

CAPT PRACTICE



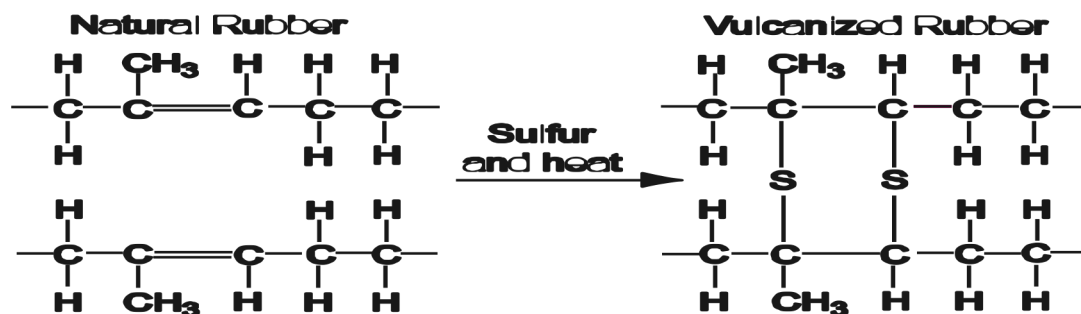
(RELEASED ITEMS)

CAPT Science Multiple-Choice Questions:

Rubber Tires

The tires on most cars are not made of natural rubber because it becomes brittle in the cold and sticky in the heat. Instead, natural rubber is vulcanized by adding sulfur and heat, making it stronger and more elastic. This process is represented chemically in the diagram below.

Vulcanization Process



(II: D16) During the vulcanization reaction shown above, the natural rubber polymer is converted to a new polymer by the _____.

- cross-linking of carbon atoms with sulfur atoms
- cross-linking of hydrogen atoms with sulfur atoms
- replacement of carbon atoms with sulfur atoms
- replacement of hydrogen atoms with sulfur atoms

(II: D14) The complete combustion or burning of **natural rubber** will produce _____.

- hydrogen and oxygen
- oxygen and water
- hydrogen gas and water
- carbon dioxide and water

The following data are recorded during a supervised investigation.

Experimental Data

Type of Container	Total Burning Time (min.)	Amount of Fuel at Start (grams)	Amount of Fuel Remaining (grams)
Closed	5	100	73
Open	12	100	0

(II: DINQ1) What question was the investigator **most likely** trying to answer?

- How does the presence of oxygen affect combustion?
- At what point is equilibrium reached in a combustion reaction?
- What are the byproducts of an incomplete combustion reaction?
- Does the amount of fuel in a combustion reaction affect the burn time

CAPT Science Multiple-Choice Questions:

Plant Cells

Plants, like all other organisms, are composed of cells.

(IV: D30) A group of students placed spinach leaves in a beaker of water in full sunlight. After several hours, small bubbles appeared on the leaves. These bubbles probably consisted of _____.

- a. H₂O
- b. O₂
- c. CO₂
- d. H₂

(IV: D27) Generally, plants that grow in the shade have larger leaves in comparison to plants that grow in full sun. The advantage of having larger leaves in a shaded environment is _____.

- f. an increase in water supply
- g. an increase in light absorption
- h. a decrease in water loss
- j. a decrease in heat production

Students are exploring what happens to potatoes when placed in liquid. They cut one potato into slices and placed the slices in 3 different solutions, as described in the table below.

Solution	Amount of Solute (in grams)	Initial Mass of Potato (in grams)	Mass of Potato after 25 Minutes (in grams)
100 cc distilled water	0	10	12
100 cc saltwater A	7	10	10
100 cc saltwater B	25	10	8

(IV: DINQ 5) Which of the following is the independent variable in the students' experiment?

- a. the amount of time in the solution
- b. the shape of the slices
- c. the mass of the potatoes
- d. the concentration of the solutions

CAPT Science Multiple-Choice Questions:

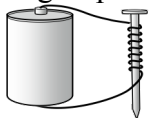
Power Plants

A power company is building a new power plant to provide electricity for several communities.

(I: D9) What is a major advantage of using wind energy instead of coal or nuclear power plants?

- f. Wind is a renewable energy source.
- g. Wind is consistently available in all locations.
- h. Windmills reduce the strength of severe storms.
- j. A single windmill produces more energy than a nuclear plant.

A group of students was studying simple electromagnets. They carried out the following experiment.



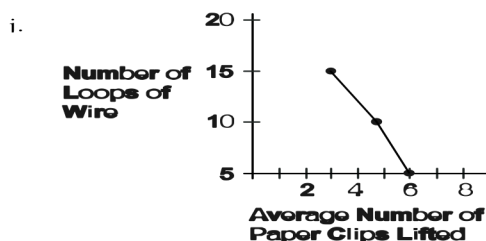
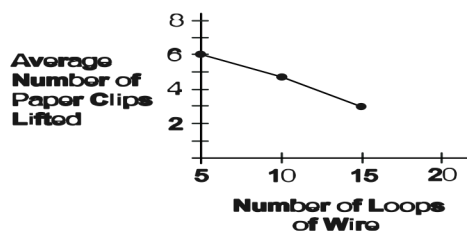
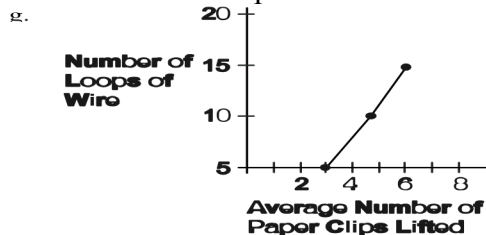
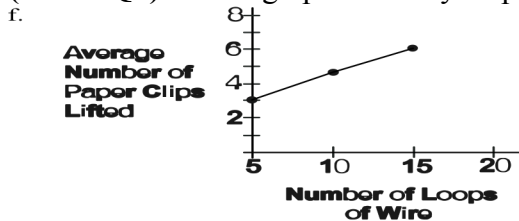
1. Take a nail and wrap a 10-cm wire around the nail five times.
2. Connect both ends of the wire to a 1.5-volt battery.
3. Measure how many paper clips can be lifted by the end of the nail.
4. Repeat for three trials.
5. Repeat steps 1–4 using the same wire and increasing the number of loops of wire around the nail by five.

Number of Loops of Wire	Number of Paper Clips Lifted			
	Trial 1	Trial 2	Trial 3	Average
5	4	2	3	3.0
10	4	5	5	4.7
15	7	5	6	6.0

(I: DINQ4) Which of the following would **most** improve the design of the experiment?

- a. Replace the nail with a wood pencil.
- b. Increase the length of the wire as the number of loops is increased.
- c. Keep the number of paper clips lifted constant in the experiment.
- d. Increase the number of loops of wire beyond fifteen.

(I: DINQ8) Which graph correctly displays the results of the experiment?



CAPT Science Multiple-Choice Questions:

Pollution

Pollution has many causes and can affect air and water quality in a variety of ways.

(III: D23) The burning of fossil fuels may contribute to an increase in global temperatures. What might lead

to this increase in temperature?

- a. The combustion products reflect solar radiation away from Earth.
- b. Carbon dioxide in the atmosphere attracts solar radiation.
- c. Carbon dioxide in the atmosphere blocks energy from escaping into space.
- d. The combustion products allow more energy to enter the earth.

(III: D22) Which of the following is directly responsible for acid rain?

- f. steam vented from a nuclear power plant
- g. sulfur dioxide released from a coal-fired power plant
- h. mining of coal for a coal-fired power plant
- j. processing of uranium for a nuclear power plant

(III: DINQ4) A student wanted to design an experiment to determine the effect of nitrates on algae growth.

Which procedure would create the **most** valid results?

- a. Vary both the temperature and the amount of nitrates.
- b. Keep the temperature constant and vary the amount of nitrates.
- c. Vary the temperature and keep the amount of nitrates constant.
- d. Keep both the temperature and the amount of nitrates constant.

CAPT Science Multiple-Choice Questions:

Illnesses

The common cold is caused by a virus that enters the human body and causes mild, flu-like symptoms.

Some people believe that the common cold can be treated by digesting the herb Echinacea.

The following table shows results from a study conducted to explore the effects of Echinacea on children with colds.

Echinacea Study

Type of Treatment	A Pill Containing Echinacea	Same Type of Pill Without Echinacea
Number of children taking pills	337	370
Average length of cold infection (days)	10	10
Children having more than one cold during the study	52%	64%
Children developing a skin rash	7.1%	2.7%

(V: DINQ2) Data in the table show that the use of Echinacea can _____.

- f. reduce the length of cold infection from 10 to 7 days
- g. increase the incidence of colds in children from 52% to 64%
- h. increase the percent of children with skin rash from 2.7% to 7.1%
- j. reduce the numbers of children having colds from 370 to 337 cases

(V: DINQ 9) A possible conclusion from the data is that Echinacea _____.

- a. is a safe remedy for the common cold
- b. is effective only for children
- c. has side effects
- d. reduces the length of colds

(V: D 40) It is very difficult to develop a vaccine against the common cold. The reason for this is that the common cold virus _____.

- f. hides in the digestive system
- g. changes rapidly due to high mutation rates
- h. includes RNA as its genetic materials
- j. is too small for the immune system to detect

CAPT Science Multiple-Choice Questions: *In the Kitchen*

Common kitchen appliances include electric stoves, toasters, and blenders. Each appliance uses an energy source and involves energy changes to prepare food.

- (I: D1). An open pot of water is heated on the stove. As water boils, the molecules _____.
- f. move slower and closer together
 - g. move faster and farther apart
 - h. get larger
 - j. get smaller

- (I: D5). When in use, the heating element in a toaster glows and gives off heat. This is because atoms within the heating element _____.
- a. undergo chemical reactions
 - b. are excited by the flow of electrons
 - c. gain electrons and increase in temperature
 - d. conduct light and heat from the outlet

A group of students carried out the following investigation.

“Our hypothesis is that the greater the wire diameter used in a toaster, the greater the resistance in the wire.”

1. We took a 4-meter length of wire with a diameter of 0.5 millimeters.
2. We attached the wire to a 3-volt battery and measured the current.
3. Knowing the voltage and current, we calculated the resistance in the wire.
4. We repeated the same steps with wires of increased diameter.
5. We organized our data in the table below.

Diameter of Wire (millimeters)	Measured Current (milliamps)	Calculated Resistance (ohms)
0.5	10	300.0
1.0	40	75.0
1.5	80	37.5
2.0	100	30.0
2.5	250	12.0

- (I: DINQ7) To be certain that data in the table are correct, you will have to _____.

- f. go online and seek additional information
- g. ask for your teacher’s opinion
- h. repeat the experiment as described
- j. repeat the experiment with different variables

CAPT Science Multiple-Choice Questions:

Plastics

Consumers use many products made of plastic. Plastics are carbon-based polymers made from smaller carbon compounds, called monomers.

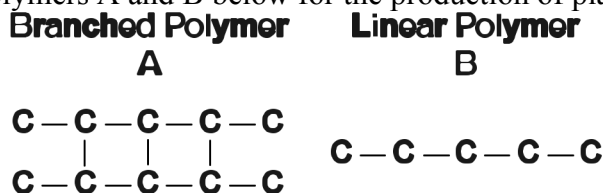
Common Plastics

Plastic	Monomer	Polymer
Polyethylene	$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} & \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$	$\left(\begin{array}{c} \text{H} & \text{H} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n$
Polypropylene	$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C}=\text{C} & \\ & / & \diagdown \\ \text{H} & & \text{CH}_3 \end{array}$	$\left(\begin{array}{c} \text{H} & \text{H} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{CH}_3 \end{array} \right)_n$

(II: D13) In organic molecules, the carbon atoms and the hydrogen atoms are held together by

- _____.
- f. hydrogen bonds
 - g. covalent bonds
 - h. ionic bonds
 - j. nuclear bonds

A company is considering polymers A and B below for the production of plastic shopping bags.



(II: D15) Which polymer is more appropriate for the production of shopping bags?

- a. Polymer A, because its branched structure provides greater strength
- b. Polymer A, because its branched structure provides greater flexibility
- c. Polymer B, because its linear structure provides greater strength
- d. Polymer B, because its linear structure provides greater flexibility

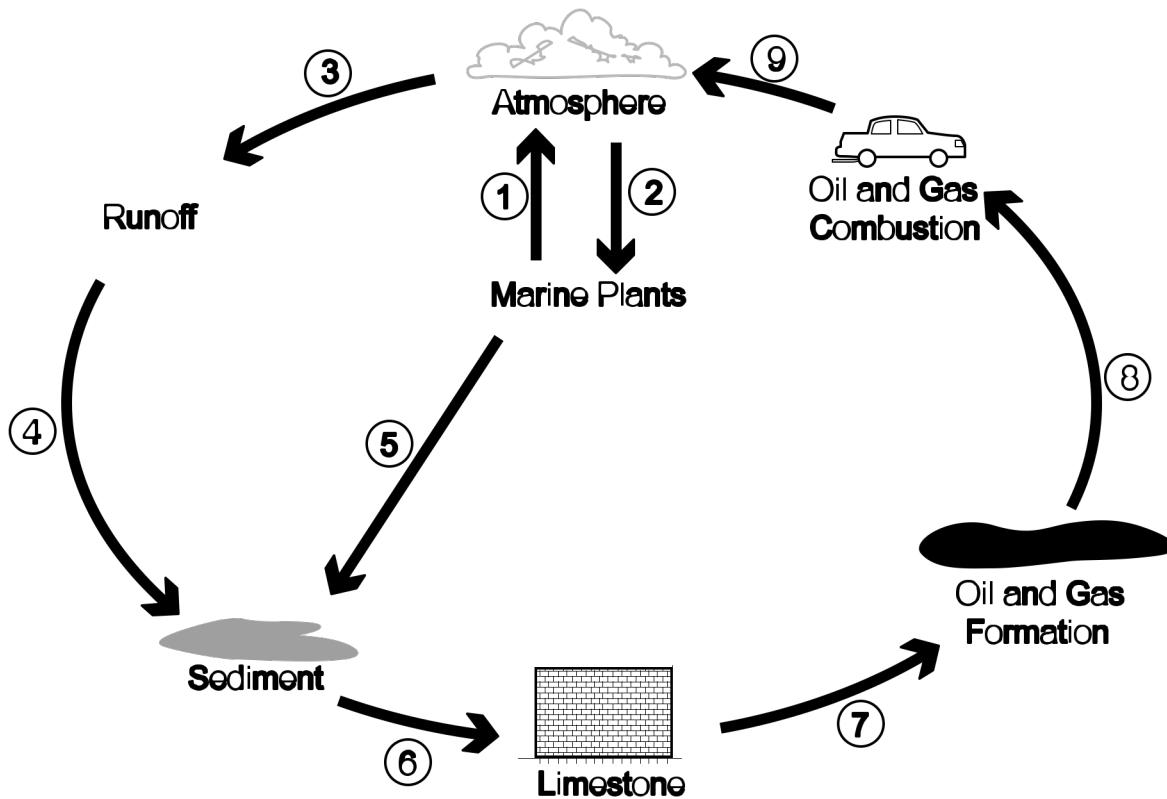
(II: D18) Many communities encourage the recycling of plastics, even though it is often expensive to do so.

Why is it beneficial to the environment to recycle plastics?

- f. Plastics are expensive to manufacture.
- g. Plastics are made from renewable resources.
- h. Plastics decompose quickly, releasing toxic chemicals.
- j. Plastics decompose slowly, taking up space in landfills.

CAPT Science Multiple-Choice Questions: Carbon Cycle

The diagram below shows carbon cycling associated with oil and gas consumption.



(III: D19)

Which arrow on the carbon cycle diagram represents the process that takes the longest amount of time to occur?

- f. 1
- g. 3
- h. 5
- j. 7

(III:DINQ2) A teacher provides her class with a table displaying the relative greenhouse effect per molecule of different gases compared to carbon dioxide.

Carbon Dioxide	Methane	Nitrous Oxide	CFCs
1	30 times	160 times	17,000 times

Based on this table, a student made the conclusion that carbon dioxide is not the main cause of the greenhouse effect. What other data are needed to make a stronger conclusion?

- a. data about the origin of the gases
- b. data about the size of each type of molecule
- c. data about the absorption of these gases by plants
- d. data about the amount of each gas in the atmosphere

CAPT Science Multiple-Choice Questions: *Potato Blight*

Blight is a plant disease caused by a fungus that affects potato plants. Some wild breeds of potato have natural resistance to the fungus. These wild potatoes contain chemical compounds that cause them to taste bad. Scientists are trying to produce potato plants that are resistant to blight but still produce potatoes that taste good.

(IV: D27) Which of the following describes an important difference between a potato plant cell and a human cell?

- a. Plant cells have a cell wall, and animal cells do not.
- b. Animal cells store water inside, and plant cells do not.
- c. Plant cells have a cell nucleus, and animal cells do not.
- d. Animal cells perform respiration, and plant cells do not.

(IV: D35) The development of a blight-resistant potato breed might be good for the environment because the new potato breed will need _____.

- f. less water
- g. less fertilizer
- h. less fungicide
- j. less field space

CAPT Science Multiple-Choice Questions: *Fossil Record*

(V: D44) The growth rate of a local population is dependent on the birth rate minus the death rate and _____.

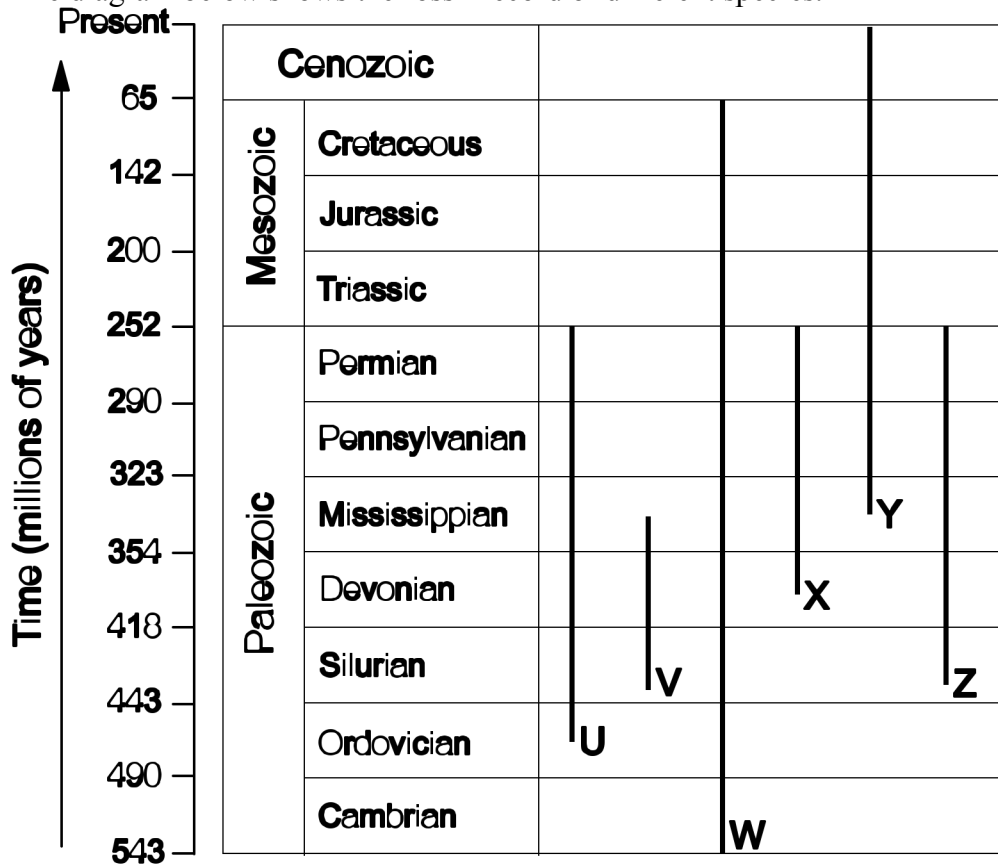
- f. the ratio of males to females in the population
- g. the lifespan of females beyond the reproductive age
- h. the amount of genetic variation that exists in the population
- j. the immigration and emigration of individuals to and from the population

(V: D41) Vestigial structures, such as hip bones in whales and appendixes in humans, are those that have little or no function for the organism. What is the **most likely** reason for this loss of function over time?

- a. The organism is undergoing speciation.
- b. The organism is experiencing genetic drift.
- c. The structure was over utilized by the organism.
- d. The structure was not highly beneficial to the organism.

CAPT Science Multiple-Choice Questions: Fossil Record

The diagram below shows the fossil record of different species.



(V: DINQ 7) When did a major extinction event **most likely** occur?

- f. at the end of the Cenozoic
- g. at the end of the Permian
- h. at the beginning of the Silurian
- j. at the beginning of the Cambrian

(V: DINQ7) . According to the records of fossil species V and W, which statement is **most likely** true?

- a. Fossil species W appeared before fossil species V, allowing fossil species W to survive longer.
- b. Fossil species W was ancestral to fossil species V because it appeared before fossil species V.
- c. Fossil species W had greater genetic variability than fossil species V, allowing fossil species W to adapt and survive longer.
- d. Fossil species W had lower reproductive success than fossil species V, allowing smaller populations to adapt and survive.

CAPT Science Multiple-Choice Questions:

(III D20)

Over 6 billion people on Earth use water every day, yet Earth's water supply remains relatively constant. This is because _____.

- a. the sea level is rising
- b. water exists in three phases on Earth
- c. water is constantly recycled by the hydrologic cycle
- d. global warming melts ice to replace water that is used

(IV D23)

Two farmers plant different varieties of corn on neighboring farms. Farmer A plants genetically modified corn. Farmer B plants a non-modified variety of corn. What would be farmer B's **primary** concern if she plans to gather seed for next year's crop?

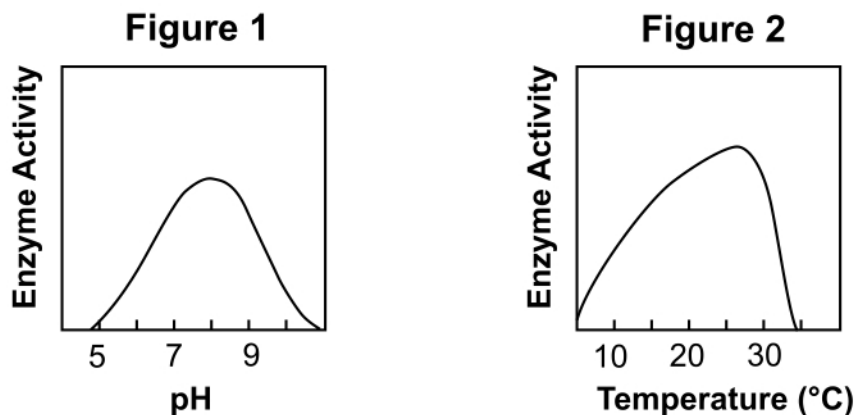
- f. loss of genetic variability in the non-modified variety
- g. that mutation rates will increase in the non-modified variety
- h. that insects will only pollinate the genetically modified corn
- j. unintended transfer of modified genes to her crop by cross-pollination

(IV D32) What is accomplished by treating a person who has a bacterial infection with antibiotics?

- a. immunity to future infections
- b. weakening of the person's immune system
- c. reduction in the duration and intensity of the infection
- d. modification of bacterial DNA to make the bacteria harmless

(IV DINQ7)

The figures below show the reaction rate of a specific enzyme at different temperatures and different pHs.



What can be concluded about the enzyme?

- f. The enzyme works best at a pH of 8 and a temperature of 25°C.
- g. The enzyme only works at a pH of 8 and a temperature of 25°C.
- h. The enzyme is used up at a pH of 11 and a temperature of 35°C.
- j. The enzyme works better at a pH of 8 than a temperature of 25°C.

CAPT Science Multiple-Choice Questions: Petroleum-based Polymers vs. Plant-based Polymers

A petroleum-based (inorganic) polymer is commonly used for grocery bags. Recently there has been a push by environmentalists to make grocery bags out of plant-based (organic) polymers. Students in a science class decided to investigate the strength of the two types of polymers. They obtained one petroleum-based (inorganic) polymer bag and one plant-based (organic) polymer bag of the same size and thickness. They added 100-gram weights to each bag until it broke.

(II DINQ5)

What is the independent variable in the investigation?

- a. the size of the bags
- b. the type of polymer
- c. the thickness of the bags
- d. the amount of weight of the bags

(II DINQ4)

The students found that the plant-based polymer grocery bag held 500 grams before breaking and the petroleum-based polymer grocery bag held 600 grams before breaking. In order to increase confidence in their results, the students should repeat the investigation using _____.

- f. only plant-based polymer bags
- g. two other types of polymer bags
- h. a double thickness of each polymer bag
- j. both the plant and petroleum polymer bags

(ID4)

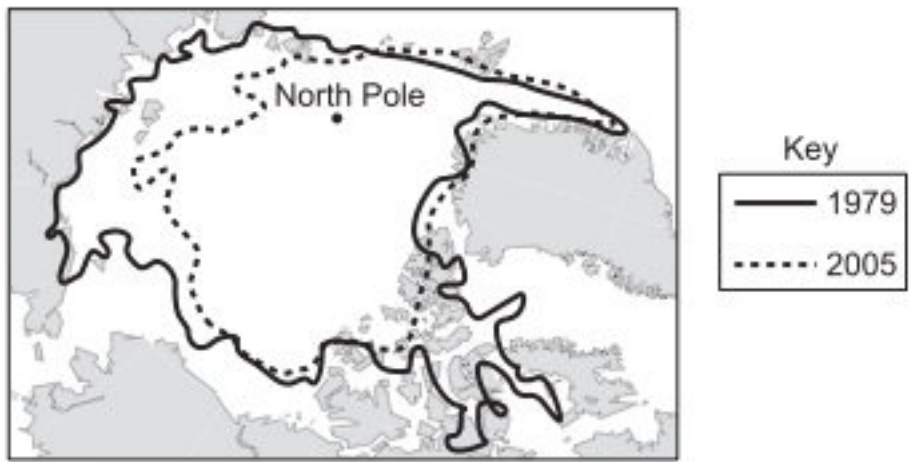
To demonstrate static electricity, a teacher takes an inflated rubber balloon and rubs it on his head. The rubber balloon picks up electrons from his hair, which causes his hair to have a(n) _____.

- f. electrical current
- g. net positive charge
- h. net negative charge
- j. buildup of magnetic energy

CAPT Science Multiple-Choice Questions:

(III DINQ3)

The picture below shows the extent of summer Arctic Sea ice in 1979 and 2005.

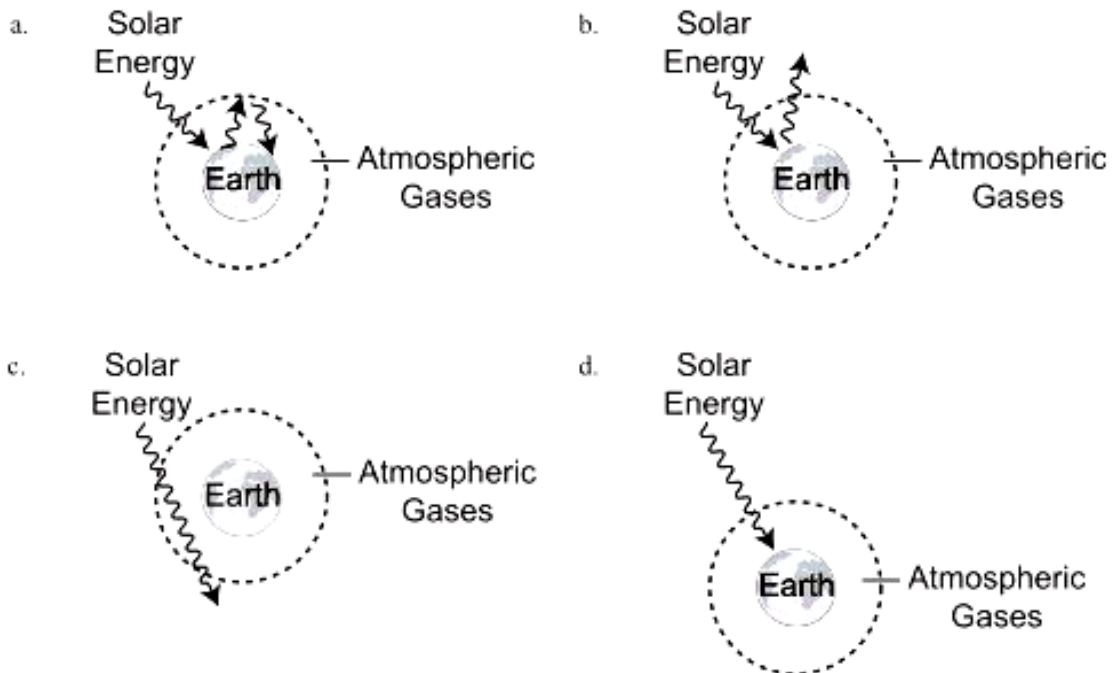


Which hypothesis is **best** supported by the changes in sea-ice coverage?

- a. Earth's climate is gradually warming.
- b. Arctic Sea ice is migrating away from Earth's poles.
- c. Global warming is caused by human activity, not nature.
- d. Global warming occurs only at Earth's poles during the summer.

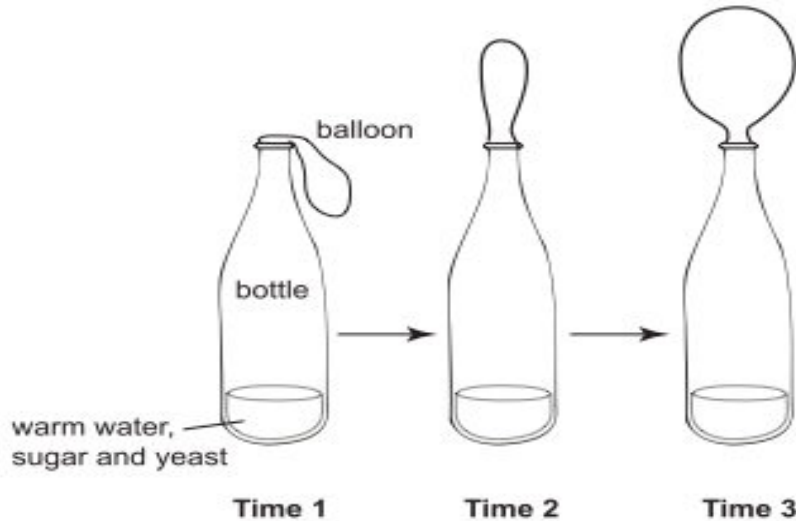
(III D23)

Which of the following pictures **best** represents the natural greenhouse effect?



CAPT Science Multiple-Choice Questions: Yeast Laboratory Investigation

In a laboratory investigation, a student mixes 1 cup of warm water (30°C) with 30 grams of sugar and 5 grams of yeast. She pours the mixture into a glass bottle and secures a balloon over the opening. After several minutes, she observes that the balloon begins to inflate, as shown in the picture below.

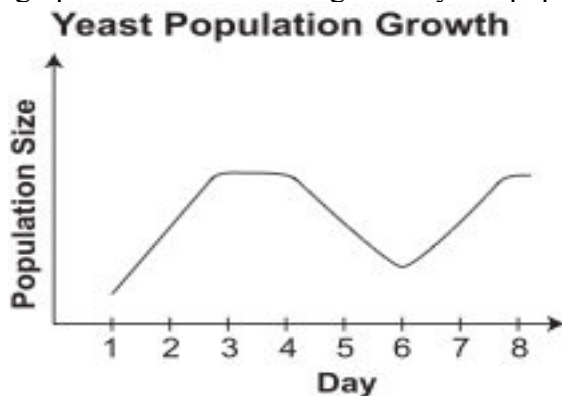


The student performs two additional trials. In trial 2 she uses water at 25°C, and in trial 3 she uses water at 20°C. She observes that the colder the water, the longer it takes the balloon to inflate.

(IV DINQ3) After reviewing her data, the student decides to perform an additional trial at 35°C. She observes that the balloon inflates faster than during the trial in which the 30°C water was used. This additional trial supports which of the following hypotheses?

- f. Warmer temperatures are more favorable for yeast fermentation.
- g. Yeast require less sugar when maintained at lower temperatures.
- h. The optimum temperature for yeast fermentation is less than 35°C.
- j. The time required for fermentation increases with increasing temperature.

(IV DINQ8) The graph below shows changes in a yeast population over the course of several days.



The yeast were placed on a nutrient dish and allowed to grow. On which day was additional nutrient **most likely** added to the yeast culture?

- a. 3
- b. 4
- c. 6
- d. 7

CAPT Science Multiple-Choice Questions: Recreation Center Pool

A local recreation center has received funding to build a swimming pool. After construction, the center will be responsible for all costs associated with pool operation. As a result, the center must consider a variety of design options, including pool size, location and heating.

(I D1) What happens to water molecules in a pool as they absorb energy?

- f. The molecules occupy less volume.
- g. The molecules begin to move more slowly.
- h. The kinetic energy of the atoms decreases.
- i. The rate of collision between molecules increases.

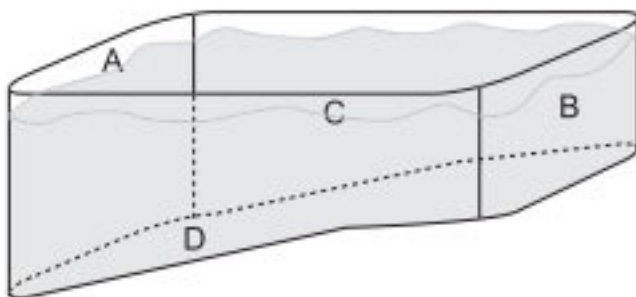
(I DINQ5)

Prior to pool construction, engineers use computer models to compare which of several pool designs require the least amount of energy to be heated. What is the dependent variable in the computer models?

- a. pool size
- b. pool shape
- c. pool location
- d. pool temperature

(I D2) Where should hot water enter the pool to better heat the water?

Recreation Center Pool



- f. A
- g. B
- h. C
- j. D

CAPT Science Open-Ended Item:

Enzymes 1

Science students conducted an investigation to determine how enzymes affect apple juice production.

Procedure:

1. Place coffee filter in paper cone, cut off 2 cm of the bottom of the cone, leaving a small hole.
2. Place 30 mL of applesauce into measuring cup, add 5 drops of enzyme A solution, and stir thoroughly.
3. Place a graduated cylinder under paper cone and add applesauce to coffee filter, stirring every minute.
4. Measure volume of apple juice in cup after 5 minutes using graduated cylinder.
5. Repeat steps 1–4 for a second trial.
6. Repeat steps 1–5 using enzyme B solution.
7. Repeat steps 1–5 using water.

Amount of Juice Produced

Enzyme Solution	Trial 1 (mL)	Trial 2 (mL)	Average (mL)
A	14	15	14.5
B	6	5	5.5
Water	5	5	5.0

- a) What conclusion can be drawn from the students' experiment and results?
- b) Assess the reliability of the results of this investigation.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item: Genetically Modified Food

Suppose a consumer reads the following news release regarding the safety of a genetically modified (GM) food product.

GM Grains Pose No Health Risk

Researchers report that genetically modified (GM) grains fed to test mice have no negative impact on health. In two trials, the offspring of mice fed GM grain for three weeks showed a similar survival rate as the offspring of mice that were fed non-GM grain. The trials have been called a victory for GM food producers. A spokesperson for the research group stated that “it is highly unlikely for any unintended side effects to occur as a result of human consumption of GM grains.”

Provide three reasons a consumer should question the conclusions presented in this news release.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item:

Acid Rain

Acid Rain

A group of students wrote the following procedure for their investigation.

Procedure:

1. Determine the mass of four different samples.
2. Pour vinegar in each of four separate, but identical, containers.
3. Place a sample of one material into one container and label. Repeat with remaining samples, placing a single sample into a single container.
4. After 24 hours, remove the samples from the containers and rinse each sample with distilled water.
5. Allow the samples to sit and dry for 30 minutes.
6. Determine the mass of each sample.

The students' data are recorded in the table below.

Sample	Starting Mass (g)	Ending Mass (g)	Difference in Mass (g)
Marble	9.8	9.4	-0.4
Limestone	10.4	9.1	-1.3
Wood	11.2	11.2	0.0
Plastic	7.2	7.1	-0.1

After reading the group's procedure, describe what additional information you would need in order to replicate the experiment. Make sure to include at least three pieces of information.

Write your answer in your answer booklet

CAPT Science Open-Ended Item:

Solar Cooker1 Investigation

Solar Cooker1 Investigation

A group of students has designed a solar cooker for an investigation. They are investigating whether the material that a container is made of has an effect on the rate of temperature change over time. They obtain three containers of identical size. They add water to each container. The containers are placed inside the solar cooker, which is made of a box lined with aluminum foil.

- a) Identify two additional pieces of equipment that the students will need to use in their investigation.
- b) Explain why each piece of equipment is necessary.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item:

Polymer Investigation

Polymer Investigation

A group of students wrote the following procedure for their investigation.

Procedure:

1. Tightly wrap a sample of kitchen wrap from manufacturer A over the top of a coffee can.
 2. Place a 10-gram weight on the kitchen wrap to see if it breaks.
 3. Continue to add 10-gram weights one at a time until the kitchen wrap breaks and the weights fall into the can.
 4. Record the number of 10-gram weights the kitchen wrap held before breaking.
 5. Repeat the procedure exactly for a sample of kitchen wrap from manufacturer B.
 6. Repeat the procedure exactly for a sample of kitchen wrap from manufacturer C.
-
- a) What question were the students attempting to answer with this investigation?
 - b) Identify the independent variable and the dependent variable in the group's investigation.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item:
Decontamination Process

Decontamination Process

A process (phytoremediation) has been developed that uses plants to remove contaminants from soils and water. Suppose a contaminated area (Brownfield site) in your town is being considered for this process. Identify at least three questions that would need to be answered before starting such a program.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item:

Enzymes2

Enzymes 2

Science students conducted an investigation to determine how enzymes affect apple juice production.

Procedure:

1. Place coffee filter in paper cone; cut off 2 cm of the bottom of the cone, leaving a small hole.
2. Place 30 mL of apple sauce into measuring cup, add 5 drops of enzyme A solution, and stir thoroughly.
3. Place a graduated cylinder under paper cone and add apple sauce to coffee filter, stirring every minute.
4. Measure volume of apple juice in cup after 5 minutes using graduated cylinder.
5. Repeat steps 1–4 for a second trial.
6. Repeat steps 1–5 using enzyme B solution.
7. Repeat steps 1–5 using water.

Enzyme Solution	Amount of Juice Produced		
	Trial 1 (ml)	Trial 2 (ml)	Average (ml)
A	14	15	14.5
B	6	5	5.5
Water	5	5	5.0

- a) Identify two variables that were held constant in the group's experiment.
- b) Explain why it is important for these variables to be held constant.

Write your answer in your answer booklet

CAPT Science Open-Ended Item:

Stretching Experiment

Stretching Experiment

Students performed the following investigation.

Procedure:

1. Cut a piece of plastic from each of the following:
 - dry-cleaning bag
 - kitchen wrap
 - plastic sandwich bag
 - plastic grocery bag
2. Hold the sample of the dry-cleaning bag between thumb and forefinger.
3. Attach a clamp to the bottom of the sample.
4. Add weights to the clamp and measure the length the plastic stretches.
5. Repeat for other samples.
6. Record data in table.

The students recorded the following data from their investigation.

Stretching Ability

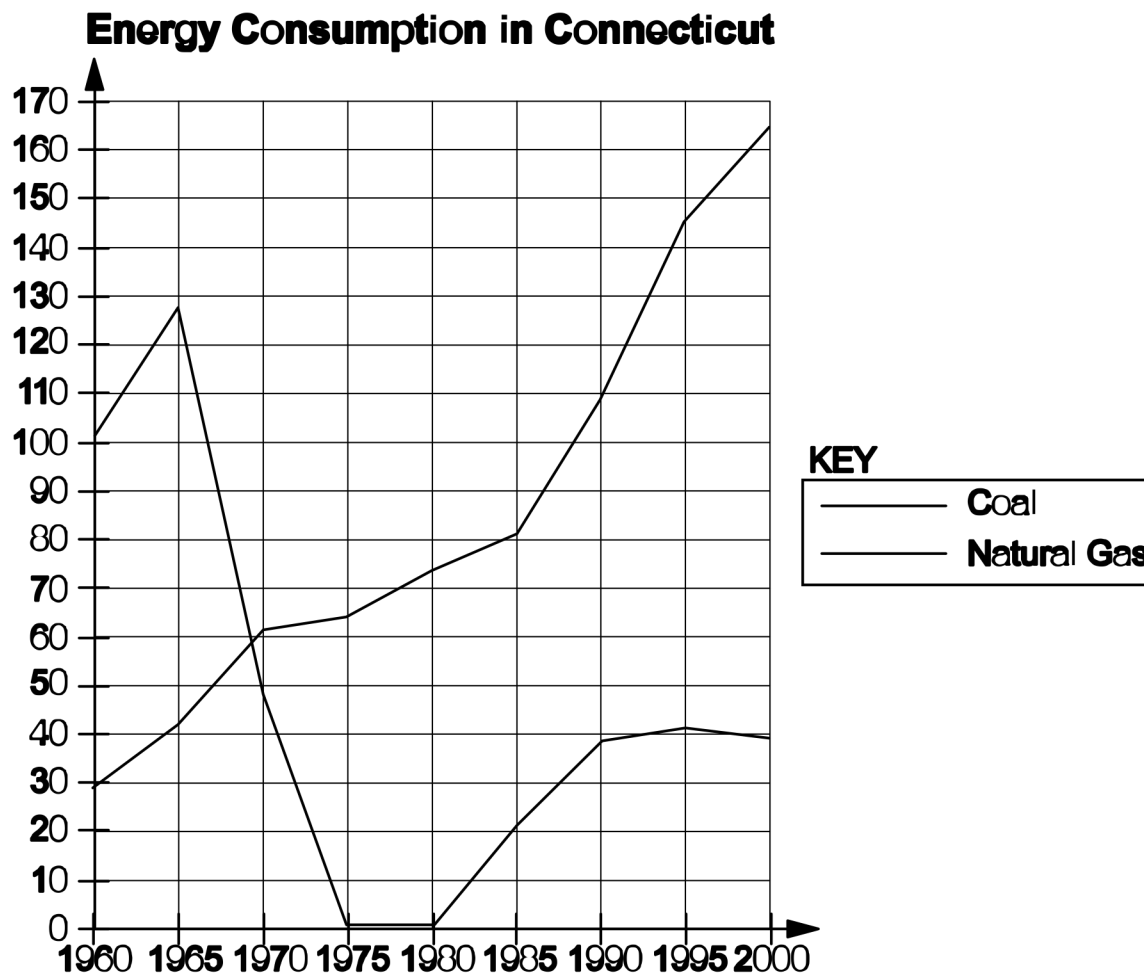
Plastic type	Trial 1
dry-cleaning bag	23 mm
kitchen wrap	16 mm
sandwich bag	14 mm
grocery bag	7 mm

- a) After analyzing the data, the students concluded that the data supported their original hypothesis. What could have been the students' hypothesis?
- b) Support your answer with specific information from the investigation.

Write your answer in your answer booklet

CAPT Science Open-Ended Item: *Energy Consumption* Energy Consumption

The graph below shows the energy consumption for coal and natural gas in Connecticut for 40 years.



- Describe the overall trend for coal or natural gas from 1960–2000.
- Make a prediction regarding the energy consumption of coal or natural gas for the year 2015.
- Support your prediction with specific information from the graph.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item:

Yeast Experiment

Yeast Experiment

A group of students wrote the following procedure for their experiment.

Procedure:

1. Place 35 mL of 25% molasses solution into three small collection tubes.
2. Place 1 mL of the yeast suspension into each collection tube.
3. Place your palm over a small collection tube and mix each suspension well.
4. Carefully slide a larger tube down over the smaller tube. Invert the tube. Repeat for each tube.
5. Measure the height of the bubbles in the smaller tubes and record.

6. Place one tube at 10°C in a refrigerator. Leave the second one out at room temperature at 25°C. Place the third tube in a warming oven at 35°C. Make sure all tubes are in the dark and in an undisturbed location. Leave the three samples for 24 hours.

7. Measure the change in bubble size after 24 hours. Record the data.

The table below shows the results of the group's experiment.

Temperature (in °C)	Height of CO ₂ Bubble (in mm)
10	2
25	8
35	10

- a) What conclusion can be drawn from the students' experiment and results?
- b) Describe two ways the students could have improved their experimental design and/or validity of their results.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item:

Enzyme3 Investigation

Enzyme3 Investigation

A group of students hypothesized that adding an enzyme to applesauce would produce more juice than adding an enzyme to mashed pears. The students wrote the following procedure for their investigation.

Procedure:

1. Place a coffee filter in each of two plastic funnels and place each funnel in a separate beaker.
2. Put 113 g of applesauce in one filter-covered funnel.
3. Put 113 g of peeled, mashed pears in one filter-covered funnel.
4. Add 3 drops of enzyme A to the applesauce and stir for one minute.
5. Add 3 drops of enzyme B to the mashed pears and stir for one minute.
6. Allow the fruit to sit for 10 minutes.
7. Measure and record the amount of juice contained in each beaker.
8. Repeat the procedure exactly for a second trial to verify data.

The data collected during the investigation are shown in the table below.

Type of Fruit	Juice Produced (mL)		
	Trial 1	Trial 2	Average
Applesauce	12	11	11.5
Mashed Pears	13	12	12.5

The students claimed that their original hypothesis was correct.

- a) Explain why the credibility of the students' claim should be questioned.
- b) Describe two changes that the students should make to their procedure that would allow their original hypothesis to be more accurately tested and/or would ensure the accuracy of their results.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item:

Solar Cooker2 Investigation

Solar Cooker2 Investigation

A student hypothesized that container size will affect the performance of solar cookers in heating water. The student wrote and performed the following procedure to support her claim.

Procedure:

1. Line three identical cardboard boxes with aluminum foil to use as solar cookers.
2. Place the solar cookers outside in direct sunlight.
3. Place a large glass container of water in the center of the first box.
4. Record the initial temperature of the water.
5. Allow the container to sit in the sun for 2 hours, and then check and record the final temperature of the water.
6. Place a medium-sized glass container of water in the center of the second box.
7. Repeat steps 4 and 5.
8. Place a small-sized glass container of water in the center of the last box.
9. Repeat steps 4 and 5.

The chart below shows the student's data.

Solar Cooker Data

Container	Temperature (°C)	
	Initial	Final
Large	39	48
Medium	39	49
Small	39	49

a) Draw a conclusion regarding container size and the effectiveness of solar cookers in heating water, based on the student's results.

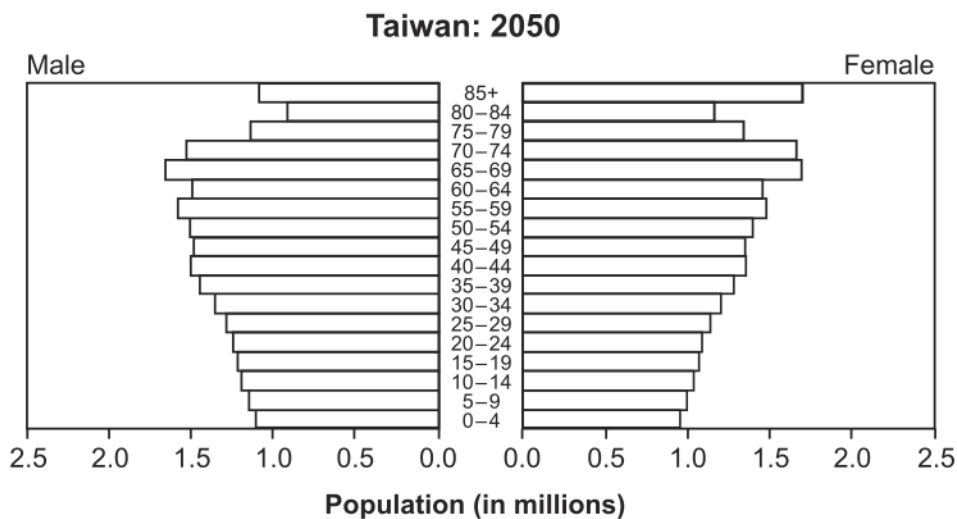
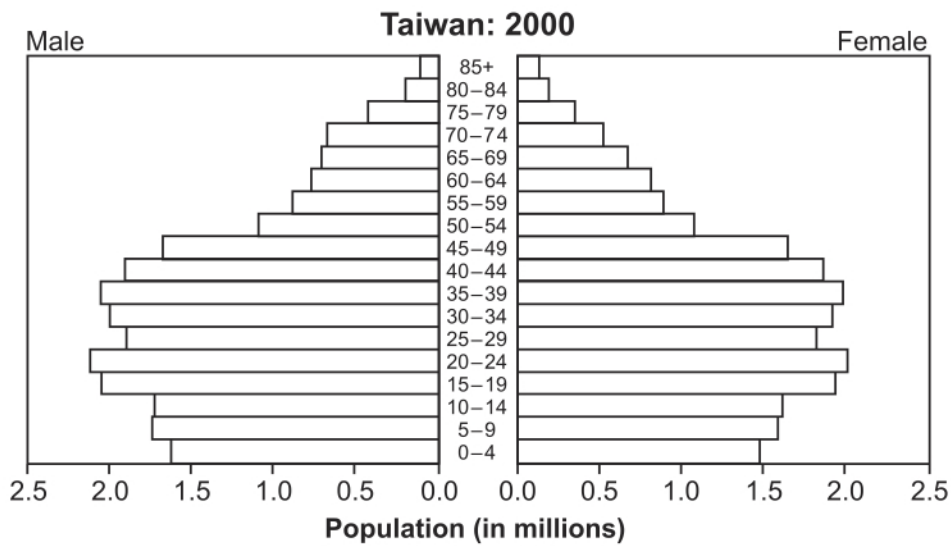
b) Describe two ways the student could have improved her experimental design and/or the validity of her results.

Write your answer in your answer booklet.

CAPT Science Open-Ended Item: *Population Graphs for Taiwan*

Population Graphs for Taiwan

The graphs below show the population of Taiwan in 2000 and the predicted population of Taiwan in 2050.



Use the graphs to:

- Draw a conclusion regarding the overall population change in Taiwan from 2000 to 2050.
- Describe two factors that may contribute to the predicted population changes from 2000 to 2050.

Write your answer in your answer booklet.

**CAPT RELEASED ITEMS
OPEN ENDED RUBRICS:**

Rubric for *Enzymes1*

Possible Correct Responses:

Conclusions:

- Enzyme A produces the most apple juice from applesauce.
- Enzyme B is not very effective at producing apple juice from applesauce.

Reliability:

- The results are reliable because the experimental design included a variable and a control.
- The results are reliable because the experiment was repeated once and similar results were obtained.
- The results should be questioned because only two trials were performed which is not sufficient data upon which to base a sound conclusion.

3-Point Rubric:

Score 3

The response draws a valid conclusion supported by the students' experimental results and explains why the results were or were not reliable.

Score 2

The response draws a valid conclusion supported by the students' experimental results and provides a general explanation for why the results were or were not reliable (they did the experiment twice).

-or-

The response explains in detail why the results were or were not reliable but fails to draw a valid conclusion supported by the students' experimental results.

Score 1

The response draws a valid conclusion supported by the students' experimental results. The response may also indicate that the results were or were not reliable but fails to provide an acceptable explanation.

-or-

The response indicates that the results were or were not reliable and provides a general explanation but fails to draw a valid conclusion supported by the students' experimental results.

Score 0

The response provides little or no accurate or relevant information.

Strand IV: Cell Chemistry and Biotechnology

Expected Performance: D INQ.7 Assess the reliability of the data that was generated in the investigation.

Rubric for *Genetically Modified Food*

Possible Correct Responses:

- No data are presented to back up the statement(s).
- “Similar survival rate” is vague; how similar was the survival rate?
- Survival is only one aspect of health; no other potential side-effects were mentioned (immune responses, tumor formation, etc.)
- The conclusions were based on a three-week study; what about long-term consumption of GM grains?
- There is no indication of who the researchers were affiliated with to determine whether they may have had an agenda/bias.
- Two trials are not sufficient to draw a definitive conclusion.
- Just because it does not affect mice does not mean it will not affect humans.
- Other acceptable questions.

3-Point Rubric:

Score 3

The response provides three reasons a consumer should question the conclusions presented in the news release.

Score 2

The response provides two reasons a consumer should question the conclusions presented in the news release.

Score 1

The response provides one reason a consumer should question the conclusions presented in the news release.

Score 0

The response describes little or no accurate or relevant information related to the credibility of the claims in the news release.

Strand V: Genetics, Evolution and Biodiversity

Expected Performance: D INQ.2 Read, interpret and examine the credibility and validity of scientific claims in different sources of information.

Rubric for *Acid Rain*

Possible Correct Responses:

Needed Information:

- You need to know how much vinegar was used in each container.
- You need to know what type of vinegar was used in each container.
- You need to know what materials to test.
- You need to know what size/surface area of materials should be used.
- You need to know how long each sample was rinsed in distilled water.
- You need to know what drying method to use.
- You need to know what size/type of container to use.
- Other acceptable responses.

3-Point Rubric:

Score 3

The response describes three additional pieces of information that would be needed to accurately replicate the experiment.

Score 2

The response describes two additional pieces of information that would be needed to accurately replicate the experiment.

Score 1

The response describes one additional piece of information that would be needed to accurately replicate the experiment.

Score 0

The response describes little or no accurate or relevant information from the acid rain investigation.

Strand III: Global Interdependence

Expected Performance: D INQ.4 Design and conduct appropriate types of scientific investigations to answer different questions.

Rubric for *Solar Cooker Investigation*

Possible Correct Responses:

- Graduated cylinder: to accurately measure the water that must be added to the containers.
- Three identical thermometers: to be suspended in the containers so that water temperature can be measured.
- Timing device: to make sure the data for each container are collected within the same increments of time.
- Safety equipment: glove or cloth pad to handle the containers safely after heating or safety glasses to protect eyes from hot water that could splash.
- Lamp/light source/solar heat: to heat up the solar cooker.
- Meter stick: to measure the same level of water for each container.
- Other acceptable responses.

3-Point Rubric:

Score 3

The response identifies two pieces of equipment that the students would need in order to conduct their investigation and for each piece of equipment explains why it is necessary to the investigation.

Score 2

The response identifies two pieces of equipment that the students would need in order to conduct their investigation and for one piece explains why it is necessary to the investigation. -or-

The response provides explanations for two pieces of equipment that are consistent with what is needed to conduct the investigation, but only identifies one piece of equipment or fails to identify either piece of equipment.

Score 1

The response identifies two pieces of equipment that the students would need in order to conduct their investigation, but fails to correctly explain why either piece of equipment is necessary. -or-

The response identifies one piece of equipment that the students would need in order to conduct their investigation and explains why it is necessary to the investigation.

-or-

The student provides an explanation for a piece of equipment that is consistent with what is needed to conduct the investigation, but fails to identify the equipment.

Score 0

The response identifies one piece of equipment that the students would need in order to conduct their investigation but fails to explain why it is necessary to the investigation.

-or-

The response describes little or no accurate or relevant information related to the solar cooker investigation. **Strand I: Energy Transformation Expected Performance: D INQ.6** Use appropriate tools and techniques to make observations and gather data.

Rubric for *Polymer Investigation*

Possible Correct Responses:

Possible Question:

- Which type of kitchen wrap is the strongest?
- Is there a difference in strength between different kitchen wraps?
- Which kitchen wrap can hold the most weight?
- Other acceptable responses.

Variables:

The independent variable is the type of kitchen wrap used and the dependent variable is the amount of weight the kitchen wrap can hold without breaking.

3-Point Rubric: Score 3

The response provides a scientifically valid question that could be answered using this procedure and identifies the independent and dependent variables.

Score 2

The response provides a scientifically valid question that could be answered using this procedure, identifies the independent variable, but fails to identify the dependent variable. -or-

The response provides a scientifically valid question that could be answered using this procedure, fails to identify the independent variable, but correctly identifies the dependent variable. -or-

The response fails to provide a scientifically valid question that could be answered using this procedure, but correctly identifies the independent and dependent variables.

Score 1

The response provides a scientifically valid question that could be answered using this procedure, but fails to identify the independent and dependent variables.

-or-

The response fails to provide a scientifically valid question that could be answered using this procedure, correctly identifies the independent variable, but fails to identify the dependent variable. -or-

The response fails to provide a scientifically valid question that could be answered using this procedure, fails to identify the independent variable, but correctly identifies the dependent variable.

Score 0

The response provides little or no accurate or relevant information related to the polymer investigation.

Strand II: Chemical Structures and Properties Expected Performance: D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

Rubric for *Decontamination Process*

Possible Correct Responses:

- What is/were the sources of contamination?
- What are/were the contaminants of concern?
- What is the extent of the affected property?
- How deep does the contamination extend into the sediment?
- What are the potential effects on the local ecosystem/food webs?
- What type of ecological restoration is being sought (recreation, residential, etc.)?
- What is the timeframe needed for total restoration?
- What is the cost associated with this program compared to other programs?
- What special resources (tools, people, etc.) are required?
- Other acceptable questions.

3-Point Rubric:

Score 3

The response provides at least three relevant questions that would need to be answered before a town implements a phytoremediation program.

Score 2

The response provides two questions that would need to be answered before a town implements a phytoremediation program.

Score 1

The response provides one question that would need to be answered before a town implements a phytoremediation program.

Score 0

The response provides little or no accurate or relevant information.

Strand III: Global Interdependence

Expected Performance: D INQ.1 Identify questions that can be answered through scientific investigation.

Rubric for *Enzymes2*

Possible Correct Responses:

- the amount of apple sauce used in measuring cup for each trial
- the number of drops of each enzyme used in each trial (volume)
- the stirring of the apple sauce (done every minute)
- the amount of time enzyme is allowed to act before measuring apple juice
- the cut off of 2 cm of the bottom of the cone allowing the apple juice to drain

If any of these factors are not controlled, they could affect the results preventing the students from drawing a valid conclusion.

If the students were to test more than one variable at a time, they would not be able to tell which variable is responsible for the results or if it was a combination of both.

3-Point Rubric:

Score 3

The response clearly identifies two specific variables that were held constant and provides an explanation that addresses the validity of the results in terms of testing too many variables at once.

Score 2

The response clearly identifies two variables that were held constant but fails to provide a clear explanation of why it is important to hold these variables constant.

-or-

The response clearly identifies one variable that was held constant and provides an explanation that addresses the validity of the results in terms of testing too many variables at once.

Score 1

The response clearly identifies one variable that was held constant but fails to provide a clear explanation of why it is important to hold this variable constant.

-or-

The response provides a clear explanation of why it is important to hold variables constant without clearly identifying any of the variables that were held constant.

Score 0

The response provides little or no accurate or relevant information.

Strand IV: Cell Chemistry and Biotechnology

Expected Performance: D INQ.5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

Rubric for *Stretching Experiment*

Possible Correct Responses:

- The plastic used to make grocery bags is stronger (less likely to stretch or tear) than the other plastics: the plastic grocery bag stretched 7 mm, which was less than the other plastics.
- The plastic used to make dry cleaning bags is weaker (more likely to stretch or tear) than the other plastics: the plastic dry cleaning bag stretched 23 mm, which was more than the other plastics.
- The plastics used to make sandwich bags and grocery bags have similar strength: the amount of force required to stretch both of these plastics is similar, there was only a 2 mm difference.
- Other acceptable hypotheses.

3-Point Rubric:

Score 3

The response provides a valid hypothesis that is supported by a description that includes specific information from the polymer investigation.

Score 2

The response provides a valid hypothesis that is supported by a general description based on the polymer investigation (some of the plastics stretched more than others).

Score 1

The response provides a valid hypothesis that is not supported by a valid general description based on the polymer investigation.

Score 0

The response provides little or no accurate or relevant information.

Strand II: Chemical Structures and Properties

Expected Performance: D INQ.3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

Rubric for *Energy Consumption*

Possible Correct Responses:

Trend:

- **Coal:** coal use has varied over the 40-year period, from very high in the 1960s to almost zero in the late 70s. Its use has been moderate since 1990.
- **Coal:** coal use has declined overall from the beginning of the 40-year period.
- **Natural Gas:** natural gas use has increased relatively consistently since 1960.

Coal

Prediction:

- The consumption of coal for 2015 will be approximately 40 trillion BTU.
- The consumption of coal will stay level.
- The consumption of coal for 2015 will be less than 40 trillion BTU.
- The consumption of coal will continue to decline.
- The consumption of coal for 2015 cannot be predicted with any degree of confidence.

Support:

- Coal consumption from 1990 to 2000 has been relatively stable at about 40 trillion BTU.
- Coal use since 1990 peaked at 40 trillion BTU and has started to decline.
- Coal use plummeted from almost 130 trillion BTU in 1965 to almost nothing from 1975 to 1980.

Natural Gas

Prediction:

- The consumption of natural gas for 2015 will exceed 165 (or any number above that up to 250) trillion BTU.
- Consumption of natural gas has increased from 30 trillion BTU in 1960 to over 160 trillion BTU in 2000 and there is no evidence that this trend will change.
- The consumption of natural gas for 2015 will continue to increase but at a slower rate.

Support:

- Natural gas consumption has increased 20 to 30 trillion BTU for every 5 years that pass; therefore, it can be expected to continue increasing by this amount.
- Consumption of natural gas has increased from 30 trillion BTU in 1960 to over 160 trillion BTU in 2000, and there is no evidence to suggest that this trend will change in the future.
- From 1985 to 1995, consumption of natural gas increased by 30 trillion BTU for each 5 years that passed. From 1995 to 2000 it dropped off to a 20 trillion BTU increase. It can be expected to keep increasing, but at a slower rate. Note: Math errors aren't penalized.

3-Point Rubric:

Score 3 The response describes the overall trend of either coal or natural gas and makes a valid prediction. The prediction is supported with specific information from the graph.

Score 2 The response describes the overall trend of either coal or natural gas and makes a valid prediction but fails to provide sufficient support for the prediction.

-or- The response makes a valid prediction and supports the prediction with specific information from the graph but fails to accurately describe the overall trend of the resource.

Score 1 The response describes the overall trend of either coal or natural gas but fails to make a reasonable prediction. -or- The response makes a valid prediction but fails to provide sufficient support for the prediction and fails to describe the overall trend.

Score 0

The response describes little or no accurate or relevant information.

Strand I: Energy Transformation

Expected Performance: D INQ.7 Assess the reliability of the data that was generated in the investigation.

Rubric for *Yeast Experiment*

Possible Correct Responses:

Conclusions:

- CO₂ production in yeast increases with increasing temperature.
- CO₂ production in yeast decreases with decreasing temperature.

Improvements:

- The students could repeat the experiment to verify their results or do multiple trials at each temperature and average their results.
- The students could add additional trials at higher (and/or lower) temperatures to see if the trend holds.
- The students could perform the test again at smaller temperature increments.
- The students could use a warming oven for the test tube subjected to room temperature (25°C), because in 24 hours, temperatures could fluctuate a few degrees which could affect results.
- The students should use a consistent size for the gas collection tube (not clear in procedure).
- Other acceptable responses.

3-Point Rubric:

Score 3

The response provides a valid conclusion and describes at least two ways the students could improve their experimental design and/or the validity of their results.

Score 2

The response provides a valid conclusion and describes one way the students could improve their experimental design and/or the validity of their results.

-or-

The response describes at least two ways the students could improve their experimental design and/or the validity of their results but fails to provide a valid conclusion.

Score 1

The response provides a valid conclusion but fails to accurately describe a way the students could improve their experimental design and/or the validity of their results.

-or-

The response describes one way the students could improve their experimental design and/or the validity of their results but fails to provide a valid conclusion.

Score 0

The response describes little or no accurate or relevant information.

Strand V: Genetics, Evolution and Biodiversity

Expected Performance: D INQ.9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.

RUBRIC FOR ENZYME³ INVESTIGATION

Possible Correct Responses:

Credibility Problem:

- The procedure allowed for more than one variable.
- The students used different enzymes in each type of fruit.
- Data doesn't support the claim.
- Other acceptable responses

Changes:

- Use the same enzyme in each type of fruit (either A or B, but not both).
- Use both enzymes on each fruit.
- Add a control to the investigation (a sample of each fruit to which no enzyme is added).
- Perform additional trials.
- Other acceptable responses

3-Point Rubric:

Score 3

The response provides an explanation for why the credibility should be questioned and describes two changes the students could make that would allow their original hypothesis to be more accurately tested and/or would ensure the accuracy of their results.

Score 2

The response provides an explanation for why the credibility should be questioned and describes one change the students could make that would allow their original hypothesis to be more accurately tested and/or would ensure the accuracy of their results.

-or-

The response fails to provide or provides an incorrect explanation for why the credibility should be questioned, but describes two changes the students could make that would allow their original hypothesis to be more accurately tested and/or would ensure the accuracy of their results.

Score 1

The response provides an explanation for why the credibility should be questioned, but fails to correctly describe any changes.

-or-

The response fails to provide or provides an incorrect explanation for why the credibility should be questioned, but describes one change.

Score 0

The response describes little or no accurate or relevant information related to the enzyme investigation.

Strand IV: Cell Chemistry and Biotechnology

Expected Performance: D INQ.2 Read, interpret, and examine the credibility and validity of scientific claims in different sources of information.

Rubric for *Solar Cooker2 Investigation*

Possible Correct Responses:

Conclusion:

- Container size appears to have little or no effect on the efficiency of solar cookers.
- Small or medium-sized containers heat water more than larger containers.
- The investigation was not conclusive because the student failed to take temperature readings during the two hours, and while the final temperatures were similar, one container may have heated to that temperature faster than the others.
- Other acceptable variations

NOTE: If the student takes the position that the investigation results were inconclusive, the student must explain why. No credit will be awarded for simply stating that the investigation was not conclusive.

Experimental Design Improvements:

- Clearly indicate the amount of water that was put in each container, making sure it is identical.
- Check and record the temperature at frequent and equal time increments during the investigation.
- Perform additional trials; repeat the investigation exactly.
- Add more containers of varying size to the investigation.
- Test the three solar cookers at the same time.
- Add a control (water in a container outside of the solar cookers).
- Use an artificial light source because the sun's rays vary due to clouds, etc.
- Other acceptable responses

3-Point Rubric:

Score 3 The response provides a reasonable conclusion and describes two ways the student could have improved her experimental design.

Score 2 The response provides a reasonable conclusion and describes one way the student could have improved her experimental design.

-or-

The response describes two ways the student could have improved her experimental design, but fails to provide a reasonable conclusion.

Score 1 The response provides a reasonable conclusion, but fails to describe how the student could have improved her experimental design.

-or-

The response describes one way the student could have improved her experimental design, but fails to provide a reasonable conclusion.

Score 0 The response describes little or no accurate or relevant information related to the solar cooker investigation.

Strand I: Energy Transformations

Expected Performance: D INQ.9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.

Rubric for *Population Graphs for Taiwan*

Possible Correct Responses:

Conclusion:

- The population in Taiwan will begin to stabilize over the next 50 years.
- Population growth in Taiwan will slow down over the next 50 years.
- There will be more older people and less younger people in 2050.
- Other acceptable responses

Factors:

- Reproductive rates could decline some (people of reproductive age having fewer children).
- Longevity could increase (increased survival rate for the elderly).
- Mass immigration to other countries for various reasons.
- Increased access to healthcare or better healthcare provisions.
- Other acceptable responses

3-Point Rubric:

Score 3

The response draws a valid conclusion regarding the overall population change in Taiwan from 2000 to 2050 and describes two factors that may contribute to the predicted population changes from 2000 to 2050.

Score 2

The response draws a valid conclusion regarding the overall population change in Taiwan from 2000 to 2050 and describes one factor that may contribute to the predicted population changes from 2000 to 2050.

-or-

The response describes two factors that may contribute to the predicted population changes from 2000 to 2050, but fails to draw a valid conclusion regarding the overall population change.

Score 1

The response draws a valid conclusion regarding the overall population change in Taiwan from 2000 to 2050, but fails to correctly describe any factors that may contribute to the predicted population changes from 2000 to 2050.

-or-

The response describes one factor that may contribute to the predicted population changes from 2000 to 2050, but fails to draw a valid conclusion regarding the overall population change.

Score 0

The response provides little or no correct information regarding population changes in Taiwan over the 50-year period.

Strand V: Genetics, Evolution and Biodiversity

Expected Performance: D INQ.7 Assess the reliability of the data that was generated in the investigation.