1989

A Unit of Instruction on Evolution

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College of William & Mary - School of Education

A UNIT OF INSTRUCTION ON EVOLUTION:

Facts about Evolution

Theories on Evolution from Various Sources

Values Lesson on Eugenics

Darwin's Birds

Earthquakes and Coral

Homo Sapiens and Evolution

Solving the Puzzles of Evolution: Johann Mendel

Isolated vs. Nonisolated Populations

SUBMITTED TO: The College of William and Mary, School of Education

COMPLETED: Tuesday, November 9, 1989

SUBMITTED BY: Judith Gail Williams
in partial fulfillment of the requirements
for a Master's Degree in Secondary Education

TO THE USER:

This unit of instruction was designed to fill a void in the secondary instructional curriculum as mandated by the Department of Education. It is intended only that the teacher select the components that fit the needs of the course and students being taught at any particular time.

This paper is dedicated to my parents, Harvey and Mary Dale Williams, for teaching me the meaning of love and truth.

Thank you.

Day one:

Anticipatory Set: Put the following question on the board: Where did Homo sapiens come from? Spend 4-5 minutes at the beginning of class discussing this question. Write answers on the board.

Behavioral Objectives:

BO-1: The student will be able to identify the subject of the reading (see pp. 9 ff.), questions addressed, and when scientists began to consider evolution.

Questions:

1. What evolutionists are discussed in the reading?
2. What questions are addressed by the reading?
3. When did scientists and philosophers begin to consider evolution as a theory of biological origins?

BO-2: The student will be able to identify general beliefs about the origin of Homo sapiens.

Questions:

1. Where did Homo sapiens come from?
2. What were scientists and philosophers doing before evolutionary theories were introduced?

BO-3: The student will be able to identify the beliefs of the Chippewa Indians, Indian Hinduism, Greeks, Norsemen, and Hebrews.

Questions:

1. What did Galileo and Newton discover about the earth?
2. Where did the Chippewa Indians believe Homo sapiens came from?
3. In India what was the common belief on the origins of Homo sapiens?
4. What did the Greeks think about the origins of Homo sapiens?
5. What did the Norsemen think about the origins of Homo sapiens?
6. What did the Hebrews believe about the origins of Homo sapiens?
7. What questions does each explanation of origins try to answer?

Summary: Conclude class by discussing the origins of Homo sapiens again with the information the students have acquired today.

Day two and day three:

Anticipatory Set: How would you calculate the age of the earth?

Behavioral Objectives:

BO-1: The student will be able to list the individuals who tried to calculate the age of the earth and the methods they used to do this.

Questions:

1. List the individuals who tried to calculate the age of the earth.
2. How did they do this?
3. What were the results?

BO-2: The student will be able to identify various individuals and their ideas on evolution.

Questions:

1. Who was George Lecleric? What did he do? How?
2. Who was Anaximandros? What did he suggest?
3. Who was Chaun-tze? What did he suggest?
4. Who was Lucretius?
5. Who were Lamarck and Cuvier? What did they propose?
6. What did Lamarck create?
7. How did Cuvier prove extinction?
8. What happened to Cuvier's theory of Catastrophism? How did this occur?
9. What did Lyell propose? What is gradualism?
10. What did Agassiz discover? When?

BO-3: The student will be able to identify Darwin's four basic principles of evolution and will be able to identify when Origin of Species was published.

Questions:

1. What were Darwin's four basic principles of evolution?
2. When did Darwin publish On the Origin of Species?

BO-4: The student will be able to identify and compare concepts in various theories of evolution.

Questions:

1. How do Lamarck's and Darwin's ideas compare?
2. What is the relationship of Lamarck's and Cuvier's ideas about evolution?
3. What was Buffon's importance?
4. How did evolution affect religion and politics?
5. How does evolution affect us today?

Summary: Penquins do not fly. How would Darwin and Lamarck each explain this?

Homework: Write an essay on how religion and politics have reacted to theories of evolution.

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QUIZ #1:

1. How did the Chippewa Indians believe the Earth was formed?

2. Explain the Hebrews' beliefs about the origin of Homo sapiens and the earth.

3. What was the difference between the Chippewa Indians' belief and the Hebrews' beliefs?

4. What was Lamarck's theory of evolution?

5. What was Darwin's theory of evolution?

Day four:

Anticipatory Set: Give the student a petri dish with corn, beans, rice, and pumpkin seeds. Each dish should have a different number of each type of seed. Label each petri dish for later identification. Have the students, working in groups, count the number of each type of seeds. How many total seeds are present. List each group's findings on the board.

Behavioral Objectives:

BO-1: The student will be able to define variation and discuss its effects on a population.

BO-2: The student will be able to define and discuss the chance changes that occur in an environment.

BO-3: The student will be able to define and apply the principles of natural selection in a population.

Summary: Have the students discuss, in light of their new information, the "population" of seeds. How does chance affect populations? How does natural selection affect populations? How does variation affect the population?

Day five:

Anticipatory Set: When and where did the evolutionary line of Homo sapiens probably arise? What do past events enable one to predict with regard to the future? Spend 5-7 minutes discussing this. Make notes on the board.

Behavioral Objectives:

BO-1: The student will be able to define eugenics. He or she will be able to identify concepts of the theory of evolution.

Questions:

1. What are assumptions/concepts about the theory of evolution?
2. What is eugenics?
3. What is our genetic makeup? What are the advantages/disadvantages of sexual reproduction? What is the significance of chromosomes/traits, for example, no two are the same?
4. How are evolution and eugenics related, if at all?
5. What does eugenics do to a gene pool?

BO-2: The student will observe the Science and Mankind slide series, Leonardo Divinci.

BO-3: The students will participate in a discussion on the application of eugenics in the world today.

Summary: Have the students, individually, begin the homework assignment.

Homework: Define the scientific, political, and ethical problems inherent in a society where eugenics is used (at least two written pages).

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QUIZ #2:

1. What was Lamarck's theory of evolution?

2. What was Darwin's theory of evolution?

Day six and day seven:

Anticipatory Set: Put the following question on the board: How is eugenics affecting your life today?.

Behavioral Objectives:

BO-1: The student will be able to state and defend an ethical position on the use or nonuse of eugenics.

Questions:

1. Would you ever support the use of eugenics as a policy of the government? Why or why not?

BO-2: The student will be able to identify societies and their criteria for: Controlling reproduction, abortion, involuntary sterilization, limiting the number of offsprings, and other applications of eugenics available.

Questions:

1. What would we use to decide who gets to reproduce and who does not?
2. Would you include yourself in the group that got to reproduce? Why, or why not?
3. How would abortion laws be affected if eugenics were to become a part of our public policy? Would you support the changes that you foresee?
4. What about involuntary sterilization? Under what conditions should it be used?
5. Should adults who give birth to children with birth defects continue to have more children? Should the government seek to control this problem?
6. What would the deciding factor be in the number of children allowed: The parents' IQ, wealth, social position, or physical attractiveness?
7. Outside of eugenics, what are some other solutions for the control of population?
8. What relevance is eugenics in a world of five billion people whose population is expected to double within the next fifty years?

Summary: Explain why many mentally retarded individuals, who were institutionalized, were involuntarily sterilized. Is this a form of eugenics? If so, is this a violation of human rights?

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QUIZ #3:

1. Define eugenics:

2. What country is involved? How is eugenics applied in today's world? Give a brief summary.

   a. COUNTRY:

   b. SUMMARY:

Reading #1

EVOLUTION: Theory of evolution through natural selection.

For thousands of years, whenever they could take time off from everyday affairs, thoughtful persons have asked: Where did we come from? And, where are we now? The first question meant: How did the earth and Homo sapiens come into being? The second meant: What is the earth? What is it made of, what is its shape, and what are the heavens?

For a long time, people asked these questions of their spiritual leaders, who were supposed to know more about such things than ordinary persons. The earth, they were told, was a flat disk; the sky a kind of bowl turned upside down on top of it. As for how man originated, that was simple. God, or the gods, created man and the universe much as they are today.

In time, voyages to distant places and the work of scientists like Galileo and Newton taught some facts about the shape of the earth and the heavens. They learned that the earth is a ball of minerals which is hot inside its crust, spins around on its axis, and sails in an elliptical path around the sun. They learned that the stars were other suns at unimaginably vast distances from our own.

The answer to the first question--Where did we come from?--was long delayed. Without the tools of modern science, one could only

imagine what happened in very ancient times. All sorts of guesses were put forward about the origin of the earth and man.

The Chippewa Indians thought that the muskrat had dived to the bottom of the ocean and brought up a gob of mud, from which he made the first continent. In India, Hindu priests said that the god, Varuna, had created the world by a magical spell. The ancient Greeks believed that: Sky was the first who ruled over the universe. And having wedded earth, he begat first the Hundred-handed, as they are named--that is, three giants with fifty heads each--then more races of giants and various gods and goddesses. One god, Prometheus, molded men out of water and earth and gave them fire also.

Likewise, the Norsemen thought that Odin, the king of the gods, came upon the lifeless body of the first man and breathed the spirit of life into him. The Hebrews taught that: "In the beginning God created the heaven and the earth" and, during the next five days, the dry land, the plants, the animals, and Adam and Eve. They wrote this belief in the Book of Genesis, which later became the first book of the Old Testament.

Two hundred years ago, most Europeans and people of European descent thought that the story of Genesis gave an accurate account of the beginning of the earth, of life, and of man. Yet, from the early days of Christianity, many respected churchmen believed that Genesis should be taken not as a statement of literal fact but as

an allegory or myth that explained the philosophical nature of man and his relationship to God, the Creator. Although the general public knew little and cared less about these speculations, a few scientists, as a result of their researches, had become doubtful of the literal truth of Genesis.

Meanwhile, other men were trying to calculate the age of the earth. In the seventeenth century, a scholarly Irish bishop, James Ussher, added together the lengths of the lives of the patriarchs as listed in Genesis and decided that 4004 B. C. was the date of the Creation. After publishers began to print this date in their Bibles, many Christians believed that this supposed date of Creation was just as authentic as the rest of the sacred writings. While nineteenth-century geologists could not tell the actual lengths of the geological periods and eras, they realized that the earth was much older than 6,000 years and sought to discover its true age.

Earlier scientists had already tried to measure the age of the earth. One of the first to attempt this calculation was the French naturalist, Georges Leclerc, Comte de Buffon (1707-88), who was a friend of the American patriot, Benjamin Franklin. In Buffon's time, men had already guessed that the sun had somehow given birth to the earth, or that a single event had produced both bodies. They also knew from volcanoes that, deep inside its rocky crust, the earth was hot. It seemed likely, therefore, that the earth had once cooled to its present state.

Buffon made a number of balls of stone and metal. When they were completed, he placed them, one by one, in a wire holder, heated them to white heat, and let them cool. From the time it took these balls to cool, he calculated that a ball the size of the earth would require 74,832 years to cool to its present temperature.

As things turned out, Buffon's procedure was based on invalid assumptions. During the next century, other scientists made other estimates of the earth's age, basing their figures on such facts as the amount of salt in the sea or the time needed to lay down a layer of sedimentary rock. The results were not at all consistent, but at least they indicated that the earth had been around for millions of years.

Another consideration was the question of how long man had been on the planet earth and was early man different from present-day man. Before Darwin, at least a hundred persons had considered the possibility of evolution. Anaximandros, a Greek philosopher of the sixth century B. C., suggested that "man was originally, similar to a different animal, that is, a fish." In the fourth century B. C., the Chinese scholar Chaun-tze asserted: "All living things are species developing to various forms through the process of variation." In the first century B. C., the Roman poet Lucretius composed a poem on nature, which not only advocated evolution but even hinted at Darwin's principle of natural selection.

In 1589, the aged Bernard Palissy, a famous French potter and naturalist, died in the dungeons of the Bastille because, among other crimes and heresies, he speculated on evolution. In 1619, Lucilio Vanini was burned at the stake in Toulouse on similar charges. Several eighteenth-century thinkers, including Comte de Buffon and Darwin's grandfather, Dr. Erasmus Darwin, also toyed with the idea. In Scotland, the jurist James Burnet, also known as Lord Monboddo, was considered mad for speculating about man's descent from apes.

In France, while science was flowering in the revolutionary years from 1790 to 1815, two scientists working for the French government were arguing over fossils and evolution. Each was partly right and partly wrong as compared to the viewpoints of contemporary scientists. One of these thinkers was Jean Baptiste de Lamarck (1744-1829), the son of a petty noble of Picardy. After winning honors for heroism as a soldier, Lamarck became the King's Botanist and Keeper of the King's Gardens.

After the French revolution, the fifty year old Lamarck became the first professor of invertebrate biology. In fact, he created the science by making order out of the scraps of knowledge that existed about animals without backbones. He invented the word "biology" and made the first sensible classification of invertebrate animals--mollusks, insects, worms, jellyfish, and the like.

Lamarck was a pioneer evolutionist. He believed that all living things had evolved from other, different forms of life. On the other hand, Lamarck's understanding was not complete. Despite his genius, he usually managed to arrange himself on the wrong side of a scientific controversy. For instance, he refused to believe that any animal had ever become extinct. Lamarck also upheld the old but mistaken idea that physical features gained during an animal's lifetime as a result, say, of exercise or diet, are passed on to the beast's descendants.

Lamarck's more-or-less friendly rival was Baron Cuvier (1769-1832), who turned out a tremendous amount of work by organizing it with remarkable efficiency. Cuvier founded the sciences of comparative anatomy (the study of the bodily structures of various animals) and vertebrate paleontology (the study of extinct vertebrates). He established relationships between the physical characteristics of the various animals and their habits. Cuvier also proved that extinction was a fact, that many species had indeed vanished from the earth. On the other hand, Cuvier did not believe in evolution. He argued that existing animals had not evolved.

To account for the extinction of species, Cuvier asserted that a series of cosmic catastrophes, perhaps four, had visited the earth. The planet wobbled in its course, causing the oceans to splash out of their beds and drown the animals of whole continents.

Fish and crabs, left stranded on exposed seabottoms, died for want of water. Then the waters settled back into their basins, and the devastated lands filled up with immigrants from other continents that had not been affected by flood waters. This theory was called catastrophism. Cuvier's younger colleague, Alcide d'Orbigny, carried the idea further. He argued that, on twenty-seven occasions, God had wiped out all life on earth and started over with a new Creation.

Cuvier's catastrophism seemed reasonable when only a few widely separated geological periods were known. However, as the nineteenth century wore on, geologists continued to close the gaps between periods. Soon, enough formations and fossils had been found to show that the evolution of life and the building up and tearing down of rocks had been continuous. Paleontologists began to find many "missing links" between extinct and living forms. Then the rival theory of "gradualism," put forth by Charles Lyell (1797-1875) took the place of catastrophism. Lyell taught that the form of the earth's surface today is due to the gradual, day-by-day action of wind and water, such as we see about us all the time. There had been no sudden catastrophes.

Lyell's idea, in its turn, had to be modified when the Swiss naturalist, Jean Louis Agassiz (1807-1873), discovered the Ice Age while vacationing in the Alps in 1836.

We have discussed the level of scientific knowledge available when Darwin first began to research evolution. The evolutionists

were, in fact, a tiny minority. While they were not in serious danger of persecution, they still had to watch their step if they did not want to risk unpopularity by rejecting popular opinion. After years of observation and experimentation, Charles Darwin published On the Origin of Species on November 24, 1858. In his book he proposed four major ideas about evolution. The first is that the process of evolution is gradual and continuous. The second is that similar organisms are related or descended from a common ancestor. The third is that the environment is not static but evolving. The last principle is that evolution is the result of natural selection. Natural selection is a two-step process. The first step is a seemingly inexhaustible supply of large and small differences within species. The second step is survival of the fittest. The concept of an evolving environment, rather than a static one, was almost universally accepted by serious scientists even before Darwin's death in 1882. Those who accepted evolution also accepted the concept of common descent.

Of all the revolutions in the thinking of mankind, none has had greater impact on civilization than the doctrine of evolution. It has influenced religious beliefs and political action. It has proved how far man has struggled upward from lowly beginnings. It has taught us about our relation to the natural world in which we live. It has given us the opportunity to control our destiny by protecting our environment and our own genetic inheritance from the

destructive forces of pollution, overcrowding, atomic radiation, and concentrated chemicals. It permits us to dream that, with present knowledge intelligently applied, we have the power to improve our children's children in a better world than the one we know today.

This revolution in thinking was the work of many people. Towering above all others, stands the colossal figure of Charles Robert Darwin, one of the outstanding thinkers of modern civilization.

CCNTENT DRTA 1: EVOLUTION

I. Survey the text to be evaluated:

What "evolutionists" are included in reading #1?

What questions are addressed by the reading?

When and what caused scientists and philosophers to begin to consider evolution?

II. Questions or terms related to specific concepts:

How did people answer the question: "Where did Homo sapiens come from?"

What did Galileo and Newton discover about the earth?

Where did the Chippewa Indians believe Homo sapiens came from?

In India what was the common belief on the origins of Homo sapiens?

What did the Greeks think?

What did the Norsemen think?

What did the Hebrews believe?

What were scientists and philosophers doing at this time?

List the individuals who tried to calculate the age of the earth. How did they do this? What were the results?

Who was George Leclerc? What did he do? How?

Who was Anaximandros? What did he suggest?

Who was Chaun-tze? What did he suggest about the origins of humans?

Who was Lucretius? What did he suggest about the origins of humans?

Who were Lamarck and Cuvier? What did they propose?

What did Lamarck create?

How did Cuvier prove extinction existed?

What happened to Cuvier's theory of Catastrophism? How did this occur?

What did Lyell propose? What is gradualism?

What did Agassiz discover? When?

When did Darwin publish <u>On the Origin of Species</u>?

What were Darwin's four basic principles of evolution?

III. Press students on their responses to the above questions.

How would Lamarck explain giraffes' long necks?

How would Darwin?

How would Lamarck explain the color change in pepper moths in industrial England?

How would Darwin explain color changes in pepper moths?

Penquins do not fly! How would Darwin and Lamarck explain this?

IV. Reread the text for specific purposes outlined in the content organizing questions seeking to confirm what they

may know and locating information to deal with what they do need to know.

V. Content questions:

How do Lamarck's and Darwin's ideas compare?

What is Lamarck's and Cuvier's relationship?

What was Buffon's importance?

How did evolution affect religion and politics? Why?

How does evolution affect us today? Are there new species to observe today? Has evolutionary theory changed the way we think about ourselves?

VALUES LESSON: EUGENICS

LEVEL I (FACTS)

1. What is eugenics?

LEVEL II (CONCEPTS)

1. Invent a society where eugenics is used.
2. Describe the application of eugenics in the world today.

LEVEL III (VALUES)

1. How is eugenics affecting your life today, if at all?
2. Would you ever support the use of eugenics as a policy of the government? Why or why not?
3. What would we use to decide who gets to reproduce and who does not?
4. Would you include yourself in the group which got to reproduce? Why, or why not?
5. How would abortion laws be affected if eugenics were to become a part of our public policy? Would you support the changes that you foresee?
6. What about involuntary sterilization? Under what conditions should it be used?
7. Should adults who give birth to children with birth defects continue to have more children? Should the government seek to control this problem?
8. What would the deciding factor be in the number of children allowed: The parents' IQ, wealth, social position, or physical attractiveness?

Day eight:

Anticipatory Set: Imagine a flock of seed-eating birds who were in a big storm. They were blown off course and are now stranded on a remote island. There are few seeds and lots of insects. How would evolution occur so that in the future generations of their offspring would survive on this island?

Behavioral Objectives:

BO-1: The student will be able to discuss the variations in the finches on the Galapagos Islands.

Questions:

1. What types of birds does the finch family include?
2. What diet do nearly all finches have?
3. How are the Galapagos Islands finches different from other finches?
4. Why should the finches in the Galapagos Islands play the part in nature's scheme that elsewhere was taken by birds of quite different kinds?
5. Why should the different islands harbor different species of finches, when the climate and vegetation were just about the same?

BO-2: The student will be able to identify and discuss species modification and relationships.

Questions:

1. What is species modification? Why does it occur?
2. Why, on these various islands, are the species so similar yet dissimilar?

Summary: Quiz

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QUIZ #4:

1. What do you think should be the criteria for reproduction in a eugenically controlled society? Defend your stand.

2. Should eugenics be used to assist in a cure for cancer and heart disease? Defend/explain your answer.

3. Should eugenics be a part of a policy to control overcrowding in world population size? Why or why not?

Reading #2

DARWIN'S BIRDS

Darwin reported on the rocks, the plants, and the animals from a variety of land areas in the Galapagos. When Darwin collected his specimens of birds, he found a curious assortment. Of the twenty-six species, all but one were peculiar to the Galapagos--that is, they lived nowhere else in the world. Of the twenty-five unfamiliar species, thirteen belonged to the finch family, which includes the sparrows and the canaries. In the rest of the world, finches are nearly all seed-eaters. However, the Galapagos finches lived on a variety of diets, and their beaks, accordingly, differed in shape--slender beaks for insect-eaters, stout beaks for nut-crackers, and beaks adapted to eating fruit and flowers.

In the Galapagos the thirteen species of finches were never found altogether. Instead, a few lived on one island and a few on another. Why should the finches in the Galapagos play the part in nature's scheme that elsewhere was taken by birds of quite different kinds? Why should the different islands be inhabited by different species of finches, when the climate and vegetation were just about the same? (CLASS DISCUSSION--one species taken and modified for different niches.)

He found similar questions among other life forms. For instance, the tortoises, too, differed from island to island.

An official told Darwin that he could determine which island a tortoise came from merely by glancing at the shape and color of its shell. The birds and reptiles were apparently related to those of South America, yet plainly different from them. Mollusks (shellfish) showed the same relationships and differences. Why, on these islands, are the species so similar and yet dissimilar? (CLASS DISCUSSION.)

Day nine:

Anticipatory Set: Place, on the board pictures of a coral atoll being formed.

Behavioral Objectives:

BO-1: The student will be able to define an atoll.
Questions:
1. What is coral? What are its living conditions?
2. What is an atoll?
3. Where would one likely find an atoll?

BO-2: The student will be able to identify early theories of atoll formation.
Questions:
1. How did Lyell think atolls were formed?

BO-3: The student will be able to discuss the process used by Darwin and FitzRoy and how they developed the atoll theory.
Questions:
1. How did Darwin and FitzRoy test for coral?
2. What seemed so strange to Darwin about the atolls?
3. How did Darwin develop the atoll theory? What evidence did he use to support this theory?

Teaching example: Solve the hypothetical problem related to atoll formation. Suppose a reef existed around a small sinking island. (Draw a diagram on the board for class discussion. Correct it, if necessary, with different color chalk.)

Summary: Discuss how evolution would effect this process.

Reading #3

EARTHQUAKES AND CORAL

The Keeling Islands are a group of atolls. Many such ring-shaped islands, made of crumbled coral, are found in the tropical parts of the Pacific. Coral is a kind of limestone secreted by small, soft-bodied animals called polyps. A mass of coral is covered with hundreds of polyps, each living in its own little stony cavity. Although different species secrete corals of distinctive shapes and colors, all require warm water and do not grow at depths much below 120 feet.

Earlier geologists like Lyell believed that these rings had formed on the tops of extinct volcanic craters when the peaks of the volcanoes had risen near enough to the surface of the sea. Darwin and FitzRoy went out in a boat and dropped a sounding lead over the side, with a lump of tallow in its base, to find out what sort of ground lay beneath the waves. In shallow water, they hauled the lead up with imprints of coral animals in the tallow. As the water got deeper, the coral animals became scarcer, until there was nothing on the tallow but sand.

It seemed strange to Darwin that, all over the Pacific, hundreds of submarine volcanoes should have risen to within 120 feet of the surface and then stopped growing. Moreover, not all atolls were circular like volcanic craters; some were long and narrow. (At this point call for CLASS DISCUSSION--ask for a possible solution.) As he

rowed about the lagoons and dropped the sounding lead, a possible solution occurred to him: What if these peaks had been sinking instead of rising? If the mountains in South America had risen, why should not the South Sea Islands have sunk?

Little by little, the answer occurred to Darwin. Along the shores of continents and large islands in the tropics--for example, the Great Barrier Reef of Australia--coral reefs built themselves up parallel to the shore. They did not extend right up to the land, because close to shore the fresh water and silt, carried into these waters by the runoff from rainstorms, killed the corals. The distance of the reef from shore varied from a few yards to over a hundred miles, depending on local conditions. Where a river emptied into the sea, there was a gap in the reef through which ships could sail because fresh water with its silt flowed farther out to sea, destroying coral animals in its path.

Now, suppose that such a reef existed around a small, sinking island. (CLASS DISCUSSION on possible results.) As the island sank, its land mass would shrink, and the reef would extend itself inward towards the remnant of the island. As the island's foundation sank beneath them, the coral animals of the reef would continue to build it up to the surface of the ocean. When the original island disappeared, a ring of coral--an atoll--would be left. The original island could sink to a great depth; but, so long as it did not sink too fast for the corals to raise their reefs above it, the reefs

would continue to break the surface of the sea. (Draw a diagram on the board for class discussion. Correct it, if necessary, with different color chalk.)

Day ten:

Anticipatory Set: Display a picture of a female and male ape. Ask the question: What other current life forms may share with the apes a similar origin in their earlier evolutionary development?

Behavioral Objectives:

BO-1: The student will be able to identify the evidence leading scientists to believe that humans and apes may have had a similar evolutionary development.

Questions:

1. What are the physiological evidences?
2. What are the psychological evidences?
3. Are there any similarities between human ears and the ears of apes? (Have students observe ears.)
4. Why are Homo sapiens grouped by scientists with the Old World monkeys?

Summary: Discuss why some segments of society would not like to be descended from apes. What are some of their arguments on the origin of Homo sapiens?

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QUIZ #5:

1. What is an atoll?

2. How did Darwin and FitzRoy test for coral atolls?

3. How is an atoll formed? Be brief.

HOMO SAPIENS AND EVOLUTION

Homo sapiens have the same bones and organs as other mammals, the differences being in the size and shape of each organ. Homo sapiens reproduce the same way; the females nurse their young the same way; the young develop and grow the same way; and they even suffer from diseases and parasites of the same kinds.

Great though the mental differences are between Homo sapiens and their hairy cousins, they are differences of degree, not of kind. Animals show the same emotions as Homo sapiens; they display love, hatred, fear, anger, and shame just as Homo sapiens do. Animals even succumb to the same anti-social traits as Homo sapiens. Many monkeys have a strong taste for tea, coffee, and spirituous liquors; they will also smoke tobacco with pleasure. Apes and monkeys, moreover, show the beginnings of the ability to reason in which Homo sapiens take such pride.

Bodies of Homo sapiens also retain vestigial organs, which testify to their primitive ancestry. Homo sapiens have a rudimentary tail, with four bones and four muscles for wagging it. They have a little point on the folded rim of the ear, a remnant of the point on the ears of lower mammals. (Have students look at their neighbors' ears and find this point.) Homo sapiens are grouped with the Old World primates because these apes and monkeys differ in the structure of their skulls from the New World monkeys. It is believed that the split between the two took place long ago, early in the Age of Mammals.

Day eleven:

Anticipatory Set: Suppose a giraffe's ancestors roamed a section of Africa, and several exceptionally tall animals had the advantages of being able to browse on higher foliage. How could the taller beasts pass on their useful quality?

Behavioral Objectives:

BO-1: The student will exhibit an understanding of Mendel's experiments.

Questions:

1. What plant did Mendel work with?
2. What was his "surprising" discovery?
3. What happened when the second generation was inbred?
4. What did other plant breeders notice?
5. What was Mendel's profound discovery?
6. How can a quality be passed on invisibly?
7. What is <u>dominant</u> and <u>recessive</u>?

Summary: How did Mendel's discovery answer the question of the giraffe?

NAME: _____

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QUIZ #6:

1. What evidence do we have that leads scientists to believe that man is related to apes?

Reading #5

SOLVING THE PUZZLES OF EVOLUTION: JOHANN GREGOR MENDEL

From 1854 to 1868, Mendel taught at a school near Brunn and tested some of his scientific ideas by breeding garden peas. From this experiment, he made an unexpected discovery. When he crossed tall peas with short peas, he did not get plants of medium height, as one might expect. The peas of the second generation were all tall hybrids.

But, when he interbred the peas of the second generation, Mendel obtained a surprising mixture of offspring. One quarter of this third generation were tall peas that behaved, when interbred, like any other tall peas of pure ancestry. Another quarter were short peas, which behaved like any other short peas.

The remaining peas--half of the third generation--were tall peas, which acted just like hybrids, the mixed peas of the second generation. When interbred, they gave rise to plants of three different kinds, in the ratio of 1:2:1. That is: one quarter were true-breeding tall peas, one half were tall but did not breed true, and one quarter were true-breeding short peas.

Other plant breeders, including Darwin, had noticed that similar variations occurred in simple numerical proportions. He crossed many other plant varieties to check his findings. He learned that such characters as the colors and shapes of flowers, seeds, pods, stems, and leaves of peas followed the same rules of inheritance as did the

height of the plants. Each part followed the rules independently, so that a host of different combinations of sizes, shapes, and colors could be obtained in the same species of plant.

Darwin also bred peas, but being, as he cheerfully admitted, no mathematician, the statistical importance of the numbers of offspring of each kind eluded him. Mendel had not only made a profound discovery, he had also solved a problem to which Darwin had never found the answer. The problem was: Suppose the giraffe's ancestors roamed a section of Africa, and one exceptionally tall animal had the advantage of being able to browse on higher foliage. How could that tall beast pass on its useful quality? (CLASS DISCUSSION--remind them of past answers. In light of Mendel, what do they now think the answer is?)

The prevailing theory, before Mendel's work became known, was that two tall animals would rarely exist at the same time, meet, and mate. So the tall ancestral giraffe would be forced to mate with ordinary animals, and the good effects of its added stature would soon be lost. Scientists wrongly believed that if a six-foot-tall animal mated with a five-foot-tall beast, then the offspring, getting half its ancestry from its shorter parent, would tend to split the difference and be five and a half feet tall. The succeeding generation would be shorter yet, until the tallness character practically disappeared.

Mendel also found that a quality can be passed on invisibly, so that it bobs up in a later generation. His tall but non-true-

breeding peas possessed a hidden quality of shortness, which they had inherited from their short parents and could pass on to their offspring. These peas, Mendel reasoned, had inherited both a tallness-character and a shortness-character, one from each parent. The tallness-character, however, fixed the height of the plant. As Mendel expressed it, tallness was dominant over shortness, which he called a recessive character.

Day twelve:

Behavioral Objectives:

BO-1: The student will be able to state the difference between an isolated and nonisolated population.

Questions:

1. What is an isolated population?
2. What is a nonisolated population?

BO-2: The student will be able to define genetic drift. He will be able to explain how it would affect an isolated and a nonisolated population.

Questions:

1. What is genetic drift?
2. What role does genetic drift play in evolution?
3. How would genetic drift affect a nonisolated population? An isolated population?

Summary: How would genetic drift affect eugenics? Would there be more problems in the long run?

Homework: Develop an outline for the paper to be written in class tomorrow on evolution and eugenics. What are your feelings and opinions on the subject? Be able to support your arguments.

**If possible, have a geneticist come in and talk to the students before assigning the paper.

NAME: _____

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CLASS PERIOD: _____

QUIZ #7

1. With what did Mendel experiment?

2. How did Mendel's contribution help answer Darwin's question on giraffes?

3. Give an example of how a trait can be "invisibly" passed to another generation.

Reading #6

ISOLATED VS. NONISOLATED POPULATIONS

If, in a large population of human beings--say 10,000 people who are free to move about and choose mates within the group--one fifth, or 2,000, carry the gene causing blue eyes, this fraction will remain about the same through many generations since blue eyes confer no special advantage or disadvantage. In any one generation, the proportion of blue-eyed genes may rise a little above one fifth, and in another it may sink a little below; but, following the laws of probability, it will never vary very far from that figure.

If, on the other hand, in a completely isolated group of ten human beings, one fifth--two people--carry the blue-eyed gene, and they both perish in a canoe accident, the genetic makeup of the group would be drastically changed for good. The smaller the group the greater is the effect of genetic drift. Since it is important only to small groups, genetic drift plays but a minor role in evolution. It might, for instance, account for all the differences among the tortoises of the various islands of the Galapagos Islands, where conditions are too much alike to account for these variations in any other way. (CLASS DISCUSSION--genetic drift and its effects on a population. How would genetic drift affect eugenics?)

NAME: _____

DATE: _____

CLASS PERIOD: _____

QUIZ #8:

1. What is the meaning of isolated and nonisolated populations?

2. How can genetic drift affect a population? What are the criteria.

Day thirteen:

Anticipatory Set: Put all kinds of questions on the board at random. Use those that were used in class discussion. For example:

1. List the individuals who tried to calculate the age of the earth.
2. How do Lamarck's and Darwin's ideas compare?
3. How does evolution affect us today?
4. What is eugenics?
5. How are evolution and eugenics related, if at all?
6. What would the deciding factor be in the number of children allowed: The parents' IQ, wealth, social position, or physical attractiveness?
7. What is species modification? Why does it occur?
8. What is an atoll?
9. Why are Homo sagiens grouped by scientists with the Old World monkeys?
10. What is dominant and recessive?
11. What is genetic drift?
12. What role does genetic drift play in evolution?

Behavioral Objectives:

BO-1: The student will be able to communicate, in written form, what he or she has learned in this unit of instruction about eugenics and evolution. He or she will be able to distinguish between facts about evolution and beliefs about evolution.