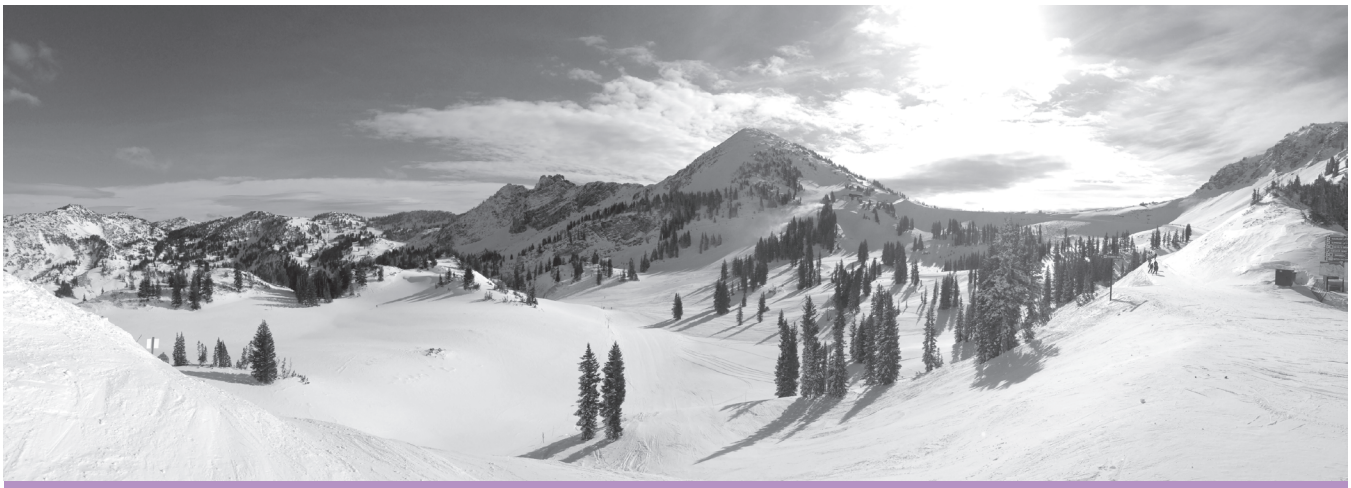
Colorado Measures of Academic Success



Grade 11

Science

Paper Practice Resource for Students

Paper Practice Resource for Students

The Colorado Measures of Academic Success (CMAS) is Colorado's standards-based assessment program designed to measure the Colorado Academic Standards (CAS) in the content areas of science, social studies, English language arts, and mathematics. The sample items included in this resource provide students with an opportunity to become familiar with the format of test items that appear in the paper-based test books.

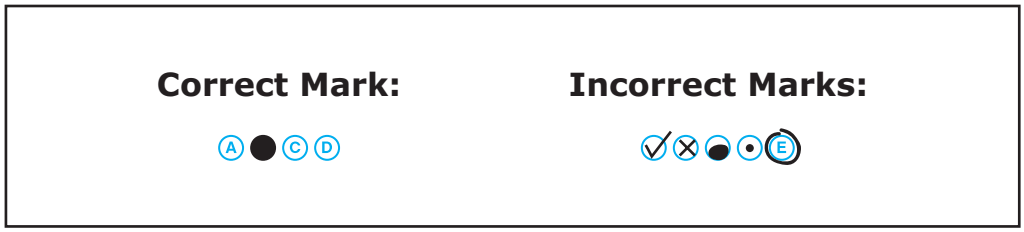
While the use of the sample items is not required, it is strongly encouraged to help ensure students are familiar with the types of items they may encounter while taking the paper-based test.

The sample item sets in the CMAS Practice Resources are not intended to be representative of a complete unit or test, nor are they intended to cover all assessed content or item types. To view assessment frameworks, high level blueprints, scoring rubrics, evidence statements and standards for the CMAS assessments, visit: https://www.cde.state.co.us/assessment/cmas_testdesign.

Item Types:

Selected Response Items

Selected response items are multiple choice questions. To respond, the student indicates their response by filling in the circle(s) next to their answer choice.



Constructed Response Items

Constructed response items are questions or prompts that require an independent, written response. To respond, the student writes his or her answer in the response box in the test book.

Converted Online Technology-Enhanced Item Types

Online technology-enhanced items converted to the paper testing format may ask students to:

- Circle the correct answer
- Complete a table with checkmarks, Xs, or letters from a list of answer choices
- Fill in the blank
- Draw lines from boxes to correct answers
- Complete a bar graph or histogram

Clusters

Clusters include groups of items that relate to a scientific topic. The information needed to respond appears before the associated items.

ITEM SET 1

1. A student drops objects of different masses to measure force. The student uses objects with these masses: 1 kilogram (kg), 10 kg, and 20 kg. The student drops each object from a height of 10 meters. All the objects take the same amount of time to fall. The resulting data are shown in the table.

Mass and Force Data

Object	Mass (kg)	Force (newtons)
W	1	9.8
X	10	98
Y	20	196

The student claims that the data support Newton's Second Law of Motion.

Newton's Second Law of Motion

The force acting on an object causes it to accelerate according to this formula

$$F = m \cdot a$$

where

F = force, in newtons (N)

m = mass, in kilograms (kg)

a = acceleration, in meters per second squared (m/s^2)

Select the **two** pieces of evidence from the investigation that support the student's claim.

Ⓐ Each object exerts the same force on Earth as Earth exerts on the object.

Ⓑ Each object starts to move only after a force is applied to it.

Ⓒ The forces are all in proportion to the masses they affect.

Ⓓ The objects are all dropped from the same height.

Ⓔ The objects all accelerate at the same rate.

Directions: Use the information to answer questions 2 through 6.

Part 1

People sometimes feel tired after eating. Students research the ways the body responds during the digestion process. A reliable website describes several steps in this process in order:

1. Hormones are released.
2. These hormones dilate blood vessels that lead to the digestive system.
3. Blood pressure starts to drop as more blood flows to the digestive system.
4. The heart pumps faster, and blood vessels in other parts of the body constrict.

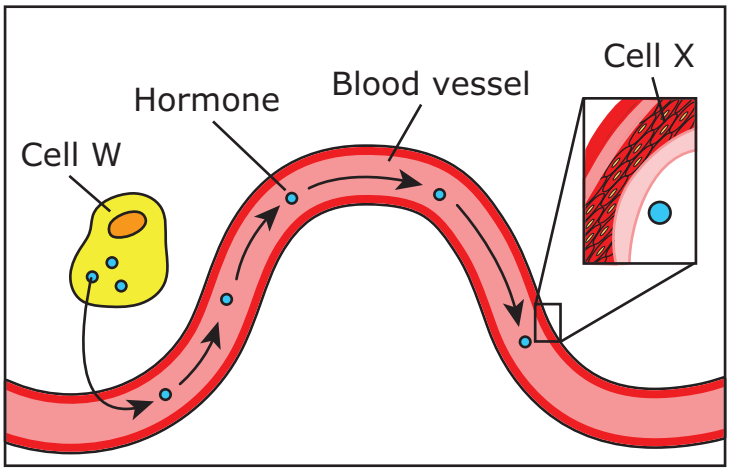
Part 2

The students decided to investigate the responses of body systems to eating a meal. They selected five subjects to participate in their investigation.

For each subject, the students collected several kinds of data:

- mass of subject
- size of meal
- heart rate and blood pressure before meal
- heart rate and blood pressure after meal
- whether subject is male or female
- age of subject

2. Study the model of hormone interactions.



Circle one correct response in each box to complete the sentences.

This model shows steps 1 and 2 of the process described in Part 1. In the model, the hormone is released by Cell W, which is part of the _____ system. The hormone leaves the

circulatory
endocrine
muscular

circulatory system and binds to Cell X in _____

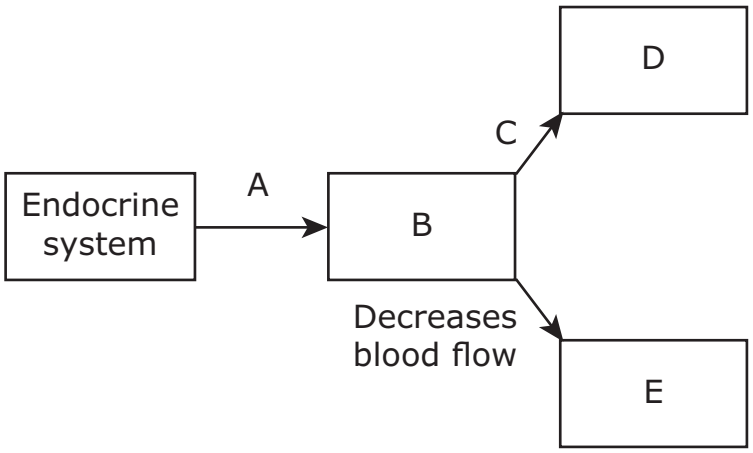
the endocrine system
muscle tissue

that _____.

changes shape to dilate vessels
captures hormones for later use

3. This model shows some interactions of the endocrine system with other body systems.

Model of Some Actions of the Endocrine System



One body system and one action are labeled in the model. Use the information and steps in Part 1 to develop the model.

Write the correct letter from the model in the table to label the step or body system. Each letter may be used once.

Letter	Step or Body System
_____	Step 1
_____	Step 3
_____	nervous system
_____	digestive system
_____	circulatory system

4. A student wants to add a fifth step to the digestion process described in Part 1 to help explain one reason why people might feel tired after eating.

Based on the information provided, which statement should be Step 5 of the digestion process?

Ⓐ More blood flows to the endocrine system.

Ⓑ Less blood flows to the endocrine system.

Ⓒ More blood flows to the nervous system.

Ⓓ Less blood flows to the nervous system.

5. A group of students discusses ideas for the frequency of data collection in the investigation described in Part 2. They come up with three possible plans.

- Plan A: Collect data 1 hour before, 10 minutes before, immediately before, and immediately after eating.
- Plan B: Collect data immediately before eating and immediately after eating.
- Plan C: Collect data immediately before, immediately after, 10 minutes after, and 1 hour after eating.

Determine which plan will give the students the most usable data. Your response should include:

- the plan that will provide the best evidence for the effect of feedback loops on homeostasis
- why this plan will provide the best evidence for the effect of feedback loops on homeostasis

6. The students want to compare the data measured for each subject in the digestion investigation described in Part 2.

Circle one correct response in each box to complete the sentences.

The students can better compare data if the ratio of

the _____ to the _____

energy content of the meal	mass of the subject
age of the subject	sex of the subject

is consistent for all the participants. This will help ensure that the data collected provides accurate evidence about how a subject's body systems work _____ to _____ homeostasis.

independently	disrupt
together	maintain

7. Giant pandas and red pandas both eat bamboo and have a modified wrist bone that functions like a thumb to help the animals grip bamboo while eating. A student claims that giant pandas and red pandas must be related because of these similarities.

Which of the following investigations would provide the **best** evidence to support or refute the student's claim?

Ⓐ a comparison of the anatomical structures of the leg bones of giant pandas and red pandas

Ⓑ a comparison of DNA patterns in the genomes of giant pandas and red pandas

Ⓒ a comparison of the fossilized ancestors of giant pandas and red pandas

Ⓓ a comparison of the behaviors of giant pandas and red pandas

Directions: Use the information to answer questions 8 through 12.

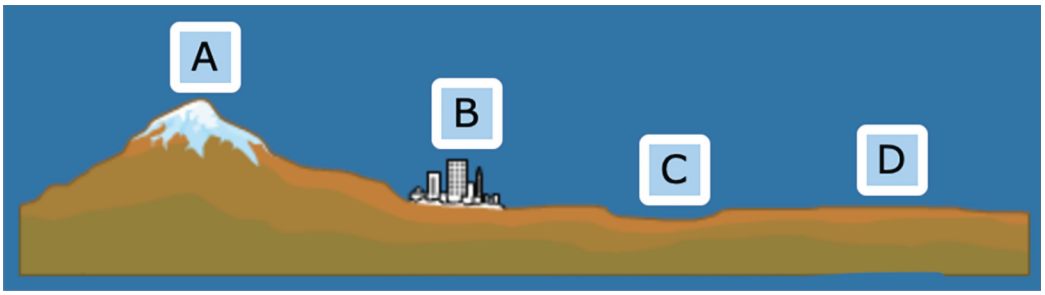
The energy output of wind turbines is influenced by three main factors: wind speed, air density, and rotor diameter. Selecting a location for wind turbines requires consideration of possible environmental impacts and effects on the community.

Part 1

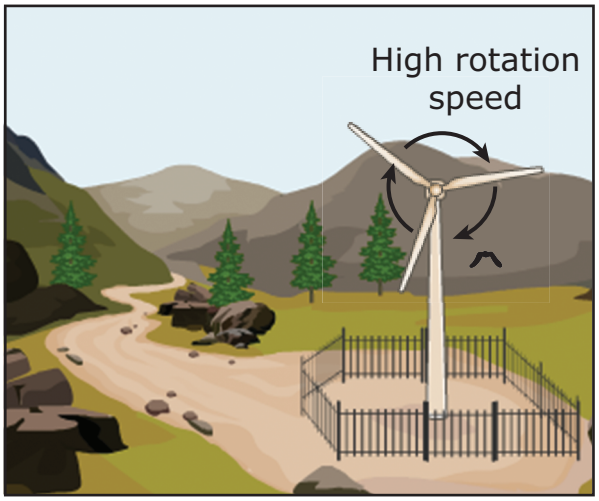
Part 1 shows four locations to consider for wind turbine placement and the impact, cost, and energy output for each location.

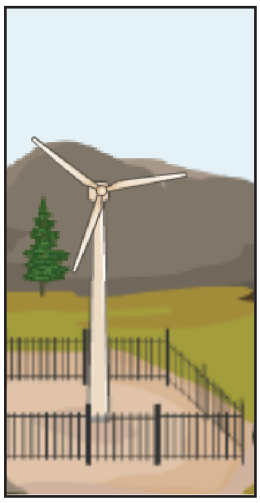
View the characteristics of the location and the movement of the wind turbine at locations A, B, C, and D. Then observe the results in the data table.

Locations A, B, C, and D



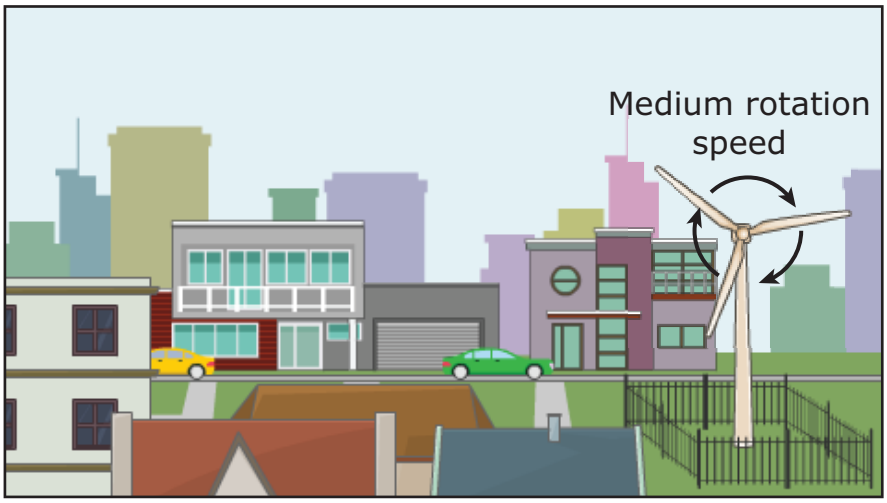
Location A



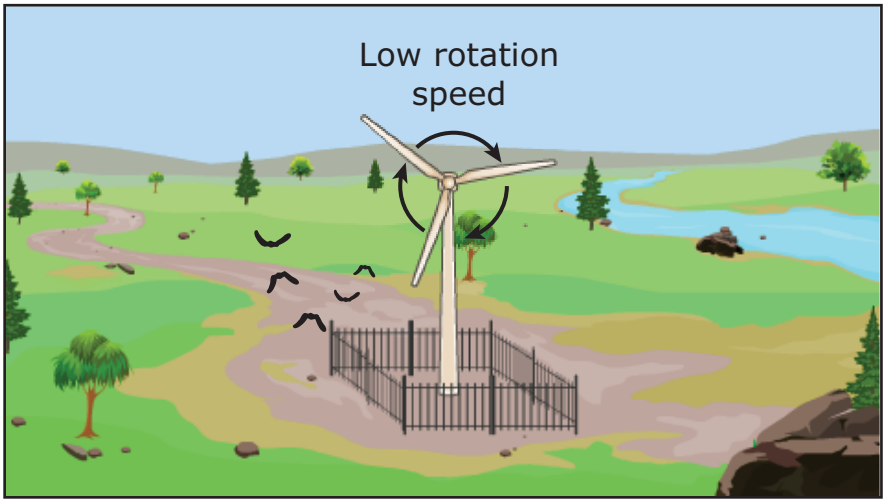


Wind speed sensors record maximum speed reached, shutting turbine down for safety.

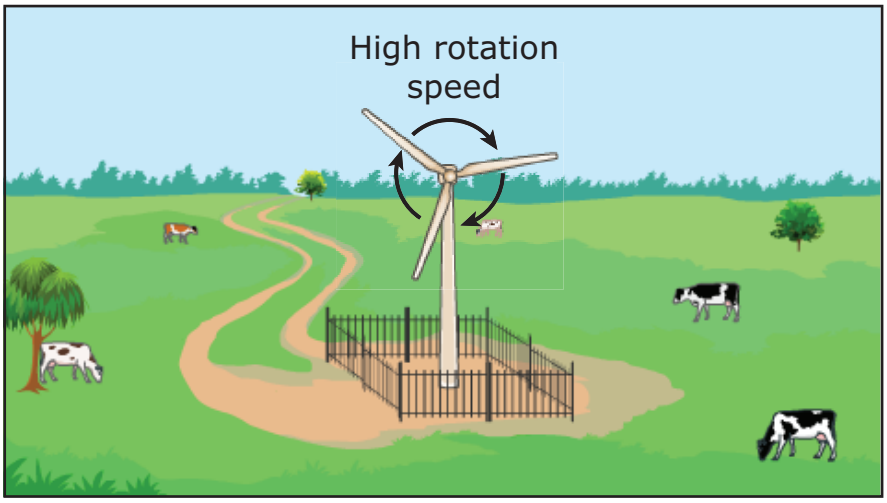
Location B



Location C



Location D



The table shows various impacts of building in each of the locations.

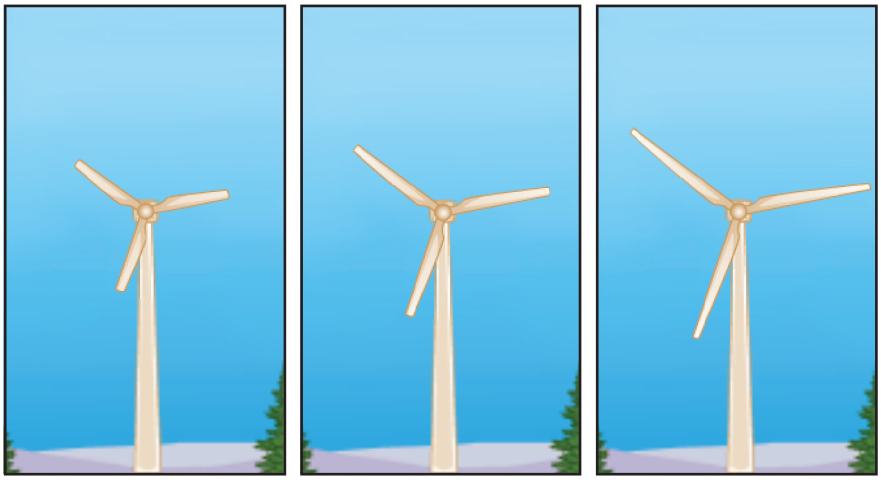
Part 1 Data Table

Location	Impact to Humans	Impact to Ecosystem	Monetary Cost	Energy Output
A	low	medium	high	high
B	high	low	medium	medium
C	low	high	medium	low
D	low	low	low	high

Part 2

Part 2 shows wind turbines with different rotor diameters, in meters (m). The rotor diameter of the wind turbine affects the amount of energy produced, in megawatt-hours (MWh).

Rotor Diameter



80 m 100 m 120 m

The data table shows the average amount of energy produced for each rotor size operating under identical conditions.

Energy Production Based on Rotor Diameter

Rotor Diameter (m)	Electricity Produced (MWh)
80	1,500
100	2,300
120	3,300

8. Two engineers are discussing whether a wind turbine should be placed in Location B. Based on the information in Part 1, determine whether each statement supports placing the wind turbine at Location B or at a different location.

Place a check mark (✔) to select an answer in each row. Select **one** box per row.

Statement	Supports Placing the Wind Turbine at Location B	Supports Placing the Wind Turbine at a Different Location
The distance between the power source and the community using the power is minimal, which reduces the cost to transmit the power.		
Additional access roads do not have to be constructed, which will conserve wildlife habitats.		
The wind turbines generate low-frequency noise, which may interrupt people's sleep.		

9. Distributed wind systems (DWS) are networks of individual turbines that power homes or businesses. A business builds a wind turbine and uses it to power a specific location. This location will then contribute any excess energy to the community power grid for others to use. The DWS can be far away from the places that it powers.

The people working in locations A, B, C, and D all use the same power grid, but use of DWS might affect them differently.

Based on the information, identify the location that would benefit the most from a DWS and explain why. Your response should include:

- identification of which location would benefit the most from a DWS rather than the installation of a local set of wind turbines
- why that location is the best selection for the DWS

10. The community builds multiple wind turbines at Location A. Why has the community **most likely** chosen Location A to install wind turbines?

Ⓐ The location is the most accessible for building large structures.

Ⓑ The location is the closest to a major metropolitan area.

Ⓒ The location has a high availability of wind resources.

Ⓓ The location has the lowest environmental impact.

11. Large rotors are often difficult and costly to transport. Despite the transportation costs, the general trend in wind energy is to utilize larger rotors. Based on the data in the table in Part 2, what is an explanation for the trend to use larger rotors?

Circle one correct response from each box to complete the sentences.

Using larger rotors means _____ turbines are needed, on average,

fewer
more

to meet electricity production goals. This ultimately leads to _____

higher
lower

long-term costs. Because different locations vary in average wind speed, peak wind speed, and a variety of other conditions, the trend toward larger rotors will _____.

accelerate over time
not be universal
soon end

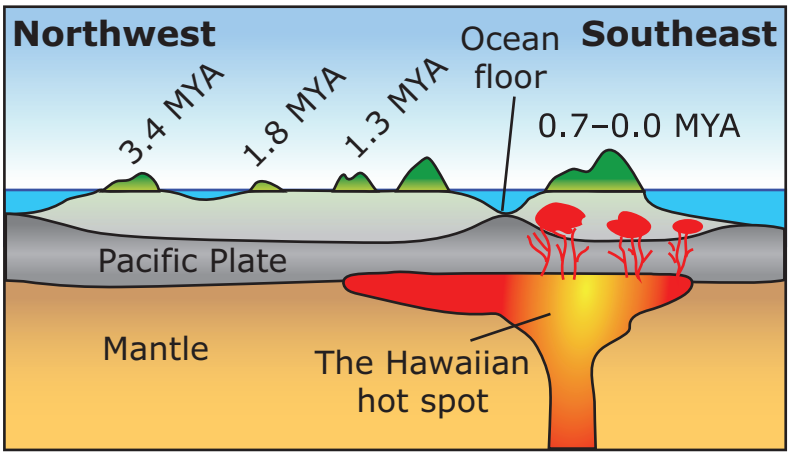
12. The cost to transport wind turbine construction materials increases with distance. An engineer compares the options of using a wind turbine with a 120 m diameter rotor at either Location C or Location D. The materials would be transported from Location B. Based on this information and the results of Part 1, explain why Location D would provide the better long-term cost-benefit result regarding transportation cost and electricity production. Your answer should include:

- a comparison between the long-term effects of higher transportation costs and the long term benefit of greater electricity production
- an explanation of how this comparison favors Location D instead of Location C

This is the end of Item Set 1.

ITEM SET 2

1. The diagram shows the Hawaiian hot spot and the ages at which some Hawaiian islands were formed millions of years ago (MYA). The oldest island shown is Oahu, which formed 3.4 MYA, while the youngest is Hawaii, which formed between 0.7 and 0.0 MYA.



not to scale

Based on the information in the diagram, which statement explains how the islands that are **not** directly over the Hawaiian hot spot formed?

Ⓐ The Hawaiian hot spot moved to the northwest, causing lava to move along the ocean floor.

Ⓑ The Hawaiian hot spot moved to the southeast, causing lava to move along the ocean floor.

Ⓒ The Pacific Plate moved to the northwest, over the Hawaiian hot spot.

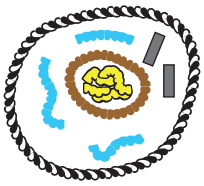
Ⓓ The Pacific Plate moved to the southeast, over the Hawaiian hot spot.

TURN THE PAGE AND CONTINUE WORKING

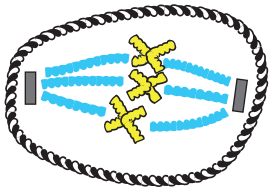
2. A student uses pieces of yarn to make a model of mitosis. However, the student does not accurately represent the end result of mitosis. The student's model is shown.

Student Model of Mitosis

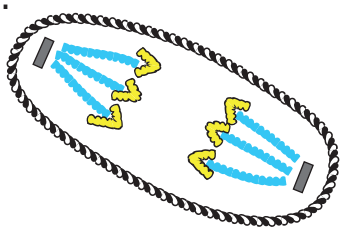
1.



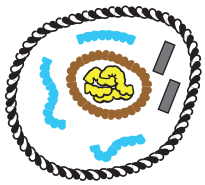
2.



3.



4.

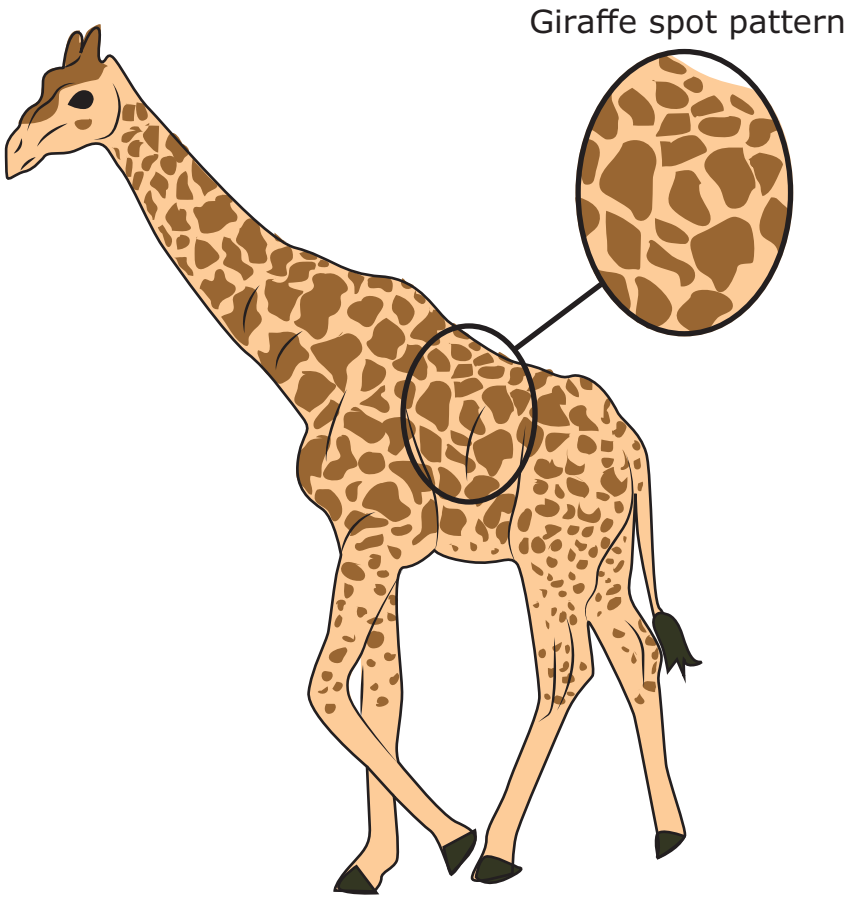


KEY	
= spindle	= nuclear envelope
= chromosome	= centriole
= cell membrane	

Explain the function of mitosis in multicellular organisms and how the student could improve the model to more accurately represent the process. Your response should include:

- an explanation of the function of mitosis
- a description of how the student could correct the end result of mitosis in the model

3. Giraffe spot patterns are unique to each giraffe. Scientists analyzed survival records and spot patterns of 31 mothers and their calves. Based on the evidence, the scientists made this claim: giraffe spot pattern traits are related to juvenile survival and are heritable.



Which question is **most** closely related to the scientists' claim?

Ⓐ How do wild giraffes' spot patterns compare with captive giraffes' spot patterns?

Ⓑ How does the color of the spots on the calves' coats change as they grow?

Ⓒ What role does DNA play in the spot patterns inherited by the calves?

Ⓓ Can variation in spot patterns be used to identify individual calves?

Directions: Use the information to answer questions 4 through 9.

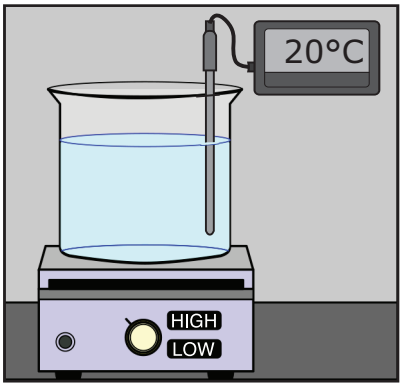
A student boils water for pasta and notices that the water boils faster when there is a lid on the pot. The student wonders whether energy can be saved by boiling water with the lid on. The student conducts an experiment to investigate the energy used to boil water at sea level under several different conditions. The experiment uses a hot plate with settings given in watts (W). The student compares the time it takes for the water to boil, in seconds (s), to the amount of electrical energy used, in watt-hours (Wh), for these four trials:

- Trial 1: low power (950 W) with lid off
- Trial 2: low power (950 W) with lid on
- Trial 3: high power (1,500 W) with lid off
- Trial 4: high power (1,500 W) with lid on

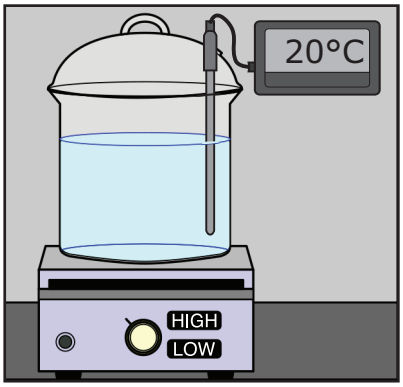
The student follows these steps:

1. Heat the water at the low power setting in the pot with the lid off until it boils.
2. Record the time it takes for the water temperature to reach the boiling point. Temperature is measured in degrees Celsius (°C).
3. Calculate the total energy used.
4. Repeat steps 1–3 for each condition.

Starting Setup for All Trials

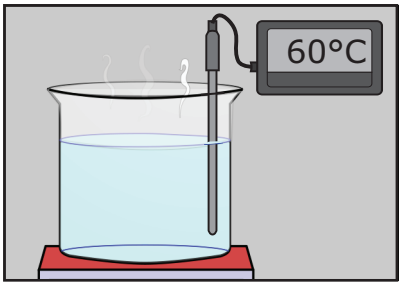


Lid off

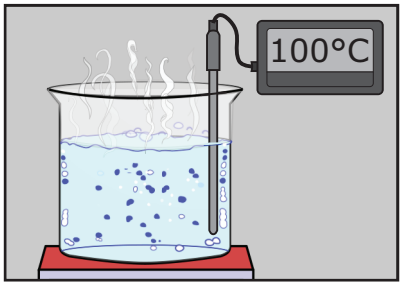


Lid on

Observations for Trial 1: Low Power (950 watts) with Lid Off

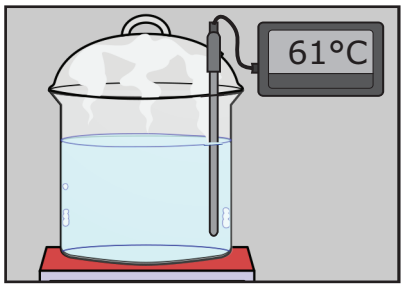


600 seconds

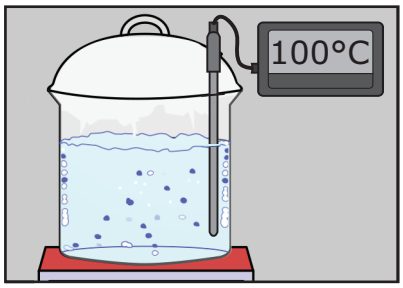


1,450 seconds

Observations for Trial 2: Low Power (950 watts) with Lid On

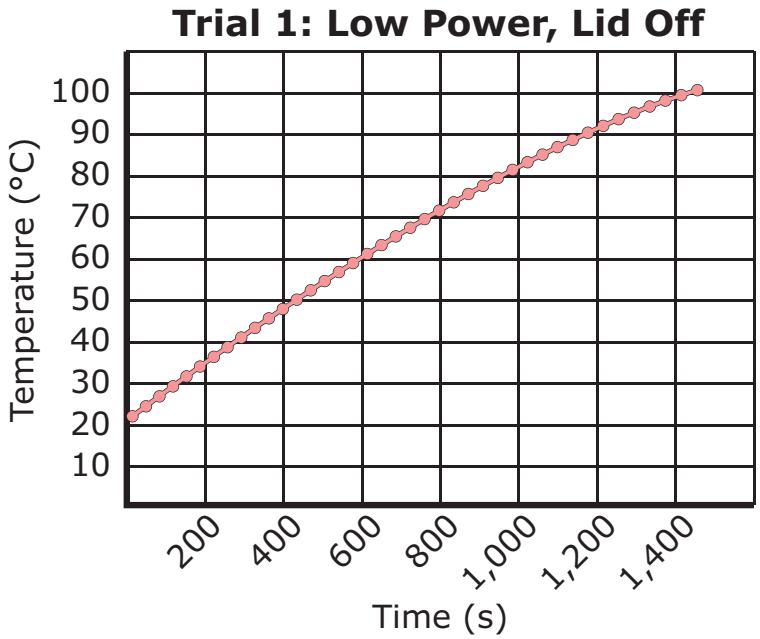


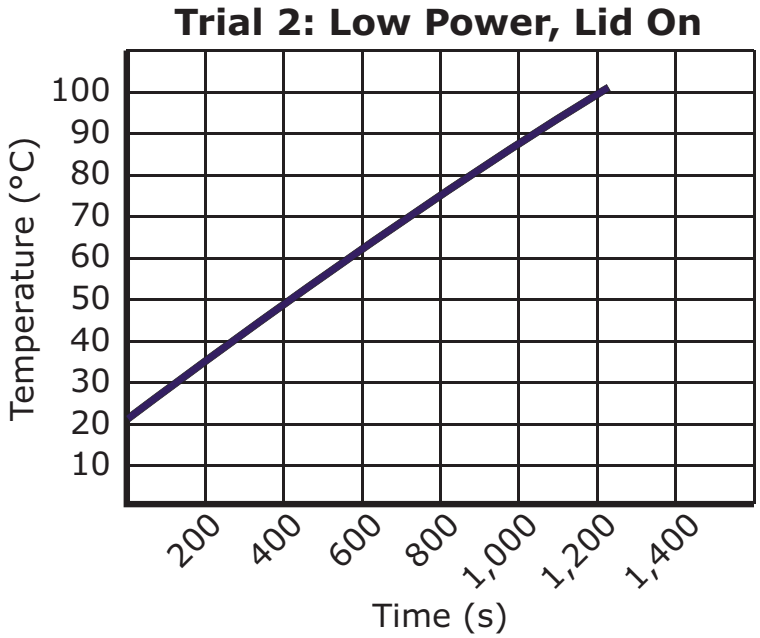
600 seconds



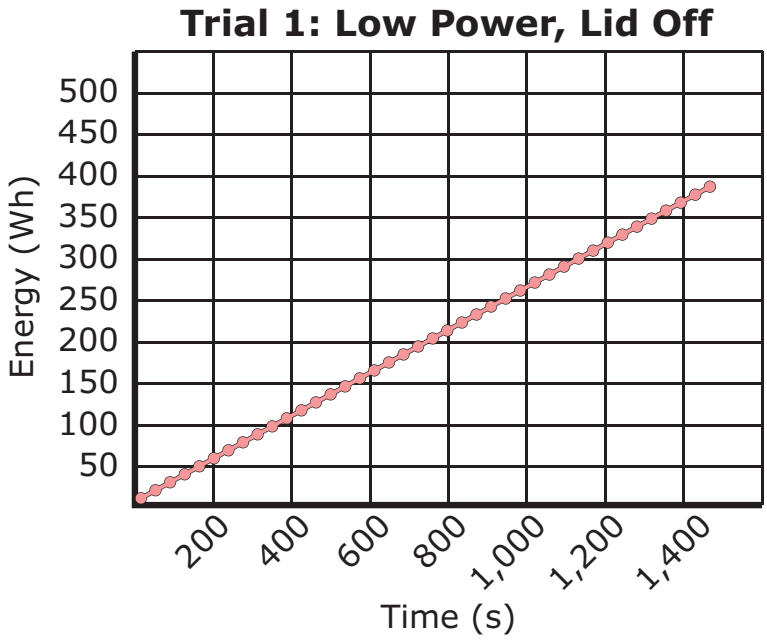
1,215 seconds

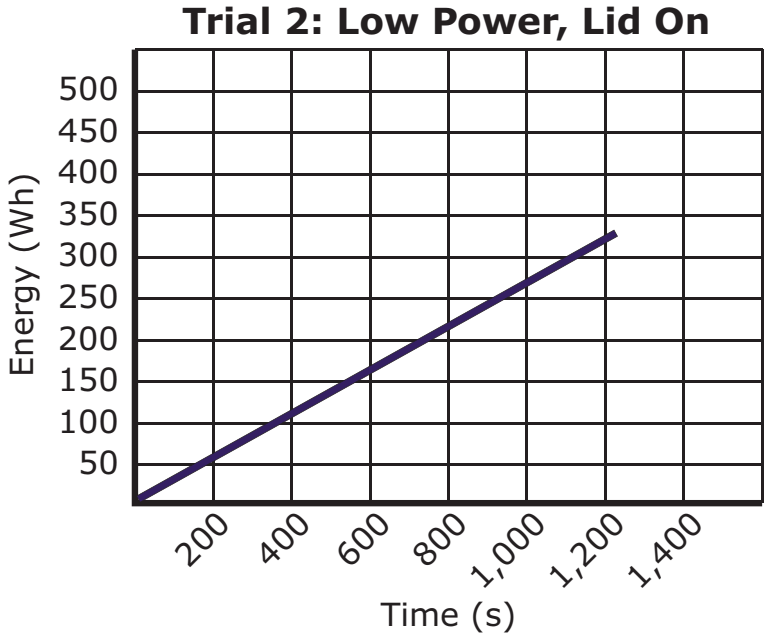
Temperature Graphs for Trial 1 and Trial 2



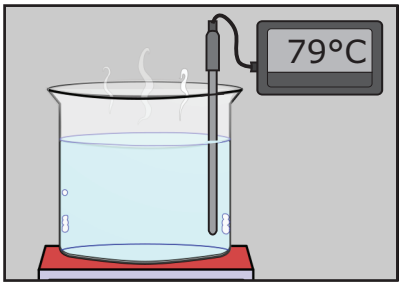


Energy Graphs for Trial 1 and Trial 2





Observations for Trial 3: High Power (1,500 watts) with Lid Off



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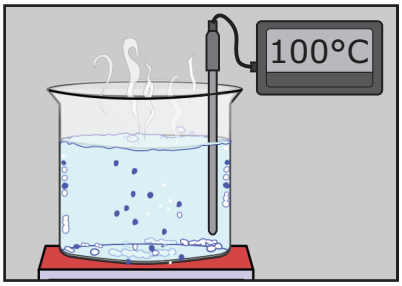
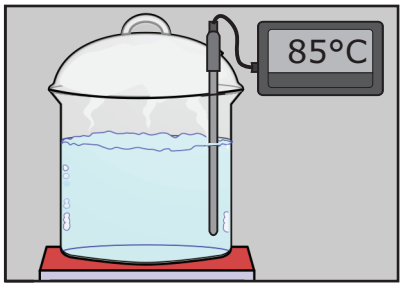
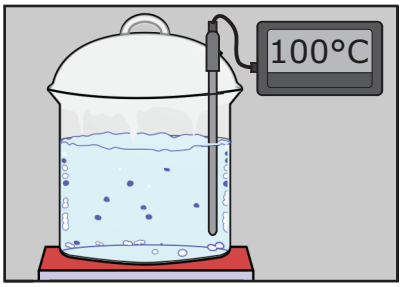


820 seconds

Observations for Trial 4: High Power (1,500 watts) with Lid On

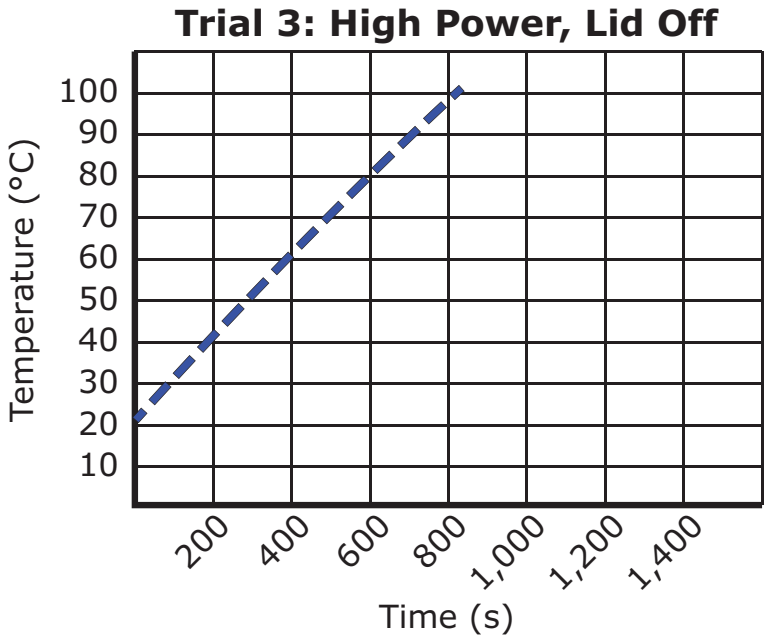


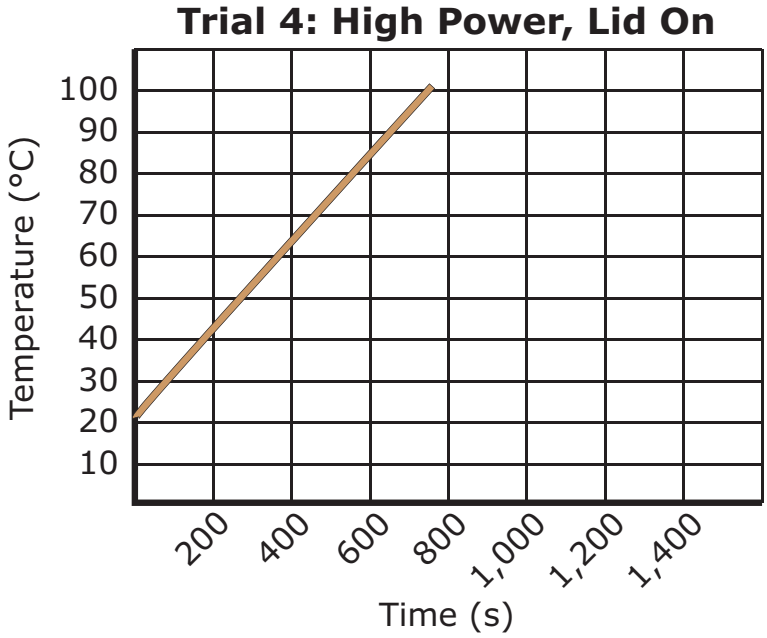
600 seconds



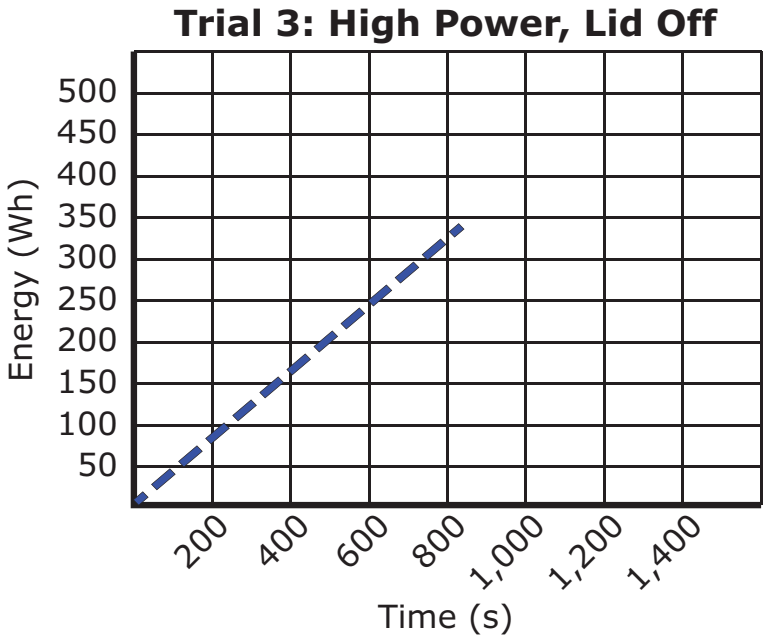
775 seconds

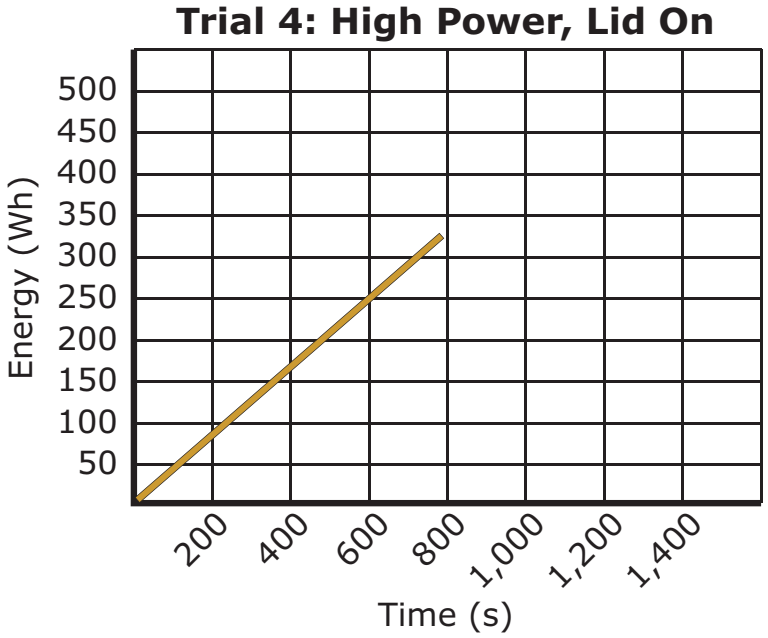
Temperature Graphs for Trial 3 and Trial 4



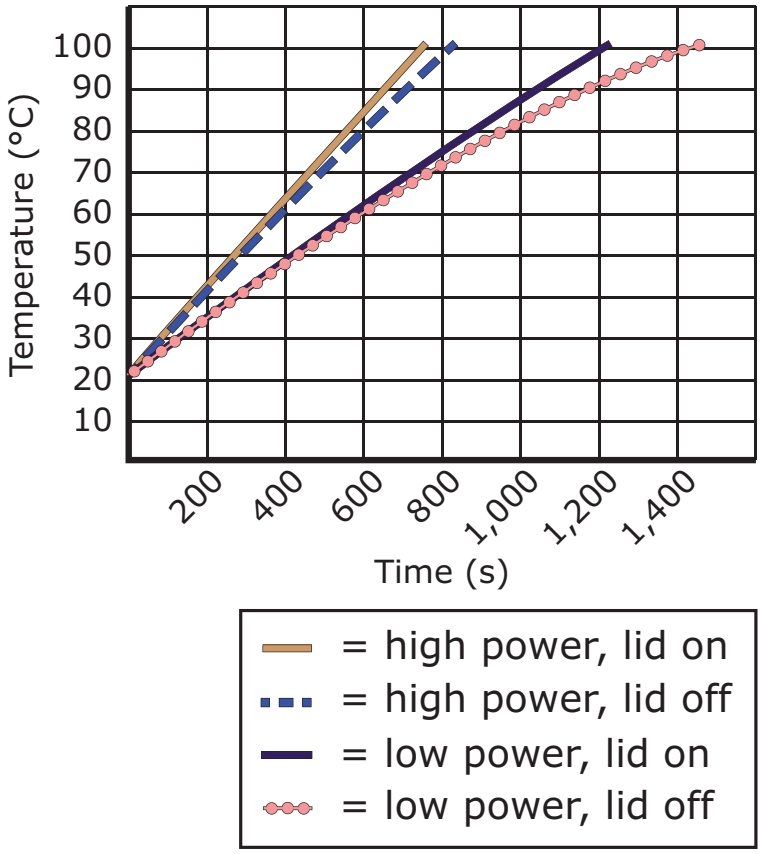


Energy Graphs for Trial 3 and Trial 4

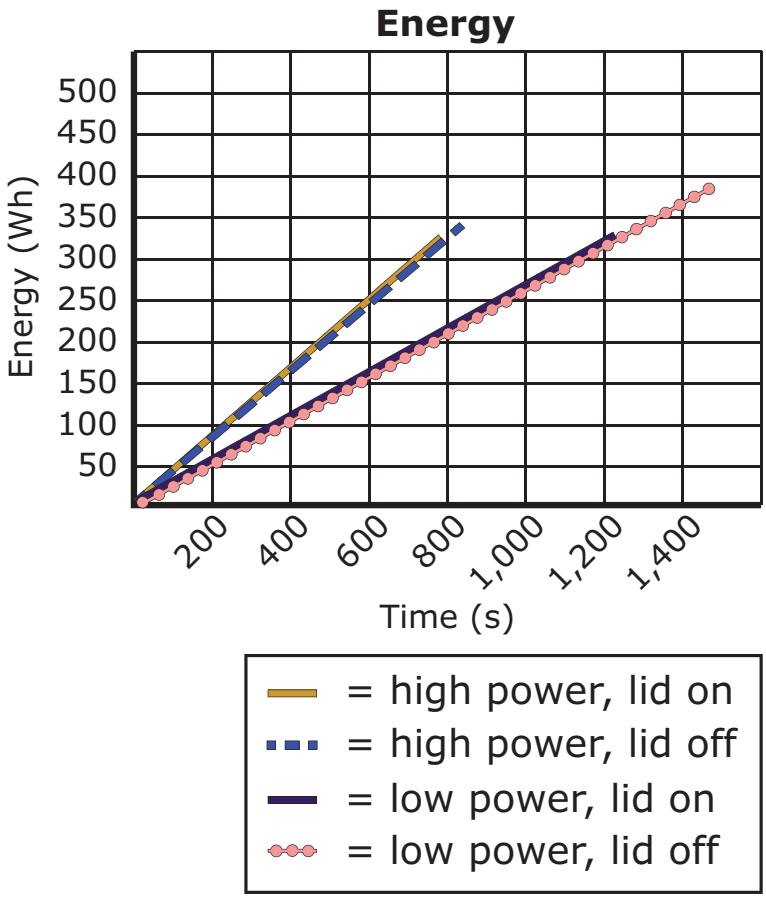




Combined Temperature Graphs



Combined Energy Graphs



Data for All Trials

Hot Plate Setting	Time to Reach Boiling (s)		Energy Used (Wh)	
	Lid On	Lid Off	Lid On	Lid Off
low (950 W)	1,215	1,450	320.6	382.6
high (1,500 W)	775	820	322.9	341.7

4. Compare the trials with the lid on the container to the trials with the lid off the container.

Circle one correct response in each box to complete the sentence.

For the low-heat trials, the difference between the

_____

time to reach boiling
energy used

data in the two trials represents the energy _____ the

transferred from
added to

system by escaping steam.

5. A method of energy transfer is considered to be more efficient when it uses less energy to perform the same task as other methods. The student modifies the investigation by using a lid made of a less conductive material than the metal lid used in the investigation to determine whether this will affect the efficiency of energy transfer.

Circle one correct phrase in each box to complete the sentence.

Using a lid made of a less conductive material than the metal lid used in the investigation will result in _____ heat lost to

less
more
the same amount of

the surrounding environment and will _____ the efficiency of

increase
decrease
not affect

energy transfer.

6. In the investigation, each trial was performed with a mass of 2.8 kilograms (kg) of water. The student researched data for energy transfer and found that 261.3 Watt-hours (Wh) is the expected amount of energy required to heat 2.8 kg of water from 20°C to the boiling point.

Use the data table from the investigation to determine which of the four trials lost the **most** energy to the surrounding environment. Your response should include:

- identification of the trial that lost the most energy to the surrounding environment
- the full calculation of the approximate energy that was lost to the surrounding environment in this trial

7. Each trial in the investigation started with 2.8 liters of water at 20°C. The student modifies the investigation to mix two samples of water at different temperatures, as shown in the table.

Water Sample	Volume	Initial Temperature
A	1.4 liters	20°C
B	1.4 liters	80°C

Predict how the time required to heat the water to the boiling point in a container with the lid off at low power will be different if Sample A and Sample B are mixed to make the initial 2.8 liters of water.

Your response should include:

- a description of how to calculate the expected final temperature, in degrees Celsius (°C), when Sample A and Sample B are mixed
- an explanation of the expected time, in seconds, for the combined samples to heat to the boiling point in a container with the lid off at low power

8. Describe the energy transfer for the investigation shown, and explain a limitation for converting all the available energy into usable energy. Your response should include:

- a description of the energy transfer, including an identification of the starting form of energy and the resulting form of energy
- an explanation of a limitation for converting all the available energy into usable energy

9. The student wants to find out how much heat is lost to the environment in this trial from the investigation:

Power (watts)	Lid
Low: 950	On

Using the data from this trial, which calculation can be used to determine how much heat is lost to the environment?

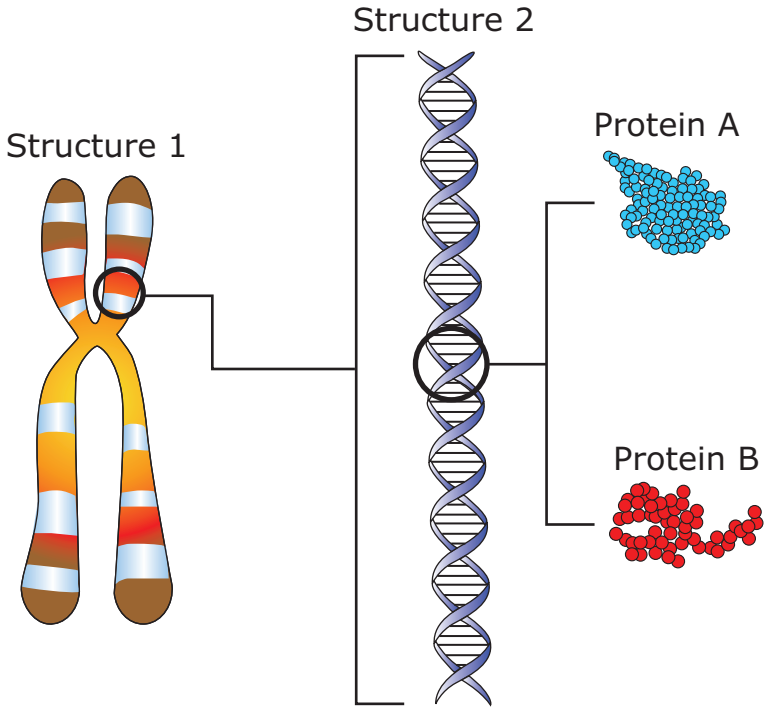
Ⓐ Subtract the energy used in this trial from the energy needed to heat the water to the boiling point.

Ⓑ Subtract the low power of the hot plate from the maximum power capacity of the hot plate.

Ⓒ Subtract the time for this trial from the time for the trial at the low setting with the lid off.

Ⓓ Subtract the initial temperature from the ending temperature for this trial.

10. A student investigates why so many parental characteristics are expressed in their offspring. The student makes a model to represent the structures involved in the passing of traits from parent to offspring.



Identify the structures using the student's model and explain how proteins that result in different traits can be formed from the same structure. Your answer should include:

- the identification of Structure 1 and Structure 2
- an explanation of how different traits arise from proteins formed from these structures

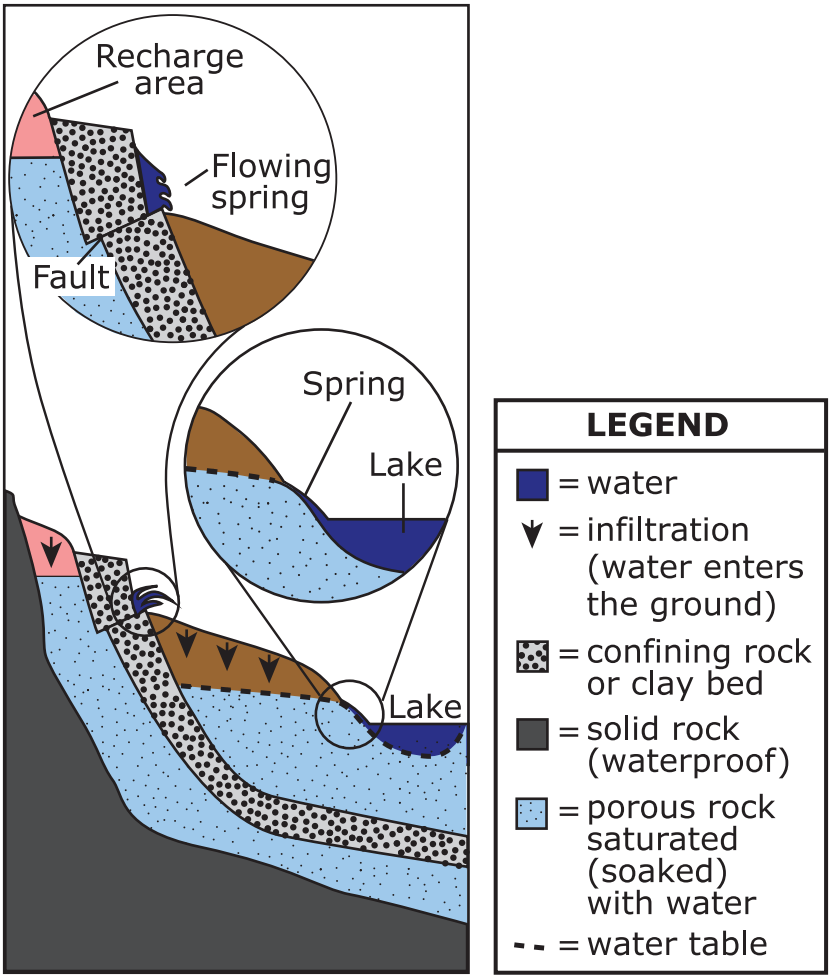
Directions: Use the information to answer questions 11 through 15.

Part 1

A television program shows a spring, a trickle of water flowing directly out of the side of a hill to become a small stream. A student decides to research different ways groundwater can reach the surface. Springs can come from groundwater in the saturated zone below the surface. They can also come from groundwater that lies beneath a rock layer through which water cannot normally pass. Water beneath such a rock layer is at higher pressure than water above the layer.

Both sources of groundwater are called aquifers. Precipitation or snowmelt can add water to an aquifer by infiltrating the soil and ground above it. The area where this happens is called a recharge area. Aquifers under confining rock layers often have much smaller recharge areas than unconfined aquifers.

Figure 1: Groundwater and Springs



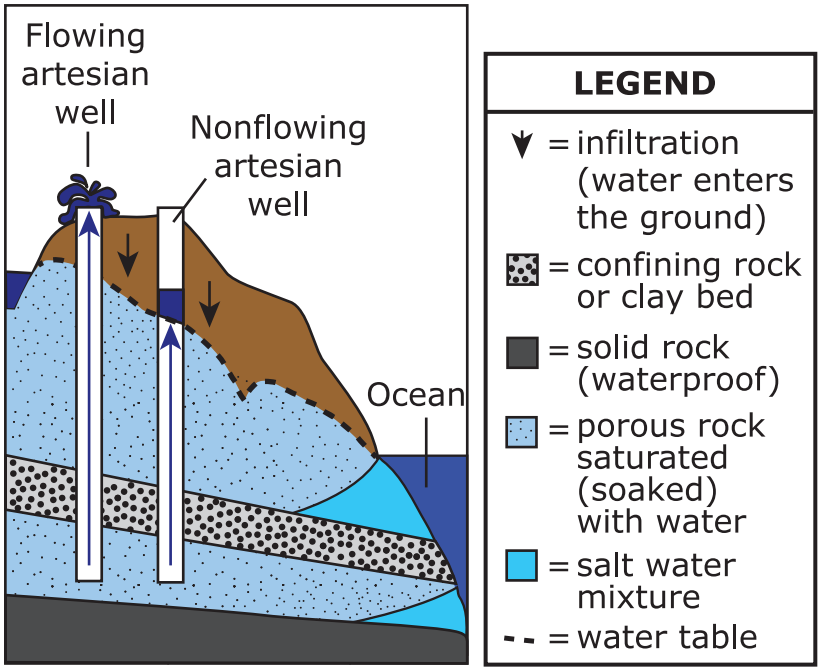
Part 2

In some places, people drill wells to access groundwater.

An artesian well is created when people drill deep enough to reach a confined aquifer. A confined aquifer is an aquifer with water that cannot reach the surface because it is below a layer of rock.

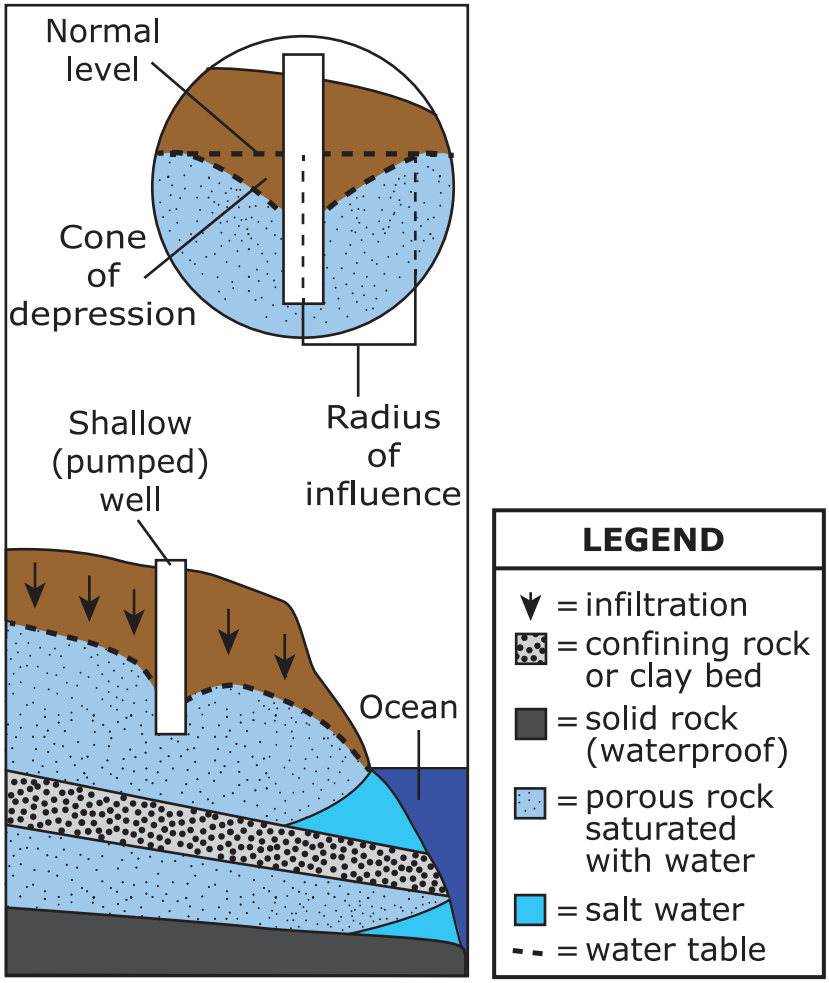
If the rock layer is breached, water pressure from a confined aquifer pushes water above the water table. This is the artesian pressure surface. When this surface is higher than ground level, water flows from the artesian well without being pumped.

Figure 2: Artesian Wells



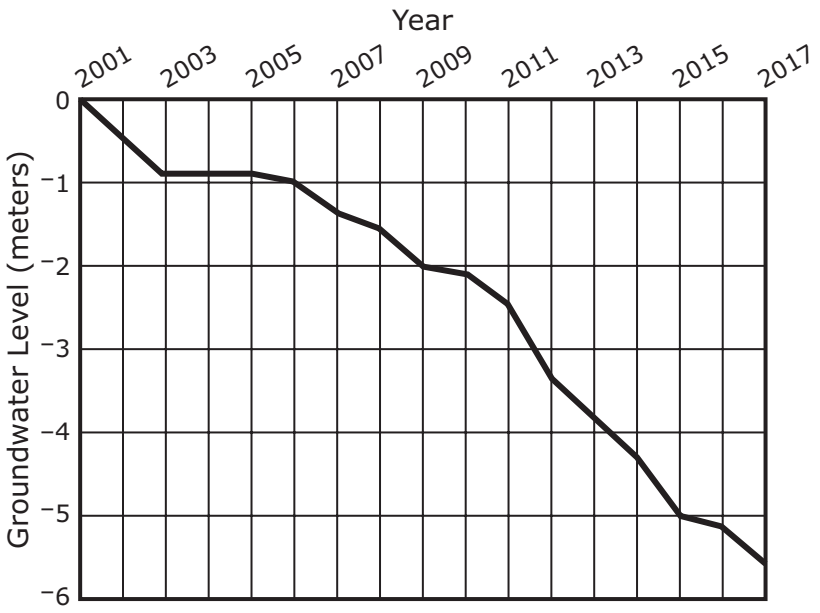
Wells that are more shallow use a pump to pull water from below the water table. While the pump operates, the water table around the well is lowered in a cone shape, named the cone of depression. The cone grows larger when the rate of pumping is greater.

Figure 3: Pumped Well



11. An agricultural community uses an aquifer, described in Part 1, as a water source for farming and for residential use. The community monitors the water level of the aquifer. The graph shows the changes in the water level from January 2001 through January 2017.

Aquifer Water Level Decline



Which actions would most effectively conserve the aquifer water level? Select **two** correct statements.

Ⓐ The local government enacts water conservation policies for residents.

Ⓑ Farmers replace the layer of topsoil to make it more permeable.

Ⓒ The community adds porous rock above the aquifer.

Ⓓ Farmers grow crops that require less irrigation.

Ⓔ The community relocates to another area.

12. Based on Figure 1, which statement most correctly explains why people need to drill below the water table in an aquifer?

Ⓐ Water below the water table in aquifers increases the water supply when there is not enough water from nearby lakes and springs.

Ⓑ Water below the water table in aquifers flows through an aquifer more rapidly than surface water flows into a lake.

Ⓒ Water below the water table in aquifers is more easily accessible than water from nearby lakes and springs.

Ⓓ Water below the water table in aquifers is under less pressure than water from nearby lakes and springs.

13. One of the most important needs for early settlers was a source of water.

Using the information in Part 2, circle one correct response in each box to complete the sentences.

People were more likely to settle in areas where the artesian pressure surface of a _____ was _____

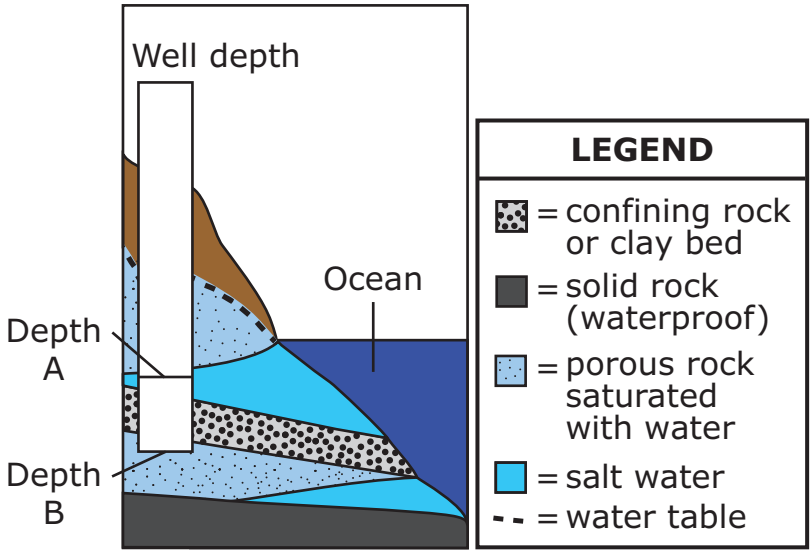
cone of depression	far below
confined aquifer	above
recharge area	

ground level.

This allowed people to use local groundwater resources without creating technology to _____.

move the water above the water table
drill through a rock layer
pump the water

14. The diagram shows a proposed drill site for a well.



Use the information in Part 2 to evaluate the costs and benefits of a well with Depth A and a well with Depth B. Your response should include:

- a cost comparison between the wells at Depth A and Depth B
- a performance comparison between the wells at Depth A and Depth B

15. A student decides to further investigate the types of wells described in Part 2. The student wants to test rock types to determine their effectiveness as aquifers. The student uses these materials:

- samples of four different rock types
- water
- graduated cylinder
- timer
- scale

The student submerges each of the four rock samples individually in 500 milliliters (mL) of water.

Circle one correct response in each box to complete the sentence.

To determine which of the rock types in the investigation would be the most efficient aquifer, the student should remove each sample from the water and measure the

_____

time the sample was submerged
volume of water remaining

to find the _____ .

amount of water held in the sample
total mass of the sample and water
flow rate of the water

This is the end of Item Set 2.

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