trophic level, energy is lost.

Energy and Matter

Track energy and mater
- flows into
- flows out of
- within systems

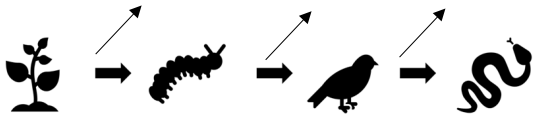
Note changes in the
- system

How does it flow in systems?

Sketch should include labels that arrows indicate energy loss at each tropic level.

Sketch may include, but are not limited to:

– a trophic pyramid



sketch a model – what are the shapes – how does it work – variables - use labels

Conclusion: As energy passes from one trophic level to the next, energy is lost. Each organism at each trophic level uses the energy consumed for its own life functions.

Lab Investigation 23: Biomagnification

Objective: The objective of this investigation is to explore how materials can become concentrated in organisms as one consumes another.

SCIENCE AND ENGINEERING PRACTICES
Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

– Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

DISCIPLINARY CORE IDEAS
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS LS2-3)
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)
- (NYSED) When matter is cycled through organisms and ecosystems, some of the matter reacts to release energy for life functions, some is stored in newly made structures, and some is eliminated as waste. (HS-LS2-4)
- (NYSED) Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, hydrosphere, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)

CROSSCUTTING CONCEPTS
Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales. (HS-LS2-5)

TEKS (b) 2, [3A, B], [4A, B], 6, 7
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, [13A, B, D]

Science, Technology, and Engineering Practices:
Phenomenon: ***May include, but are not limited to:***

– Toxins in the environment are stored in the fatty tissues of the animal.
– There is a build-up of toxins in each trophic level of the food web.

Using Mathematics and Computational Thinking

- sketch representatives

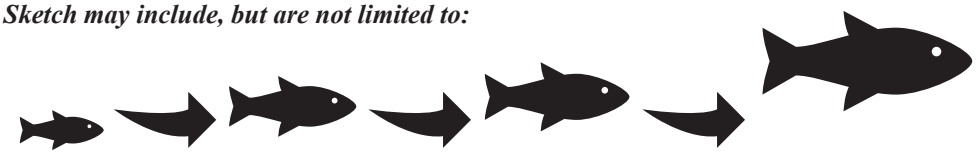
- mathematical modeling

- computational thinking

- analyze
- design solutions

Answer may include, but are not limited to:
Toxins may build up in the tissues of the organisms as they eat their prey.

Sketch may include, but are not limited to:



Sketch Your Model

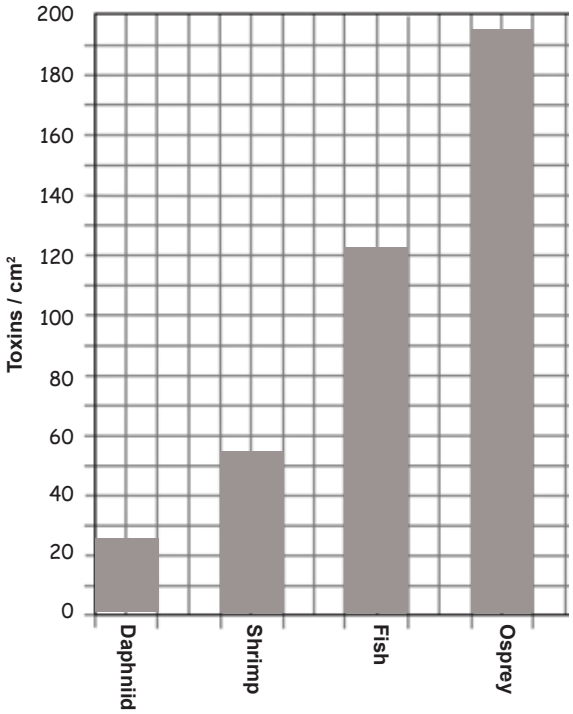
TEACHER LAB NOTE:

In the Appendix, cut along the dotted line to create labels for this lab 15: daphniid containers, 7 shrimp containers, 3 fish containers, and 1 osprey container. There should also be 4 cloth pieces per lab group of varying sizes with a 1 cm square drawn on each; the smallest marked 1 to the largest marked 4.

Cloth should be precut with 1 cm squares near the center. the cloth should be jersey knit (t-shirt). Once the cloth is affixed, students should depress the center of the square. Each pour into the cloth should be slow and deliberate. Consider your materials, sugar may dissolve but can become sticky and if lab equipment is not cleaned or disposed of after the lab, it may attract insects. Glitter represents the toxin; the color choice is yours but only use one color for all of your classes.

The performance of the lab itself is quick once lab set up is complete.

Biomagnification Lab: SAMPLE RESULTS - Graph should show an increasing concentration of toxins.



Clarifying Questions:

1. The cloth represents the tissue of the affected animal.
2. The flecks represent the toxin chemical contaminant.
3. The organism that feeds the whole ecosystem is zooplankton.
4. The food chain begins with zooplankton. The zooplankton is consumed by the daphnia. The daphnia are consumed by shrimp. Fish eat the shrimp. Ospreys eat the fish.
5. Each organism at each trophic level, consumed some material that had toxins in it. The toxins stayed in the tissue of the organism that then consumed many affected organisms.
6. The highest level, the tertiary consumer, apex predator is most affected by biomagnification because the poisons are stored in the fatty tissue of the prey.
7. The trend should indicate an increase in the toxins as one examines each increasing step in the food chain.
8. There is a significant accumulation of toxins at each tropic level.
9. DTT gets into the food supply off birds of prey. This causes these birds to produce eggs shells that are so fragile that they break on the nest. As a result, birds of prey cannot effectively reproduce.
10. Glacial melt water containing DDT. One possibility and then describe the complications of this DDT can get into water supplies / DDT can get into food web

Crosscutting Concepts:

Claim: Toxins collect in the tissues of tertiary consumers. As tertiary consumers consume affected organisms, there is a buildup of toxins.

Scale, Proportion, and Quantity

Simple tests can determine a phenomenon is dependent on:
- scale
- proportion
- quantity

Answer may include, but are not limited to:

Toxins are released into the environment and are consumed by organisms.

As each level goes up in the food web, the toxins build up.

sketch a model – use boxes to show proportion - use labels

Conclusion: Toxins are released into the environment. Tertiary consumers eat many animals that have been affected. This causes great detriment to the environment, and can have toxic levels in organisms that humans consume as well. Harmful chemicals must be closely monitered.

ADDITION RESOURCES FOR BIOMAGNIFICATION: Dead about Central Park Raptors
http://www.nytimes.com/2012/04/12/nyregion/rat-poison-is-found-in-bodies-of-3-dead-hawks.html?_r=0

Lab Investigation 24: Predator & Prey

Objective: The objective of this investigation is to find the relationship of elk and wolf populations over a forty-year time period.

SCIENCE AND ENGINEERING PRACTICES

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds from K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6)
- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8)

DISCIPLINARY CORE IDEAS

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2), (HS-LS2-6)
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

CROSSCUTTING CONCEPTS

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-7), (HS-LS2-8)

TEKS **(b) 2, [3A, B], [4A, B] 6, 7**
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, [13A, B, D]

Science, Technology, and Engineering Practices:

Phenomenon: Some animals eat other animals for food. The greatest individuals occupy the lowest level of the tropic pyramid. Removal of one species affects the ecosystem. An overabundance of one organism can damage an ecosystem.

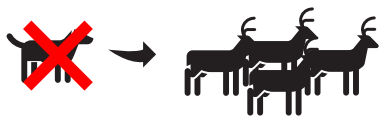
Engaging In Argument From Evidence

- evaluate the claims
- review evidence
- question reasoning for currently accepted explanations

Example arguments from evidence may include, but are not limited to:

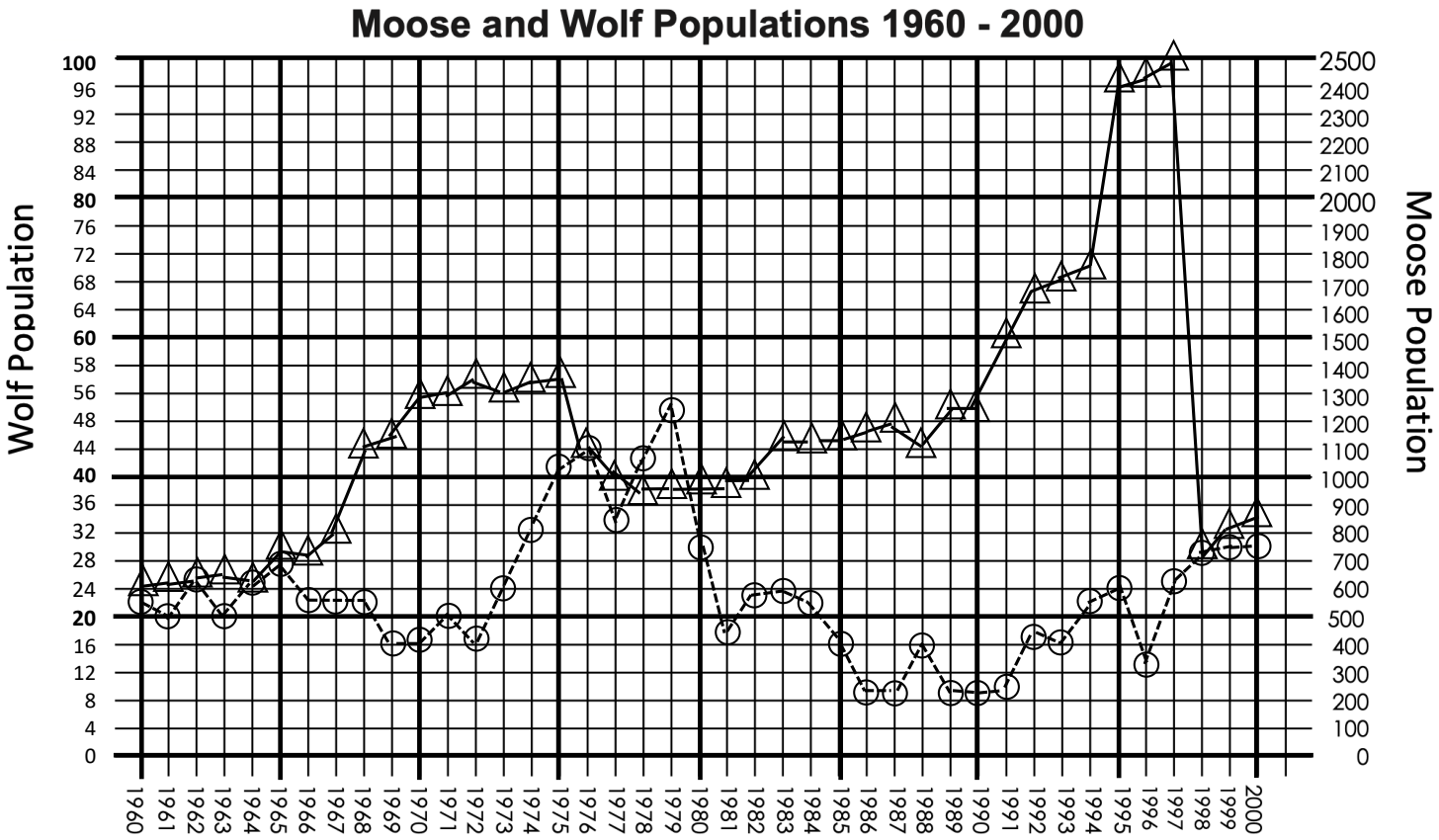
- Animals that eat other animals for food, have to eat a lot of animals in its lifetime, so more prey animals are needed.
- There has to be more prey animals in the lowest tropic level so the predators can eat.
- When wolves were removed from Yellowstone, naturalists saw the decline of the park.
- When elk overtook the park, other animals experienced a change in habitat for the worse.

Sketches may include, but are not limited to:



Sketch Your Model

Graph: Wolf and Populations 1960 - 2000



Clarifying Questions:

1. The wolf population in 1980 was 30 wolves.
2. The relationship between a wolf and a moose is wolf–predator; moose–prey.
3. *Answers vary but may include **one** of the following:*
   - Disease killed large numbers of the moose.
   - The moose population overgrazed its habitat, resulting in starvation.
   - The moose population exceeded the carrying capacity of the environment.
   - over hunting
4. The wolves are the predators and moose are the prey because the table shows that there are more moose and the wolf population follows the moose population.
5. *Answers vary but may include **one** of the following:*
   - There were more wolves, so the moose were being killed off.
   - There may have been less food available for the moose, since the moose population had been growing for 20 years.
   - Disease may have affected the moose population.
   - There may have been really bad winters.
6. *Answers vary but may include **two** of the following:*
   - number of moose
   - competition with other predators
   - diseases
   - living space on the island
   - weather conditions
   - hunting
7. An observable trend in the wolf and moose data between 1980 and 1995 is that as the wolf population decreases, the moose population increases be unrelated
8. *Answers vary but may include **one** of the following:*
   - The coyote population will decrease, as the wolf will be a competitor for the same prey as the coyote.
   - The coyote population will be unaffected because there is sufficient prey for both the wolf and the coyote.
9. *Answers vary but may include **one** of the following:*
   - The wolf was once a natural part of this ecosystem.
   - To control the deer population
   - There is adequate prey to support the wolf population.
   - It would increase biodiversity.
10. Coyote is considered a limiting factor in the Adirondack Mountains because they control the growth of certain prey populations.

Crosscutting Concepts:

Claim: ***Answers may include, but are not limited to:***

– Some animals eat other animals for food, and this regulates all populations in the ecosystem.
– The greatest individuals occupy the lowest level of the tropic pyramid because prey is food for the predator's lifetime.
– Removal of one species affects the ecosystem, because the of the overgrazing as seen in Yellowstone.
– An overabundance of one organism can damage an ecosystem, because the of the overgrazing as seen in Yellowstone.

Cause and Effect

Simple tests can be designed to:
- gather evidence
- argue about idea causes
- explain relationship
- explain causes

CAUSE
Wolves' consumption of prey animals

EFFECT
Regulation of prey animals' population

sketch a model – use arrows to show relationships - use labels

Conclusion: Predators depend on prey for food. When there is a large population of prey the predators flourish and their population increases. When populations of predators decrease it harms the prey population because predators generally hunt the weak of the herd.

Lab Investigation 25: Owls

Objective: The objective of this investigation is determine the owl's diet by examining the owl's diet.

SCIENCE AND ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)

DISCIPLINARY CORE IDEAS

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

CROSSCUTTING CONCEPTS

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-7), (HS-LS2-8)

TEKS (b) 2, [3A, B], [4A, B] 6, 7
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, [13A, B, D]

Variables: **Independent:** contents of owl pellet **Dependent:** variety of prey

Science, Technology, and Engineering Practices:

Phenomenon: ***Answers may include, but are not limited to:***

– Owls are birds of prey and eat small animals. – Owls are birds that hunt at night. – Owls do not have a crop like other birds.

Constructing Explanations

- *construct explanations*
- *designing solutions*
- *design evaluate, and refine a solution*

Sketches may include, but are not limited to:

Sketch Your Model

Pre-Lab: Owls' food sources include snakes, rabbits and mice.

Pyramid for an owl:
A. Owls, Hawks
B. Snakes, rabbits, mice
C. Frogs, grasshoppers, caterpillars
D. Wheat, clover, dandelions

Pellet Investigation

Example Observation Chart: *Answers will vary but should refer Pellet Instruction Manual for information about pellet contents.*

Clarifying Questions:

1. Owls are divided into true owls and barn owls.
2. ***Answers include but not limited to:***
   • Owls have forward facing eyes • Owls hunt at night. • They do not have a crop.
3. Owls' forward facing eyes increase the bird's depth perception.
4. Owls generally eat mice, rabbits and snakes.
5. Although hawks and owls seem to occupy a similar niche, hawks hunt during the day. Mice population would increase.

Questions 6 - 9 directly refers to your pellet investigation.

6. *Answer will very according to what **birds** were charted in the Pellet Investigation.*
7. *Answer will very according to what **small animals** were charted in the Pellet Investigation.*
8. *Answer will very according to what **other animals** were charted in the Pellet Investigation.*
9. *Answers will vary, depends on answers 6-9.*
10. This is an example of how ecosystems maintain stability over time

Crosscutting Concepts:

Claim: ***Examples of a claim, but are not limited to:***

– Owls play a role in the ecosystem by keeping smaller animals' populations smaller.

– Owls consume other animals so only the strongest survive.

– Owls reduce the populations of mice and other small animals preventing a crash of the population.

Cause and Effect

Simple tests can be designed to:
- gather evidence
- argue about idea causes
- explain relationship
- explain causes

Examples of Cause and Effect, but are not limited to:

– Owls are birds of prey and eat small animals so their populations are kept in check.

– Owls are birds that hunt at night so their prey are typically rodents and small animals.

– Owls do not have a crop like other birds therefore they must expel the waste material from their digestive tract.

sketch a model – use arrows to show relationships - use labels

Conclusion: When one examines the pellets of an owl, one can determine the diet of the animal. One can further extrapolate how many organisms the owl consumes.

Lab Investigation 26: Conservation

Objective: The objective of this investigation is to interpret events of animals' behavior based on tracks in the images provided.

SCIENCE AND ENGINEERING PRACTICES
Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)

DISCIPLINARY CORE IDEAS
LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7)

CROSSCUTTING CONCEPTS
Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6), (HS LS2-7)

TEKS (b) 2, [3A, B], [4A, B] 6, 7
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, [13A, B, D]

Science, Technology, and Engineering Practices:

Phenomenon: Conservationists study wildlife in their environment.

- construct explanations
- designing solutions
- design evaluate, and refine a solution

Constructing Explanations

Answers may include, but are not limited to:

– Animals are hunting and conservationists note populations.

– Conservationists note animal populations so that any intervention needed will be taken.

Sketch Your Model

Diagram 1: Owl and Rabbit *Answers may include, but are not limited to*:

- Rabbit (or other creature) hopping in snow.
- Owl/hawk swoops down, kills prey creature
- Owl/hawk flies away with creature
- Owl/hawk eats creature right there

Diagram 2: Predator and its Prey *Answers may include, but are not limited to*:

- Predator is dragging an animal that is too heavy for it to lift.
- Animal is being dragged in a regular fashion, does not appear to be fighting perhaps dead
- Animal seems to be dragged under predator as the footprints are on either side of the drag marks.

Diagram 3: Wolf and Moose *Answers may include, but are not limited to*:

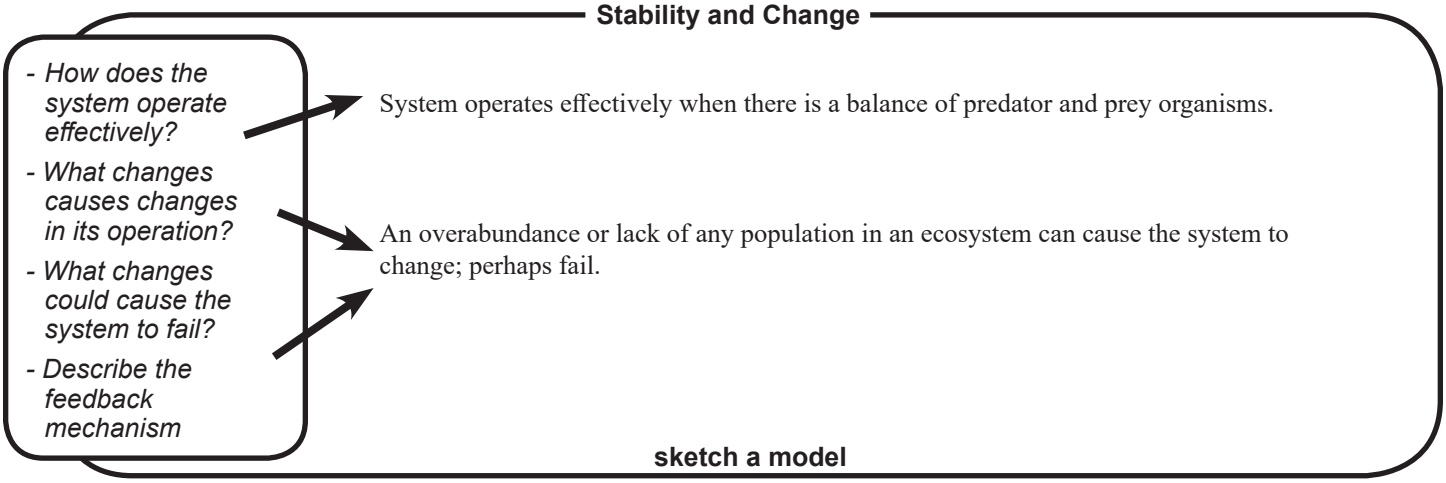
- Moose is walking through snow (tracks on right)
- Moose picks up pace
- Wolf trots along after moose
- Tracks converge on at top of page

Clarifying Questions:

1. Yes, they were obvious to easily identify the animals involved. *or* No, they were hard to easily identify the animals involved.
2. Yes, we had different ideas and interpretations. *or* No, we all agreed to the interpretations
3. Bird of prey pounced on prey
4. The prints were interpreted by the tracks in that way small prints, imprint of wings, no more prints.
5. It is inferred in diagram 2, that a cat (bobcat, lynx, house cat) over took a small animal, killed it and walked away.
6. The prints were interpreted by the tracks because larger prints overtaking smaller prints, struggle, one set of prints walks away.
7. In diagram 3, wolves overtake an elk, deer or moose.
8. The prints were interpreted by the tracks because many prints converge on the other set of prints.
9. In state forests and parks containing varieties of flowering trees and shrubs, there are signs that say "Take nothing but pictures, leave nothing but footprints." because humans can destroy habitats by removing flowering trees and shrubs.
10. Interpreting tracks in either dirt of snow, help a conservationist determine the ecosystem because these prints can serve as clues as to the events occurring in a given ecosystem. The population of predators and prey can be extrapolated from these events.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:*** In studying the tracks left behind in the snow, one can interpret the animal's behavior. In further studying these tracks one can predict the animal's behavior.



Conclusion: ***May include, but are not limited to:***

The role of the conservationist is to monitor and correct any imbalance in the ecosystem. Corrections may come in the form of limiting or expanding hunting permits.

Lab Investigation 27: Succession

Objective: Understand how succession proceeds with outside forces included.

SCIENCE AND ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)

DISCIPLINARY CORE IDEAS

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

CROSSCUTTING CONCEPTS

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6), (HS LS2-7)

TEKS **(b) 2, [3A, B], [4A, B], 5, 6, 7**
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, [13A, B, D]

Science, Technology, and Engineering Practices:

Phenomenon: ***Answers may include, but are not limited to:***

- Ecosystems change
- Ecosystems change because the environment changed from the [initial / pioneer] species that first inhabited the area.
- New species populate an ecosystem because of change to the environment.

Constructing Explanations

- construct explanations
- designing solutions
- design evaluate, & refine a solution

A sketch should include a linear model of succession as well as abiotic factors that can influence the environment.

Sketch Your Model

Primary Succession	
Bare Land	Rocks, lichens, mosses
A	Grasses, dandelions, other weeds
B	Shrubs such as blueberry, chokeberry, brambles
C	Pines, spruces, hemlocks
D	Oaks, maples, cottonwood

Ecosystem Sketch – Card Information: Inferences to build an ecosystem

Sketch should be reflective of the end result of the cards drawn.
- An ice age should reflect snow covered areas.
- Human interference should reflect human construction.

Clarifying Questions:

1. *Answers vary but may include:*
   - Some events follow regular patterns such as seasons
   - Not all events follow regular patterns
   - Most events are random
2. *Answers vary but may include:* - grasses, shrubs, weeds, etc.
3. *Answers vary but may include:* - small mammals, insects, birds
4. *Answers vary but may include:* - mountain lions, wolves, coyotes
5. *Answers will vary but must agree with the student's chart.*
6. *Answers will vary but must agree with the student's chart.*
7. *Answers will vary but must agree with the student's chart.*
8. *Answers include but are not limited to:*
   - Not mowing allowed the natural progression of plant communities to occur.
   - Mowing was preventing the plant populations from modifying the environment, making it more suitable for others.
9. *Responses may include, but are not limited to:*
   Human activity: cutting down forest
   Effect on biodiversity: Different plant and animal species will be present. Many species that live in the forest will be lost.
   Human activity: planting trees
   Effect on biodiversity: decrease biodiversity by shading out small plants or increase biodiversity by adding new species.
   Human activity: building a mall
   Effect on biodiversity: removes many plants and animals from the environment
   Human activity: planting wild flowers
   Effect on biodiversity: increase biodiversity because you are adding new plants
10. *Responses may include, but are not limited to:*
    - The ecosystem would undergo succession again and eventually return to its stable state.
    - The ecosystem would gradually change back to the climax community that was there before the flood.
    - The ecosystem would slowly change back to what it was before the flood.
    - Succession would begin from bare soil.

Crosscutting Concepts:

Claim: ***May include, but are not limited to:*** After completing this activity one can see the randomness in which certain events in nature occur and how nature of response to events that are out of the norm.

Stability and Change

- *How does the system operate effectively?* → Systems work effectively with little or no change into the system.
- *What changes causes changes in its operation?* → Changes to the ecosystem may be subtle, or catastrophic.
- *What changes could cause the system to fail?* → Changes that cause the system to fail would be drastic changes to the system.
- *Describe the feedback mechanisms* → Feedback mechanisms in most ecosystems are often between biotic factors, which in turn, affect abiotic factors.

sketch a model

Conclusion: Ecosystems change over time. Some changes are small, like one would see in succession. Some changes are big, such as volcanic eruption or astronomical events

Lab Investigation 28: Human Population

Objective: This investigation studies the relationship of human population as a community.

SCIENCE AND ENGINEERING PRACTICES

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS LS2-1)
- Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2)
- Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS2-7)

DISCIPLINARY CORE IDEAS

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7)

CROSSCUTTING CONCEPTS

Scale, Proportion, and Quantity

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1)
- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2)

TEKS (b) 2, [3A, B], [4A, B], 5, 6, 7 (c) [1A, B, E, F, G], [2A, B], [3A, B, C], 4A, [13A, B, D]

Science, Technology, and Engineering Practices:

Phenomenon: ***Examples of a possible phenomenon may include, but are not limited to:***

– Human population has grown
– Human population has overtaken many other animal populations.
– A growing human population needs land and animals to farm and eat.

Using Mathematics and Computational Thinking

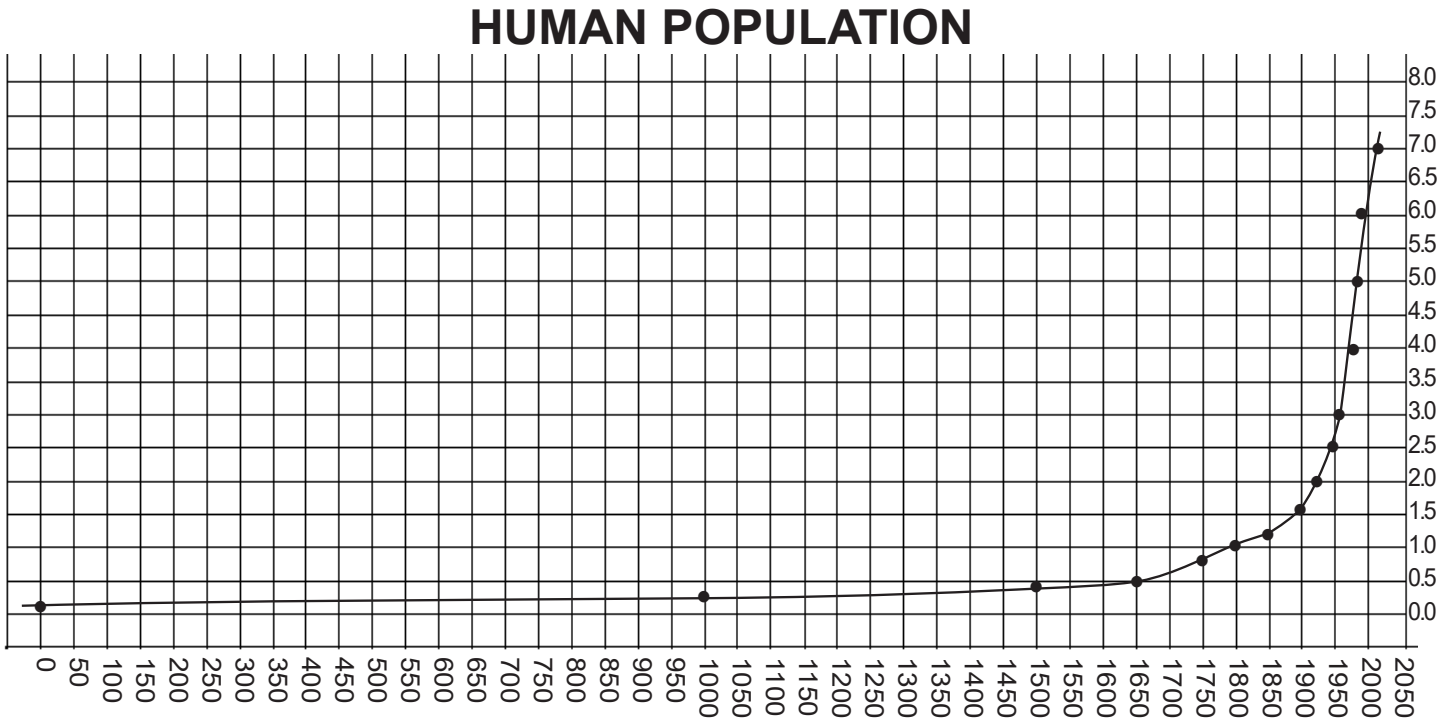
- *sketch representatives*
- *mathematical modeling*
- *computational thinking*
- *analyze*
- *design solutions*

Sketch might include a graph.
If the graph is an s-curve, allow for students to investigate it.

Sketch Your Model

Vocabulary:

Carrying Capacity: The maximum amount of the individuals that the environment can support.
Crash: When the population exceeds the carrying capacity, it will then have a die off.
Creep: When the environment is not populated, other organisms of that species will move in.



Clarifying Questions:

Answers may include one of, but are not limited to:

1. There is a population difference of one billion people.
2. The year 1500, the human population almost doubled from the previous 500 years.
   or Beginning of the year 1800 there was exponential growth in human population, every 50 years to present.
3. The chart does not fit the carrying capacity chart because it is a J-curve, not a leveling off chart.
4. I describe this as a J-curve because it only increases, it does not level off.
5. Any date within the range 1965-1975 is acceptable.
6. The population of approximately 17.5 billion people and will fall approximately around 1900.
7. Limiting factors for the growth of any population are (including, but not limited to) amount of food, shelter, climate, opportunity to find mates.
8. An estimate in the area of 30 years from now based on the fact that it doubled from 50 years ago, and previous to that, it was 80 years.
9. As human population grows, the need for farmland, food and space to live infringe on wild areas.
10. As human population grows, space to live becomes increasing limited. Disease has a greater chance to spread, sanitation would become over taxed, food would become scarce and tensions would rise.

Crosscutting Concepts:

Claim: ***Examples of a claim may include, but are not limited to:***

– Human population has grown in a J-curve; logarithmically.
– Human population has overtaken many other animal populations and is not constrained by carrying capacity.
– A growing human population needs land and animals to farm and eat and takes habitat form other animals.

Scale, Proportion, and Quantity

Simple tests can determine a phenomenon is dependent on:
- scale
- proportion
- quantity

Sketch might include a graph.
If the graph is an s-curve, allow for students to investigate it.

sketch a model – use boxes to show proportion - use labels

Conclusion: Human population has grown exponentially in the past few hundred years. It defies an S-curve, and is a J-curve.

Lab Investigation 29: Sustainability

Objective: The objective of this investigation is to understand the sustainable stewardship role of this planet.

SCIENCE AND ENGINEERING PRACTICES
Constructing Explanations and Designing Solutions

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DISCIPLINARY CORE IDEAS
LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)
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CROSSCUTTING CONCEPTS
Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-7), (HS-LS2-8)

TEKS (b) 2, [3A, B], [4A, B] 5, 6, 7
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], [4A, B, C], [13A, B, D]

Science, Technology, and Engineering Practices:
Phenomenon: ***May include, but are not limited to:***

– Humans have changed the planet.
– Humans have changed the planet to meet their growing needs.
– Humans should change their habits for the sake of the planet.

Constructing Explanations

- construct explanations
- designing solutions
- design evaluate, and refine a solution

Sketches might include humans:
- farming
- working with animals
- constructing buildings or other structures

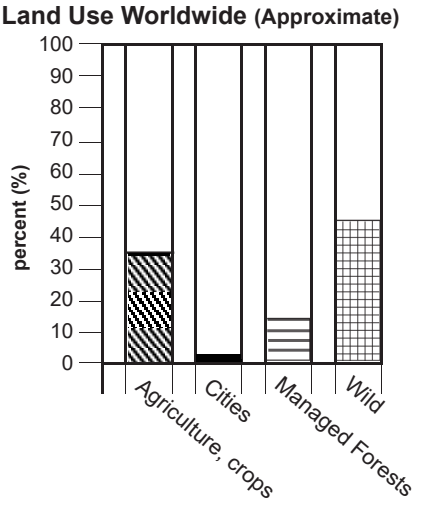
Sketch Your Model

Clarifying Questions:

1. The approximate number of species that became extinct between the years 1950 and 2000 is 22,000.
2. One possible reason for the change in the number of species extinctions between 1890 and 1990 can be one of the following:
   - The species could not adapt to rapid changes in the environment.
   - New pollutants added to the environment by humans.
   - Habitats were destroyed at a rapid rate.
   - Climate change
   - Rapid human population growth

Part 1: Land Use

Agriculture	37
Cities	3
Managed Forests	15
Wild	45



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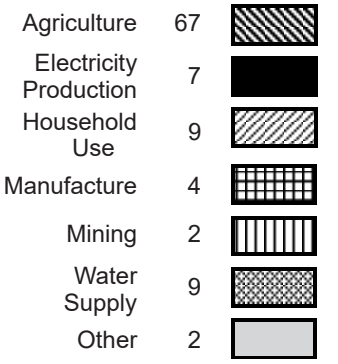

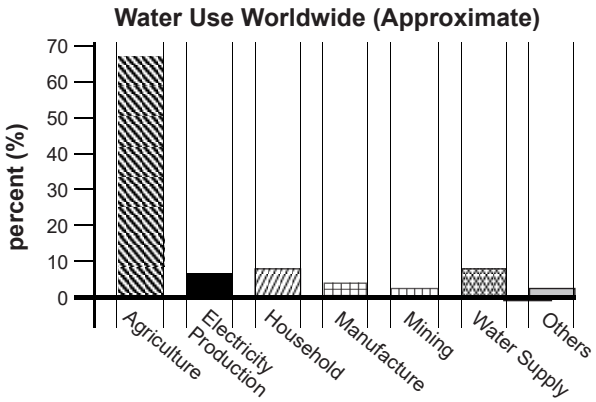

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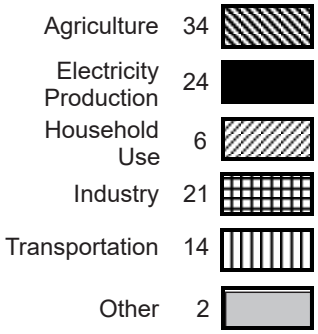
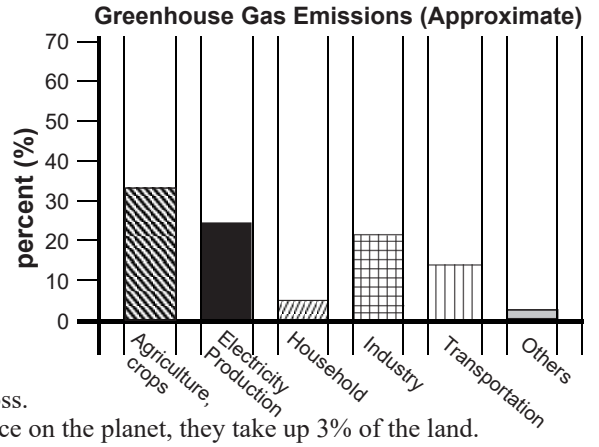




epa.gov

Clarifying Questions:

1. The driving force of extinctions on Earth is habitat loss.
2. In looking at the charts, cities do not take a lot of space on the planet, they take up 3% of the land.
3. Discounting Antarctica, the percentage of the planet that is wild is 35%.
4. As the human population of the planet continues to increase, people will turn to the wild areas to take the land.
5. Agriculture is the largest consumer of water use on the planet.
6. In order to reduce the water-use on the planet, people can improve irrigation.
7. Agriculture is the largest producer of greenhouse gases.
8. The rainforests filter the CO_2 in the atmosphere, without the rainforests, CO_2 would continue to rise. The rainforests are being replaced by agricultural concerns.
9. In order to increase the stewardship of Earth for a sustainable future:
   - The category that consistently had high numbers for land use, water consumption and greenhouse gas emissions is the production of agriculture.
   - People can reduce the demand for agricultural products grown on a mass scale; shop locally, using sustainable foods.
   - People have ingrained into their lifestyle to consume foods that are not locally grown and should become attuned to seasonal foods as well.
10. Some people have argued for the removal of cormorants from the eastern shores of Lake Ontario because of their negative effects on the fishing industry. The consequences of this action are as follows:
    - By removing cormorants from the food web you will be eliminating a predictor and competitor to the fishing industry.
    - By removing cormorants you would also effect the predators that rely on cormorants and their eggs, such as coyotes, foxes, and raccoons.
    - Have a sustainable fish restocking program.

Crosscutting Concepts:

Claim: ***Examples of a claim may include, but are not limited to:***

– Humans have changed the planet through agriculture and urbanization.
– Humans have changed the planet to meet their growing needs through agriculture and urbanization.

Cause and Effect

Simple tests can be designed to:
- gather evidence
- argue about idea causes
- explain relationship
- explain causes

Examples of Cause and Effect, but are not limited to:
Landscape and forests become industrialized, farmed, and rivers controlled.

Sketches might include humans:
- farming and shaping the landscape
- working with animals
- constructing buildings or other structures such as dams that change the landscape

sketch a model – use arrows to show relationships - use labels

Conclusion: Land and water use by humans for agriculture surpasses uses for other purposes. Greenhouse gases are also associated with these agricultural practices. In order to be proper stewards of this planet, these agricultural practices should be re-thought.

Lab Investigation 30: Nēnē

Objective: Biologic controls are methods in which animals deemed undesirable, such as invasive species, have their populations kept in check by natural predators.

SCIENCE AND ENGINEERING PRACTICES

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-LS2-7)

DISCIPLINARY CORE IDEAS

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS LS2-7)

CROSSCUTTING CONCEPTS

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-7), (HS-LS2-8)

TEKS **(b) 2, [3A, B], [4A, B] 6, 7**
(c) [1A, B, E, F, G], [2A, B], [3A, B, C], [4A, B, C] [13A, B, D]

Science, Technology, and Engineering Practices:

Phenomenon: ***May include, but are not limited to:*** – Isolated areas have ecosystems that are delicate.
– Ecosystems have feedback mechanisms to ensure its health.
– Invasive species can upset ecosystems.

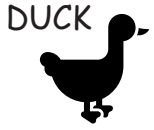
Constructing Explanations

- construct explanations
- designing solutions
- design evaluate, and refine a solution

Examples might include but are not limited to:

– Hawaii has an ecosystem that developed in isolation.
– Hawaiian ecosystem developed without predators as in other areas.
– Animals in this isolated ecosystem have to cope with invasive species.

Example of animals may include, but are not limited to:

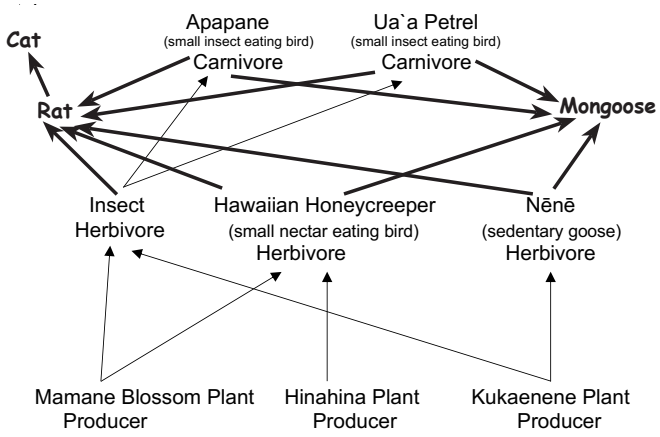


Sketch Your Model

Clarifying Questions:

1. Before: top of the food chain were Apapane, Ua`a petral, Hawaiian Honeycreeper, Nēnē.
   After: rat, mongoose, feral cat
2. The top of the food chain has been upset, the birds have been devastated by the invasive species.
3. Apapane: feral cat: cats eat birds
   mongoose: mongooses eat eggs of birds and small birds
   Norway rat: rats eat eggs of birds and chicks
   Ua`a Petral: feral cat: cats eat birds
   mongoose: mongooses eat eggs of birds and small birds
   Norway rat: rats eat eggs of birds and chicks
   Hawaiian Honeycreeper: feral cat: cats eat birds
   mongoose: mongooses eat eggs of birds and small birds
   Norway rat: rats eat eggs of birds and chicks
   Nēnē: feral cat: no significant relationship
   mongoose: mongooses eat eggs of birds and small birds
   Norway rat: rats eat eggs of birds and chicks

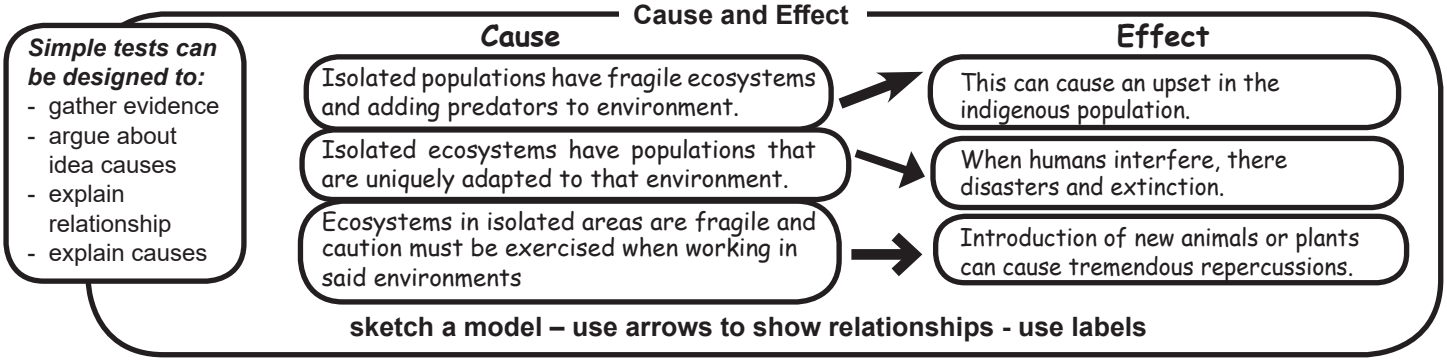
INTRODUCTION INVASIVE SPECIES FOOD WEB



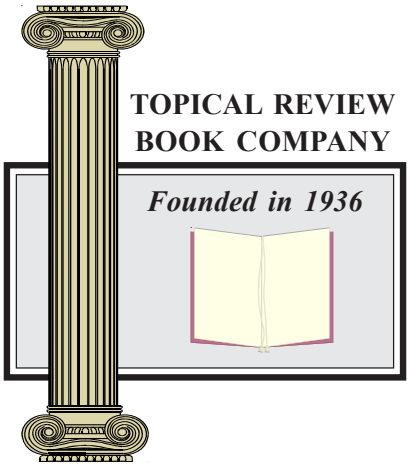
4. Three characteristics that the nēnē does not have natural are:
   • the nēnē is a sedentary bird (does not fly) • the nēnē nests in open spaces • the nēnē's eggs are a food source for rats and mongoose
5. The rat and the mongoose are omnivores so they have a wider variety of food sources, they are generalists.
6. Mongooses are diurnal, that means that they are active during the daylight hours. Rats are nocturnal, that means they are active at night.
7. *Answers include but are not limited to:*
   - It kills trees and shrubs because it covers them like a blanket, cutting down on the amount of sunlight to these plants.
   - It cuts down on photosynthesis.
   - It out-competes the trees for water or other nutrients.
   - The vine may have roots that attach to trees and shrubs and absorb nutrients from them.
8. *Answers include but are not limited to:*
   - The chemicals may be harmful to people.
   - The chemicals may affect other plants or animals negatively.
   - Using insects does not add chemicals to the environment.
9. *Answers include but are not limited to:.*
   - The insects might harm the native plants. - The insects might have a negative impact on the animals.
10. You work for the U.S. Department of Agriculture, construct a model in which you would perform ecosystem restoration to the Hawaiian ecosystem.
    • Identify the organism of focus. - mongoose / rat / feral cat
    • Explain the system and how it would work. - a system to relocate pest - a system to eradicate a pest
    • Identify the negative consequences of this plan, and how it could justifiable.
      - traps might capture pets - hunting of invasive species / animals may be mistaken for invasive species.
      - poisons might kill pets or farm animals or indigenous species. - justification is the elimination of the invasive species.
    • Argue the strengths of the program with intended outcomes. - eradication of invasive species. - restoration of native species
    • Explain the delicate balance of ecosystems, especially remote, isolate ecosystems.
      - ecosystems are the results of the interactions of plants and animals, in a specified geographic area with a given climate.
      - animals and plants in isolated areas have evolved to very specific interactions that are relative to one another.
    • Include all points about the model you created. Your essay will have an introductory statement. An informational paragraph, and a conclusive paragraph.

Crosscutting Concepts:

Claim: Hawaii is an isolated environment. It is a perfect microcosm of an enclosed ecosystem. This ecosystem as fragile as it is, serves as a study of human interference in nature.



Conclusion: Ecosystems develop a delicate and complex interaction with one another. These ecosystems would become stressed with the interaction of foreign species, particularly when the native species have no defense to the new invaders.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