

C.A.P.T.

Science Exam

2010

The test contains 50 multiple choice questions AND 2 open-ended responses.

Record your answers for the multiple choice questions on the Scantron sheet.

Use a #2 pencil.

Ensure that you have neatly PRINTED your FIRST and LAST name on the Scantron.

Write your Science teacher's name on the "HOUR _____" line of the Scantron.

You have also received a packet with 2 open-ended response questions.

Complete these questions in the packet on the lines provided.

On the open-ended response packet, write your FULL NAME AND circle the name of your science teacher.

Chemical Structures and Properties

Periodic Table

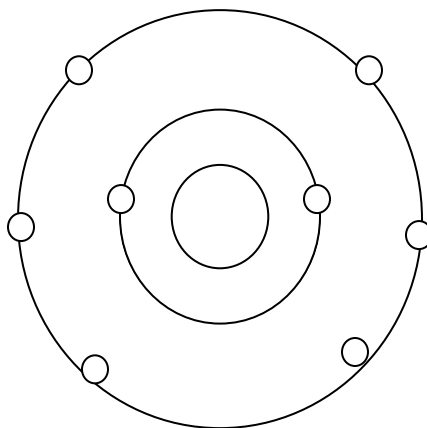
The periodic table was developed after many years of collaboration between scientists. The modern version of the periodic table is arranged by each atom's atomic number. One of the most important elements in the periodic table to humans is oxygen because we need it to remove the energy stored in food.

H 1																	He 2
Li 3	Be 4											B 5	C 6	N 7	O 8	F 9	Ne 10
Na 11	Mg 12											Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36

1 The oxygen atom's nucleus consists of:

- A. Electrons
- B. Protons
- C. Neutrons
- D. Protons and Neutrons

2. Below is a visual representation of the oxygen atom's electrons. Which element would have a valence electron arrangement most similar to the oxygen atom?



- A. N, Nitrogen
- B. P, Phosphorus
- C. S, Sulfur
- D. F, Fluorine

3. Oxygen forms ionic bonds with many elements. Oxygen combines with element X to form X_2O . Which element from the periodic table is most likely element X?
- A. Li, Lithium
 - B. Mg, Magnesium
 - C. Si, Silicon
 - D. Al, Aluminum
4. Oxygen exists in different forms called isotopes. Two of the forms are Oxygen-15 and Oxygen-16. What statement is true about these substances?
- A. Oxygen-15 contains one more electron than Oxygen-16.
 - B. Oxygen-15 and Oxygen-16 have the same atomic mass.
 - C. Oxygen-15 is more reactive than Oxygen-16.
 - D. Oxygen-15 has one less neutron than Oxygen-16.

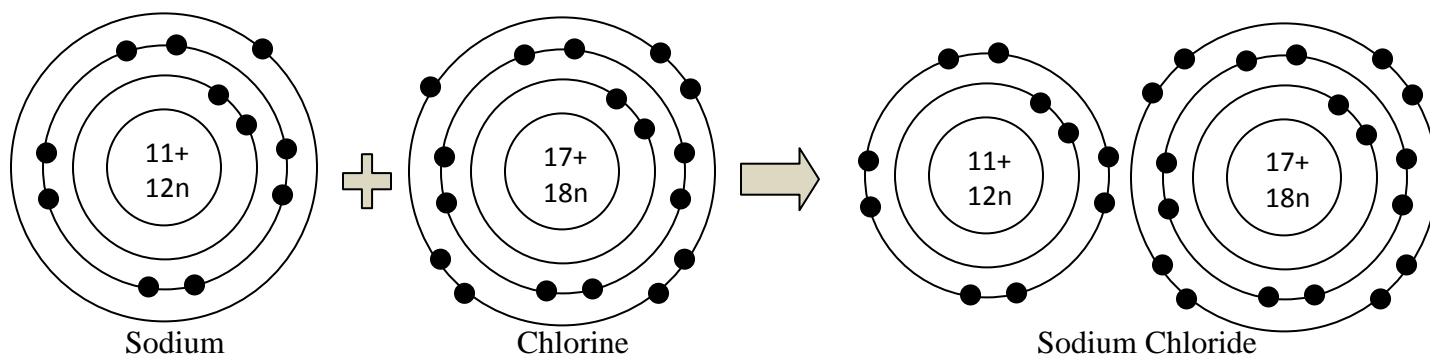


Figure 1

5. In the chemical reaction between sodium and chlorine in Figure 1
- A. Sodium shares an electron with chlorine
 - B. Sodium gives an electron to chlorine
 - C. Chlorine gives an electron to chlorine
 - D. Chlorine gives a proton to sodium

6. The type of bond formed by combination of sodium and chlorine in figure 1 is

- A. Hydrogen
- B. Ionic
- C. Covalent
- D. Organic

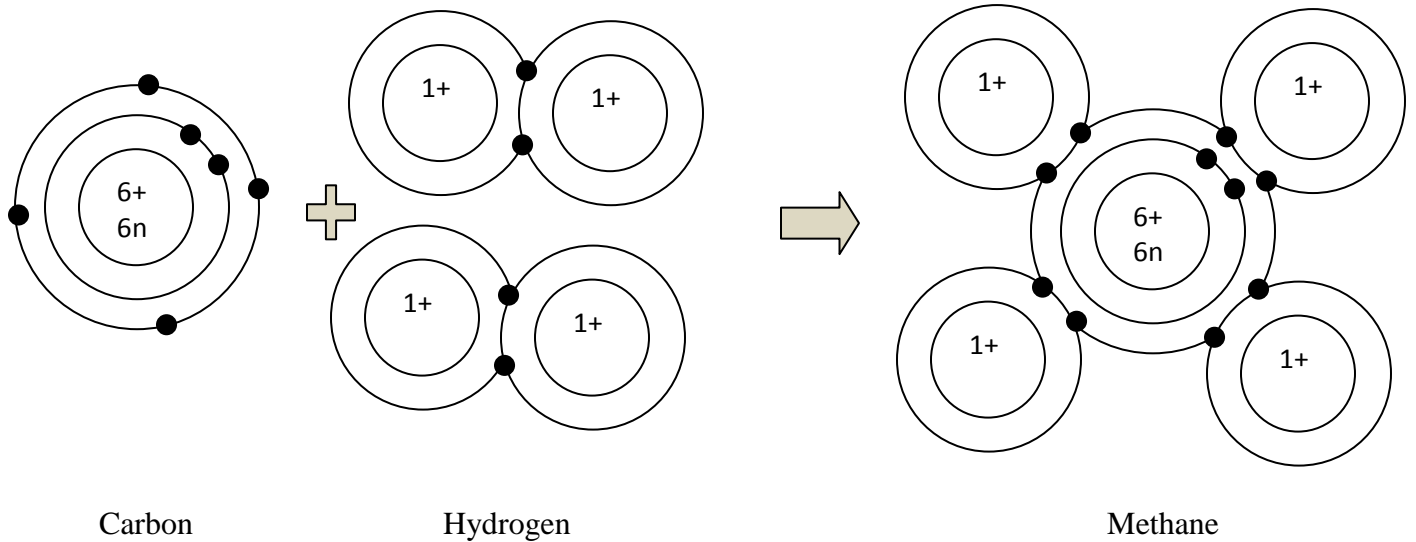


Figure 2

7. The type of bonds formed between carbon and hydrogen in Figure 2 is

- A. Hydrogen
- B. Ionic
- C. Covalent
- D. Organic

8. The correct chemical equation for the reaction in Figure 2 is

- A. $C + 4H \rightarrow CH_4$
- B. $C + H \rightarrow CH$
- C. $4C + H \rightarrow C_4H$
- D. $C + 2H_2 \rightarrow CH_4$

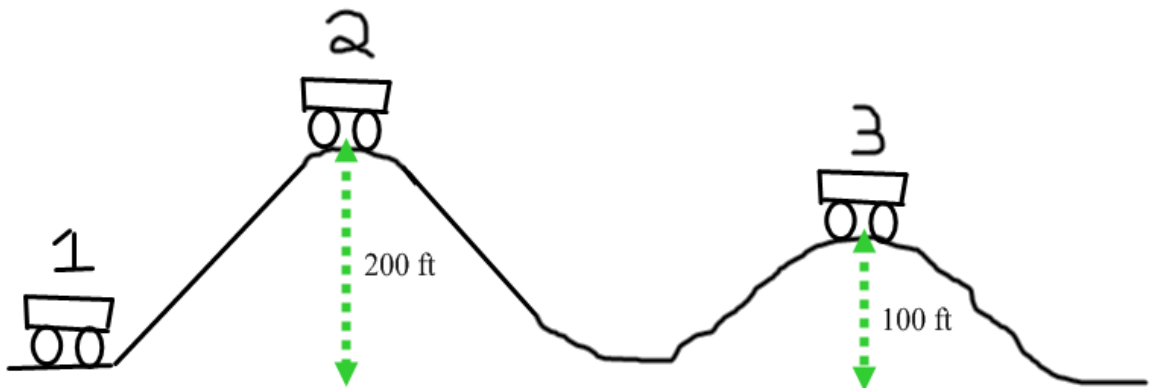
9. A unique characteristic of Hydrogen is that it is
- A. a very large atom.
 - B. always a positive ion.
 - C. diatomic.
 - D. able to react with carbon.

Energy Transformations

Read the description and answer the questions.

Item 1

When riding on a rollercoaster as seen in the diagram below, the cart is connected to a chain. The chain is attached to a motor that moves the cart from position 1 up the first hill to position 2. When the cart reaches the top of the hill there is a slight pause and it is released from the chain and moves down the hill and continues to the end of the ride without any other assistance from chains and motors. This can be explained by the concept of Conservation of Mechanical Energy.



10. From position 1 to position 2, which best describes the order of energy transformation?
- A. Kinetic \rightleftharpoons Potential \rightleftharpoons Electrical
 - B. Kinetic \rightleftharpoons Electrical \rightleftharpoons Potential
 - C. Electrical \rightleftharpoons Kinetic \rightleftharpoons Potential
 - D. Potential \rightleftharpoons Electrical \rightleftharpoons Kinetic

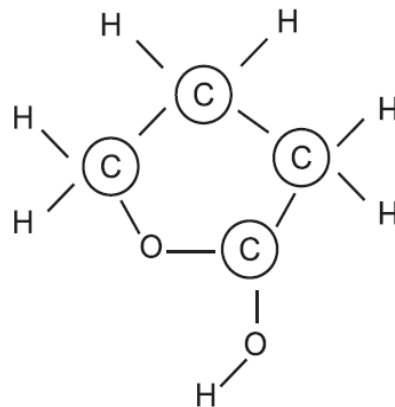
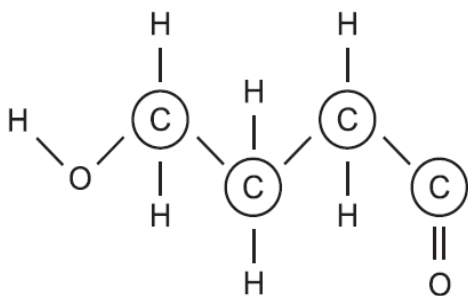
11. From position 2 to the bottom of the first hill, which best describes the order of energy transformation?

- A. Kinetic \Rightarrow Potential
- B. Kinetic \Rightarrow Electrical
- C. Electrical \Rightarrow Kinetic
- D. Potential \Rightarrow Kinetic

12. You rub two balloons against dry hair, causing the strands of hair to stick out. The two balloons now repel each other, indicating that

- A. they both are positively charged
- B. they both are negatively charged
- C. they have the same kind of charge
- D. they have opposite charges on them

The pictures below show the structures of two polymers.



13. What can be concluded from comparing these two pictures?

- A. Polymers are easily broken down into their component parts.
- B. The same number of carbon atoms may be arranged in various ways.
- C. Linear polymer structures are stronger than ringed polymer structures.
- D. It takes fewer monomers to form a linear polymer than a ringed polymer.

14. Researchers have developed a biopolymer made from orange peels and carbon dioxide. According to the researchers, using CO₂ to make polymers could reduce the amount of greenhouse gas emitted into the atmosphere. What question would an environmentalist **most likely** want answered before accepting this statement as credible?

- A. How long will it take the biopolymer to decompose?
- B. Is the biopolymer as strong as hydrocarbon polymers?
- C. Can other types of citrus be used to produce biopolymers?
- D. What happens to the CO₂ when the biopolymer decomposes?

15. Approximately 20% of paper waste and 30% of aluminum waste produced in the United States is recycled compared to only 1% for plastic waste. How do you account for the large difference in recycling between aluminum and plastic (polymer) waste?

- A. The raw material for plastics is inexpensive
- B. There are many different types of plastics found in products
- C. The task of sorting plastic products is time consuming
- D. All of the above

16. Chemicals are used to produce consumer products including automobiles and fuels, food products and packaging, cosmetics, electronics and batteries, clothing, and building materials. These products have improved our quality of life but it has also had the unintended effect of producing large quantities of waste by-products. What has industry done to reduce the impact of these waste by-products?

- A. Build chemical plants closer to rivers for easier disposal
- B. Bury the solid wastes in the ground
- C. Find new uses for the waste by-products
- D. Dispose of the waste at night when people are sleeping

Water Properties

17. Ice floats in water. From this statement it is reasonable to predict that, when a liter of water freezes to form ice, its _____.

- A. density increases
- B. weight increases
- C. density decreases
- D. weight decreases

Global Interdependence

The Changing Earth

Convection currents within the earth's asthenosphere cause cooler magma to sink and warmer magma to rise. As a result earth's plates move across the earth as if they were on a conveyor belt. This motion causes the plates to converge (come together), diverge (split apart), or to slip past one another at the plate boundaries.

18. Differences in _____ cause the magma to rise and sink in the asthenosphere.

- A. density
- B. mass
- C. volume
- D. composition

19. Motion along the plate boundaries cause:

- A. mountain building
- B. earthquakes
- C. volcanoes
- D. all of these form at different plate boundaries

20. Last year alone the United States used approximately 50 billion disposable water bottles. If you lay these water bottles end to end they would circle the entire earth three times!! It takes about 8 gallons of fossil fuels to break each bottle down during the whole recycling process. Some environmentalists believe Americans should switch to filtering their own water and cut back on the consumption of bottled water. If the switch were to occur which change would be the most important outcome:

- A. People would drink more water
- B. We would save money on water
- C. Save a valuable non-renewable resource
- D. People would recycle more

21. During the process of moving these water bottles in trucks from all around the country to the recycling plants, crushing them and then recycling the plastic, gases are produced that contribute to the following process:

- A. Global warming
- B. Solar energy
- C. Renewable energy
- D. Photosynthesis

22. If the recycling plant however were powered by one of the following fuels, it would contribute virtually no greenhouse gases to the environment. Which fuel should be used?

- A. Ethanol
- B. Nuclear power
- C. Fossil Fuel
- D. Coal

Solar Cookers use the energy from the sun to cook and warm up food. Burning wood pollutes the atmosphere and requires the destruction of forests which affects animal habitats. Gas stoves are expensive and not readily accessible. Solar Cookers are environmentally safe ways for people to use the clean and reusable energy of the Sun. Mr. Q has his students build Solar Cookers in his 9th grade Science class and he asks them to test which properties would be beneficial in creating an effective Solar Cooker. The groups are allowed to use cardboard, black and white construction paper, aluminum foil, tape, a container (which could be made from metal or glass), and a thermometer.

23. Which of the following statements is FALSE?

- A. Black paper would absorb the heat of the Sun and should be used in the construction of your Solar Cooker.
- B. Using a glass container would be better than using a metal container because metals are poor conductors of heat.
- C. Aluminum foil would reflect heat from the Sun and could be used to redirect rays from the Sun to your Solar Cooker.
- D. Smaller Solar Cookers would warm up faster than larger ones.

24. Which of the following is a DISADVANTAGE of using Solar Cookers?

- A. Poor weather can affect the efficiency of a Solar Cooker.
- B. The energy from the Sun is not clean and is harmful to the environment.
- C. Solar energy is not reusable.
- D. All of the following are true and are disadvantages of using Solar Cookers.

Since 1966, six years after the launch of the first weather satellite, every part of the Earth's surface has been photographed at least once daily by weather satellites. These satellites help meteorologists make weather predictions and track storms. They are especially useful in areas where surface observations are limited, such as oceans, deserts, and polar areas.

The usefulness of weather satellites does not end with meteorology. You might be surprised to learn that weather satellites also help fishermen, farmers, geologists, pilots and even hikers.

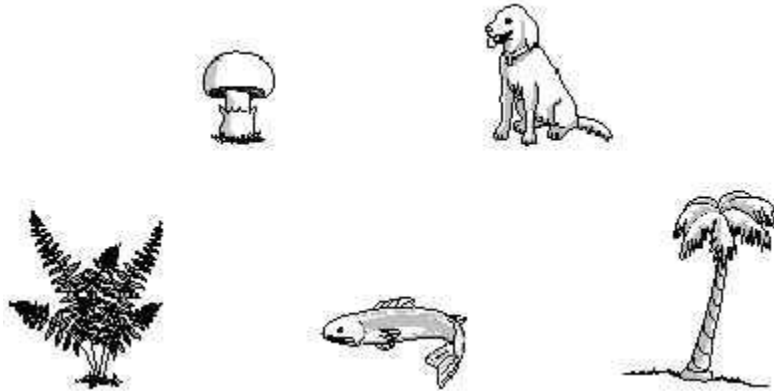
Satellite data help determine sea- surface temperatures and predict storm conditions for fishermen. Farmers can get data on crop conditions and deforestation and drought regions. These same satellites detect volcanic eruptions and the motion of ash clouds. Pilots depend on satellites data for travel conditions, including cloud formations and disturbances.

25 The author's purpose in writing this passage was probably to

- A) explain how weather satellites collect data
- B) explain that satellite technology is not developing fast enough
- C) describe some of the uses of weather satellites
- D) persuade the reader to consider a career in meteorology

Cell Chemistry and Biotechnology

Cells



26. Study the five organisms shown above. Which of the organisms have cells similar to the cell shown below?



- A. the mushroom and the dog
- B. the fern and the palm tree
- C. the dog and the fish
- D. the fern and the fish

27. A certain organism has many cells, each containing a nucleus. If the organism makes its own food, it would be classified as

- A. a bacterium
- B. a fungus
- C. a plant
- D. an animal

28. Which statement about plant and animal cells is true?

- A. Plant cells have a nucleus and a cell wall; animal cells do not have either of these structures.
- B. Plant cells have a cell wall and chloroplasts; animal cells do not have either of these structures.
- C. Plant cells have a cell wall and a cell membrane; animal cells have a cell wall but not a cell membrane.
- D. Plant cells have chloroplasts and mitochondria; animal cells have chloroplasts but do not have mitochondria.

29. Students placed a sample of red blood cells (RBC) and a sample of skin cells in 2 test tubes that contained the same glucose solution. After 24 hours, the students observed the cells under the microscope and found that the cells in both samples increased in size. What conclusion might be drawn from this observation?

- A. The cytoplasm of the red blood cells is more concentrated than that of the skin cells.
- B. Skin cells absorb water faster than the red blood cells.
- C. Both cells absorb water when placed in the glucose solution.
- D. Both cells absorb water when placed in any solution.

A sprig of an *Elodea* plant was placed in a test tube as shown below. The test tube was then placed in sunlight for 6 hours.



30. The bubbles of gas in the diagram are composed mainly of

- A. carbon monoxide
- B. carbon dioxide
- C. nitrogen
- D. oxygen

31. 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 _____.

- A. an increase in water supply
- B. an increase in light absorption
- C. a decrease in water loss
- D. a decrease in heat production

Laboratory Investigation

A laboratory technician places red blood cells into three different solutions. Observations are recorded each minute for five minutes.

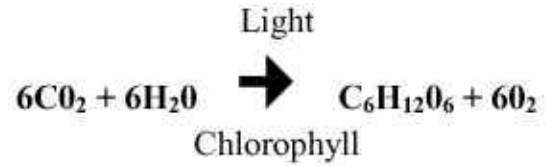
Solution	Time				
	1 min.	2 min.	3 min.	4 min.	5 min.
Solution 1	No change	Cells are slightly larger.	Cells are much larger.	Cells are huge.	Cells are gone.
Solution 2	No change	No change	No change	No change	No change
Solution 3	No change	Cells are slightly smaller.	Cells are much smaller.	Cells look wilted	Nothing that looks like a cell can be found.

32. Which of the following best explains what is causing the red blood cells in solution 1 to change size over the five-minute period?

- A. Solvent is entering the cells faster than it is leaving the cells.
- B. Solute is entering the cells faster than it is leaving the cells.
- C. The cells are making new protein.
- D. The cell's membranes are dissolving.

Photosynthesis

The following equation represents the process of photosynthesis in green plants.



(Carbon Dioxide + Water, in the Presence of Light and Chlorophyll \rightarrow Sugar + Oxygen)

33. What happens to most of the light energy during photosynthesis?

- A. It is transformed into heat energy.
- B. It is transformed into chemical energy.
- C. It is changed into carbon dioxide.
- D. It is changed into oxygen.

34. What are the products in the equation above?

- A. $6\text{CO}_2 + 6\text{H}_2\text{O}$
- B. $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- C. 6CO_2
- D. $\text{C}_6\text{H}_{12}\text{O}_6$

Enzymes

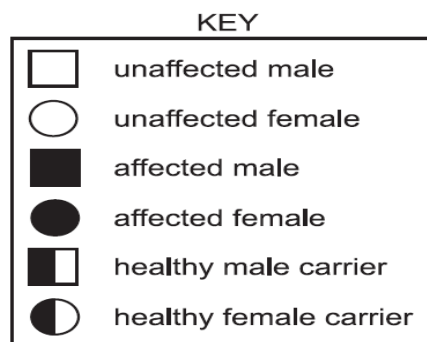
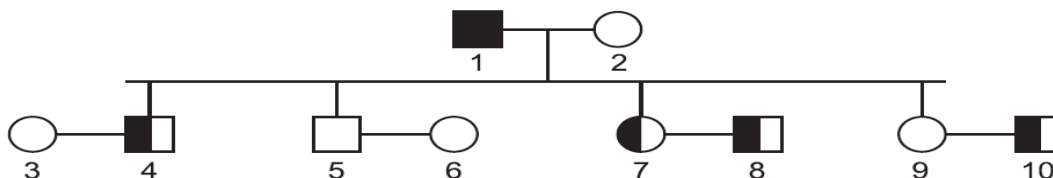
A team of pharmacists is conducting a study to test out a new pill that will help those who are lactose intolerant. Lactase, the active enzyme present in the product Lactaid®, increases the rate of the breakdown of lactose which is consumed from dairy products. Records indicate that the dietary supplement Lactaid® doesn't seem to work for anyone who suffers from acid reflux, thus the Food and Drug Administration has approved a trial run with the new drug.

35. Why do you think Lactaid® does not work for those who have acid reflux?
- A. Enzymes cannot withstand extreme temperatures.
 - B. Enzymes die when exposed to extreme pH levels.
 - C. Enzymes become denatured when exposed to extreme pH levels.
 - D. Enzymes are specific in nature.
36. Is it possible for another enzyme other than lactase to help those in digesting lactose consumed from dairy products?
- A. Yes, because enzymes help speed up chemical reactions such as digestion.
 - B. No, because enzymes are specific and only work with certain substrates.
 - C. Yes, because enzymes lower activation energy to help cells fulfill living substances.
 - D. No, because enzymes become denatured if they don't find their matching substrates.

Genetics, Evolution and Biodiversity

Cystic Fibrosis

Cystic fibrosis (CF) is a condition characterized by difficulty in breathing and digestion. CF is caused by a defect in a specific gene. The pedigree diagram below shows the inheritance pattern of cystic fibrosis in two generations of a family.



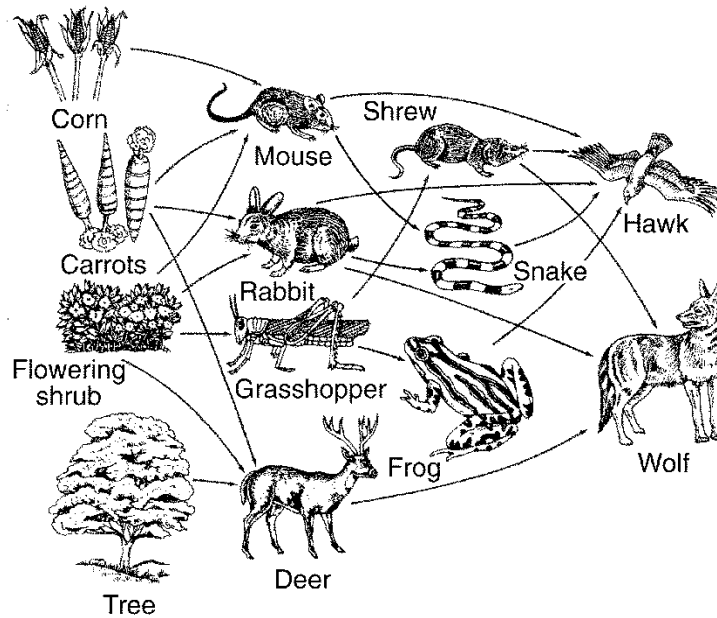
37. Which couple has a 25% probability of producing offspring who are homozygous for cystic fibrosis?
- A. 3 and 4
 - B. 5 and 6
 - C. 7 and 8
 - D. 9 and 10
38. An individual with CF is not able to transmit the disease by physical contact because _____.
- A. the gene for the disorder is only carried in the bloodstream
 - B. CF is a genetic disorder and can only be passed from parent to offspring
 - C. the bacteria that transmit the defective gene must be inherited from a parent
 - D. CF is so rare that the probability of coming into contact with an affected individual is low

Genetically Modified Foods

A gene from the bacterium, *Bacillus thuringiensis*, is toxic only to the European corn borer insect. Scientists have added this gene to corn, cotton and potatoes with large amounts of success. Insecticides that feed on these plants are exposed to a continuous dose of toxin. This is very different from 10 years ago when the toxin was sprayed on the field only twice a year by farmers. Farmers have noticed that the genetically modified crops eliminate all but a few insects that eat them.

39. What is most likely to happen if farmers continue to grow the genetically engineered crops?
- A. The insects will evolve and the genetically engineered plants will no longer be effective.
 - B. The insects population will remain low and the farmers will continue to produce large crop yields.
 - C. Herbivores will start to die because they eat the corn with insect toxin.
 - D. The toxin will pass through the food web and effect every population in the ecosystem.
40. The genetic engineered corn was most likely created when:
- A. the bacterium, *Bacillus thuringiensis*, mated with corn.
 - B. a segment of DNA from *Bacillus thuringiensis* was spliced into the DNA of the corn.
 - C. mitochondrial DNA from *Bacillus thuringiensis* was spliced into the mitochondrial DNA of the corn.
 - D. the corn absorbed the toxin when it was grown in soil that contained *Bacillus thuringiensis*.

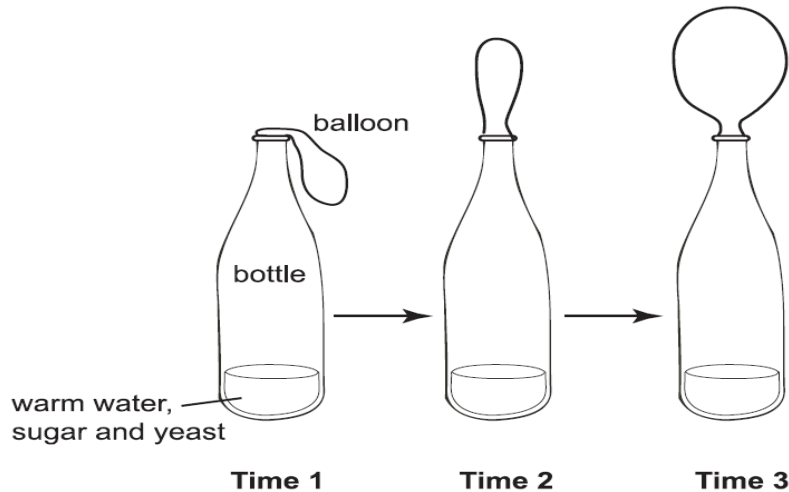
Biodiversity



41. Which of the organisms listed below would be classified as a secondary consumer in this food web?
- A. deer B. snake C. mouse D. carrots
42. Which of the organisms listed below would be classified as an herbivore?
- A. wolf B. snake C. grasshopper D. flowering shrubs
43. Which of the following statements is true?
- A. If the wolves becomes extinct, the number of deer will decrease.
B. If the Hawks and snakes becomes extinct, the number of shrews will decrease.
C. If the vegetables and plants become extinct, the populations of all the other animals will decrease.
D. If the number of mice decrease, the amount of corn will also decrease.

Laboratory Investigation

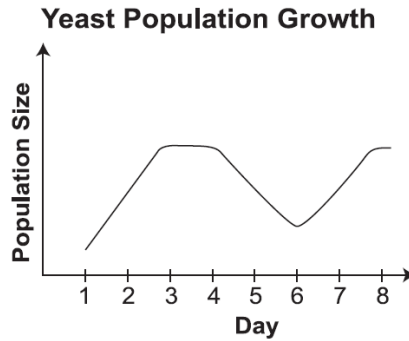
In a laboratory investigation, a student mixes 1 cup of warm water (30°C) with 30 grams of sugar and 5 grams of yeast. She pours the mixture into a glass bottle and secures a balloon over the opening. After several minutes, she observes that the balloon begins to inflate, as shown in the picture below.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



44. 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?
- A. Warmer temperatures are more favorable for yeast fermentation.
 - B. Yeast require less sugar when maintained at lower temperatures.
 - C. The optimum temperature for yeast fermentation is less than 35°C .
 - D. The time required for fermentation increases with increasing temperature.

Laboratory Investigation

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



45. 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

Microorganisms

46. The patient needed a vaccination. Vaccinations prevent disease by _____.
- A. preventing viral DNA from entering the body
 - B. destroying toxins produced by bacteria
 - C. stimulating the production of antibodies
 - D. increasing red blood cell productions
47. 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

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	20
Children having more than one cold during the study	52%	64%
Children developing a skin rash	7.1%	2.7%

48. Data in the table show that the use of Echinacea can _____.

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

49. 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

50. It is very difficult to develop a vaccine against the common cold. The reason for this is that the common cold virus _____.

- A. hides in the digestive system
- B. changes rapidly due to high mutation rates
- C. includes RNA as its genetic materials
- D. is too small for the immune system to detect