Emergency Plans

Biology

Day Four

Please complete the following:

- Worksheet: "The Elements in Your Body". Answer all questions.

- Worksheet: "A Balance in the Body". Please answer all questions.

- Worksheet: "Phospholipids". Please answer all questions.

- Worksheet: "The Chemistry Connection" Please answer all questions.

Topics in this section include:

- Elements
- pH
- Phospholipids
- Proteins and enzymes

Please print out the worksheets and complete entirely. Your work will be reviewed and graded when we return to school. Your work should be neat and organized.

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WORKSHEET

3.6 ENRICHMENT WORKSHEET INTEGRATING BIOLOGY

The Elements in Your Body

Read the following paragraphs, and complete the exercises below.

Water, proteins, carbohydrates, lipids, and nucleic acids are all important compounds in your body. In fact, these five types of substances make up 96 percent of your body's mass. These compounds are made up largely of only four different elements: oxygen, carbon, hydrogen, and nitrogen.

Although these four elements are very important, your body also requires a number of other elements to stay healthy. For example, calcium helps keep bones strong and is needed to maintain cellular structure. Phosphorus is needed to form high-energy phosphate compounds, in which the body stores chemical energy. Magnesium contributes to muscle and nerve functioning and to protein synthesis.

Trace elements

In addition, your body requires small amounts of certain elements, called trace elements. Some trace elements are cobalt, copper, fluorine, silicon, and tin. Although trace elements are only required in small amounts, they are important to good health. Copper deficiency, for example, has been linked to heart disease.

With all of these different elements, compounds, and trace minerals to worry about, you might think that your body would have a hard time getting everything it needs to survive. Fortunately most of these things can be found in a well balanced diet. To keep your body healthy, you must make sure that your diet contains a variety of foods from all of the recommended food groups in the USDA Food Guide Pyramid.

Exercises

1. Name three important compounds in the body.

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2. Why is calcium important to the body?

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3. What are trace elements? Name some examples.

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4. Explain why it is important to have a well-balanced diet.

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WORKSHEET

6.4 ENRICHMENT WORKSHEET INTEGRATING BIOLOGY

A Balance in the Body

Read the following paragraphs, and complete the exercises below.

Acids and bases play an important role in how your body functions. Amino acids, for example, are the molecules that combine to form proteins. And some of the major components of DNA are organic bases. Many of the body's systems depend on the properties of certain acids or bases to carry out their functions.

How a buffer maintains pH

The addition of even a small amount of an acid or base can change the pH of a system, strongly affecting how the system performs. Fortunately, your body has ways of ensuring that the proper pH is maintained. One common way is through the use of a *buffer.* A buffer is a system of two similar compounds that act together to maintain pH when a small amount of acid or base is added to the system.

The pH of a solution indicates the concentration of hydronium ions (H_3O^+) and hydroxide ions (OH^-) in the solution. To keep a solution at a certain pH, a buffer must keep both of these concentrations constant. It does this by neutralizing excess amounts of acid or base when they are added to the system.

A buffer in the bloodstream

Your blood has a buffer made up of carbonic acid (H_2CO_3) and hydrogen carbonate ions (HCO_3^-). Excess hydronium ions (H_3O^+) in your blood lower the pH. Fortunately, the hydrogen carbonate ions in the buffer system react with the hydronium ions, forming carbonic acid and water:

$$HCO_3^- + H_3O^+ \rightarrow H_2CO_3 + H_2O$$

On the other hand, excess hydroxide ions (OH^-) raise the pH. But carbonic acid reacts with the hydroxide ions to form hydrogen carbonate ions and water:

$$H_2CO_3 + OH^- \rightarrow HCO_3^- + H_2O$$

Exercises

1. What is the purpose of a buffer?

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2. What raises the pH of a system? What lowers the pH of a system?

_____

_____

3. How are the products of the two buffer reactions shown above related?

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WORKSHEET

6.5 ENRICHMENT WORKSHEET INTEGRATING BIOLOGY

Phospholipids

Read the following paragraphs, and complete the exercises below.

How soap and phospholipids are similar

Soap is effective at removing oil from your hands because it is an emulsifier, a substance that causes two liquids that normally do not mix to spread throughout each other in an emulsion. Soap has this effect because one part of the soap molecule is attracted to water and another part is attracted to oil. When you mix oil, water, and soap, they stay together so that you can wash them all away together.

Phospholipids are arranged in a similar way to soap molecules, but they are not used for washing. Phospholipids are one of the main components of the membrane that forms the boundary around plant and animal cells. This membrane creates a strong barrier between the water-soluble substances inside the cell, such as proteins and nucleic acids, and the watery environment outside the cell.

How phospholipids make up the cell membrane

Phospholipids are made up of a head and two tails. The heads are charged and are attracted to water, and the tails are nonpolar and repel water. In the cell membrane, the phospholipids are lined up in two layers. The nonpolar tails from the two layers meet between the layers.

The tails bond together loosely to create a nonpolar layer that water does not penetrate. Away from this layer, both inside and outside the cell, the charged heads interact with water-soluble substances. The nonpolar layer allows the membrane to keep the inside of the cell separate from its environment. When necessary, however, the cell membrane can transport substances between a cell and its environment.

Exercises

1. How are phospholipid and soap molecules similar in structure?

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2. What would happen if the water-soluble substances inside the cell were not separated from the watery environment outside the cell?

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3. Why might it be important for the molecules that form the cell membrane to be able to both interact with and repel water?

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WORKSHEET

1.3 ENRICHMENT WORKSHEET INTEGRATING CHEMISTRY

The Chemistry Connection

Read the following paragraphs, and complete the exercises below.

Scientists define chemistry as the study of matter and the way it changes. Because a change in matter requires a change in energy, changing energy from one form to another is also part of chemistry. Chemistry is a principal investigation tool for many fields of science. Scientists who use chemistry include physicists, who study atoms, and astronomers, who study stars and planets. Earth scientists use chemistry to help them understand changes in rock. Biologists and health scientists use chemistry to study living organisms.

Proteins are chemical compounds

Proteins are a major interest to scientists who study the chemistry of living things. All living organisms contain protein. Plants make the proteins they need from substances in the air and soil. Humans and other animals must obtain the building material for proteins from the food that they eat.

The human body contains many proteins

Your blood, brain, muscles, and tooth enamel all contain protein. Even tiny bacteria have protein, and viruses, which are even smaller than bacteria, are made almost entirely of nucleoproteins. Nucleoproteins are combinations of proteins and nucleic acids. You are probably most familiar with the form of nucleic acid known as genes, which determine heredity.

Enzymes help chemicals in the body react

Genes are made of a nucleic acid called deoxyribonucleic acid (DNA). In addition to determining heredity, genes control the reproduction and daily functions of cells. DNA controls the formation of another nucleic acid, ribonucleic acid (RNA). RNA spreads through cells and controls the formation of proteins and enzymes. Enzymes trigger the various chemical reactions that are necessary for life.

Exercises

1. Why is protein chemistry of great interest?

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2. What is the role of food in the production of human proteins?

_____

3. Why might every person be called a chemist?

_____

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Emergency Plans

Biology

Day Five

Please complete the following:

- Worksheet: "Was There an Aquatic Stage of Human Evolution?" Please answer all Review questions and Consider This questions.

- Worksheet: "Two Species are Not Two Species". Please answer all review questions and Consider This questions.

- Worksheet: "How Can New Plant Species be Developed?" Please answer all review questions and Consider This questions.

Topics in this section include:

- Human Evolution
- Species
- Plants and evolution of new species

Please print out the worksheets and complete entirely. Your work will be reviewed and graded when we return to school. Your work should be neat and organized.

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Was There an Aquatic Stage of Human Evolution?

Until the 1980s, most people who studied human evolution thought that the human family, called the hominids, diverged from the ape family about 20 million years ago. More recent evidence based on genetic and biochemical analysis shows that the split was much later, possibly as recently as 5–8 million years ago. Yet the earliest known hominid fossils are only about 3.5 million years old.

The gap in the fossil record poses many questions and problems for anthropologists and other researchers. Many important changes took place as the hominids evolved from the apes. For example, the bipedal, upright posture characteristic of hominids evolved during this period. How and why did such changes take place? Why are there no fossils of the "missing link," a transitional animal with characteristics of both apes and humans? One hypothesis that some researchers have proposed to answer these and other questions is called the Aquatic Ape Theory.

According to the Aquatic Ape Theory, human ancestors went through a period during which they lived near the sea. It is suggested that during this time, human ancestors evolved to be efficient swimmers that traveled, hunted, and possibly reproduced in water. Eventually their descendants returned to a terrestrial lifestyle, but retained many of their aquatic characteristics. These characteristics are believed to be still evident in modern humans.

What evidence do proponents of the Aquatic Ape Theory use to support their idea? Consider first the important feature of the bipedal, upright posture. When mammals adapt to an aquatic, swimming niche, they usually develop a streamlined form that reduces water resistance. Four-legged mammals are generally poor swimmers. This problem is overcome in some mammals, such as otters, by a downward rotation of the pelvis. This arrangement has the effect of straightening the legs out behind the body, rather than under the body. The pelvic structure of such mammals closely resembles the change in pelvic structure that occurred in hominids during the gap in the fossil record.

Aquatic mammals also tend to have downward-facing nostrils. This arrangement prevents water from entering the nose when the animal swims forward. Humans differ from other primates in their downward-facing nostrils. Finally, humans have less body hair than other primates, a common adaptation among aquatic mammals such as walruses and whales.

Critics of the Aquatic Ape Theory point out that there is absolutely no direct evidence for the theory, which should really be called a hypothesis. There is no fossil evidence of hominid societies in coastal areas, or any other solid evidence to support the idea. To a scientist, an idea is not considered to be a valid theory just because it seems to make sense.

Supporters of the idea are not surprised by the lack of fossil evidence. Fossils do not preserve well along coasts due to erosion and changing shorelines. Therefore, advocates interpret the lack of fossils as an observation that supports their idea. Until information is found that either proves or disproves the hypothesis, the issue of the aquatic ape will probably never be resolved.

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REVIEW *On the lines provided, answer the following questions.*

1. Approximately how long is the gap in the fossil record?

2. What structural characteristics of modern humans suggest an aquatic period of evolution?

CONSIDER THIS *On the lines provided, answer the following questions.*

1. What sort of evidence will need to be found in order to confirm or reject the Aquatic Ape hypothesis ?

2. If the hypothesis is true, and hominids had remained aquatic, what further adaptations might have evolved in humans?

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Two Species Are Not Two Species?

Living things exist in many different shapes, sizes, and colors. If you consider just the animals, the variety of characteristics among them is seemingly endless. Even among animals in one group, such as mammals, the variety is amazing.

Similarities and Differences Dogs and horses have several physical characteristics in common. For example, both animals have four legs and are covered with hair. Both have two eyes, two ears, and two nostrils in a damp, skin-covered nose at the front of the head. Yet you would never mistake a dog for a horse—even a very big dog for a very small horse.

In spite of their similarities, the two animals are different in many ways. A horse has hooves; a dog has clawed toes. A horse has large, flat, uniformly sized teeth; a dog has sharp, pointed teeth of varying size and length. These characteristics show that the animals are genetically very different.

Suppose you were asked to compare two dogs: a Saint Bernard and a Chihuahua. At first glance, these two animals appear to be very different. The Saint Bernard is quite large and is covered with long, curly hair. The Chihuahua is smaller than most house cats and has very short, bristly hair. In such characteristics as feet and teeth, however, the two are quite similar.

Species A *species* is often defined as a group of individuals that are reproductively isolated. In other words, a male dog can mate with a female dog, but cannot interbreed with a female of another species, such as a cat or a pig. This definition works fairly well for animal species and is generally accepted by zoologists. However, it does not work as well with plants, or with bacteria and the many unicellular eukaryotes. Therefore, the operational definition of the term species generally applies only to animals.

Crossbreeding by members of different species may occasionally produce offspring. Such offspring, called *hybrids*, often show some traits of both parent species. Perhaps the best-known example of a hybrid animal is the mule, the offspring of a male donkey and a female horse.

Mules cannot produce viable gametes and are thus sterile. In fact, most hybrid animals are sterile. Sterility is one of the mechanisms by which species maintain their genetic isolation. In nature, mating between members of different species is often prevented by *premating mechanisms*. These mechanisms include mating calls or rituals and other signals used to attract members of the opposite sex. On the rare occasions when members of different species attempt to mate, or succeed in doing so, certain *postmating mechanisms*—such as offspring sterility—maintain genetic isolation.

An Inter-Species Dilemma At one time, the black rhinoceros ranged over much of the African continent. As recently as 20 years ago, there were more than 65,000 of them in the wild. Today, that number is less than 3000 and declining.

The reason for the dramatic decline in the black rhino population is not drought or disease or any other natural phenomenon. The black rhinos are being killed by poachers—illegal hunters—for their horns. Rhinoceros horns sell for thousands of dollars on the black markets of Asia, where some people believe they have medicinal powers.

Government officials of several African countries would like to leave the black rhinos in the wild, but they may be forced to place the rhinos in animal sanctuaries to prevent their extinction. In the 1920s, officials were faced with a similar situation with the white rhinoceros. At that time, there were fewer than 100 of these animals, all of them in sanctuaries. Today they number more than 5000, and their numbers are growing.

Despite their names, both types of rhinos are large, gray animals. The white rhino can

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weigh as much as 2300 kilograms, whereas the black rhino can weigh 1500 kilograms. The lips of the white rhino are slightly thicker, or wider, than those of the black rhino. The name *white* is believed to be a mistranslation of the Boer word *widje*, which means wide. This term was used to distinguish the wide-lipped from the narrow-lipped rhinos.

You may wonder why endangered black rhinos are not relocated to the sanctuaries where white rhinos are thriving. Presumably the black and white rhinos would interbreed and repopulate. It's not that simple. Despite their similarities in appearance, the black rhino and the white rhino are different species of the genus *Rhinoceratidae*. So, although some hybrid offspring may be produced through crossbreeding, they probably would not be able to reproduce. Consequently, interbreeding would not increase the rhinoceros population over time or develop a new species. The only way to save the black rhinoceros is to protect these animals from their most dangerous predator—humans.

REVIEW *On the lines provided, answer the following questions.*

1. Why is the black rhinoceros in danger of extinction?

2. What is a mule? Why does a mule not belong to a species?

3. Would crossbreeding the black and white rhinoceros prevent black rhinos from becoming extinct? Explain your answer.

CONSIDER THIS *On the lines provided, answer the following questions.*

1. Do you think that it is important to save the black rhinoceros from becoming extinct? Explain your reasons.

2. Do you think that it is important to try to save all endangered species from extinction? Give reasons to support your answer.

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How Can New Plant Species Be Developed?

There are many varieties of oranges on the market, each variety with different traits. The navel orange, for example, is seedless and easy to peel, but it has a tart taste and little juice. The Valencia orange is sweet and juicy, but is difficult to peel and is full of seeds. An orange with the best characteristics of both varieties would be very desirable. How could such a species be developed?

What Is a Species? The definition for the term *species* is a group of organisms that can naturally interbreed and produce fertile offspring. This definition works well for animal species, and is generally accepted by zoologists. It does not work well, however, for plants.

Most plants can reproduce in a variety of ways. Many plants can reproduce asexually and may be able to form fertile hybrids with other species. Thus, botanists use the term *species* as a convenience to indicate a defining set of characteristics.

Cloning Plants Scientists have been growing plant cells in test tubes for more than a half century. Plant fragments are implanted in a medium containing various combinations of nutrients. The fragments multiply and form clumps of undifferentiated cells. The cells are stimulated to grow and develop into mature plants by adjusting the hormone balance in their medium. Using this technique, hundreds or even thousands of small plants can be produced from a single parent plant. All of the offspring are genetically identical replicas called clones. At one time, cloning was the preferred technique for growing sensitive plants, such as orchids.

Within the last 20 years, similar techniques have been used to grow isolated protoplasts. Protoplasts are plant cells without walls. These cultured protoplasts are being used in a variety of ways. They can be used in screening tests to determine specific characteristics of the plant, such as resistance to a specific disease. Before this technique was developed, such tests were time consuming. They had to be conducted with actual plants and far smaller samples.

Protoplasts can also be used in the development of new types of plants. Protoplasts from two different species of plant are fused, producing a hybrid. This technique may make it possible to combine the desired characteristics of species that cannot crossbreed in nature.

In one protoplast fusion, a potato was combined with a tomato. Tomato plants are resistant to the microorganism that causes potato blight, a disease that has threatened potato crops for centuries. Researchers hope that protoplast fusion will make it possible to produce a type of potato that, like the tomato, is resistant to the disease-causing microorganism.

Recombinant DNA techniques can also be used to engineer new types of plants. Scientists are working on developing plants with characteristics such as pest resistance, increased productivity, improved storing and shipping qualities, the ability to grow in poor soil, and so on. Perhaps some of these new "species" could be used to help solve hunger problems worldwide.

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REVIEW *On the lines provided, answer the following questions.*

1. Why do botanists use the term *species* differently than zoologists do?

2. Why is a hybrid plant sometimes hardier than either of its parent plants?

CONSIDER THIS *On the lines provided, answer the following questions.*

1. How might the successful production of a variety of "super plants" affect the problem of world hunger?

2. Do you think scientists should try to develop hybrids between different species of animals? Explain your answer.