The interaction between heredity and environment

Environment, Ecology

ASSIGN BUSTER

Have you ever wondered why people resemble their parents? The answer to this and other questions about inheritance lies in a specialized branch of biology called genetics. Geneticist found that most aspects of life have a hereditary basis and that many traits can appear in more than one form. For instance, human beings have blond, or red, or brown, or black hair. They may have one of several different types of blood, one or several colors of skin. Their ear lobes may be attached or free. They may or may not be able to manufacture certain enzymes.

Some of these traits are much more important to the life of the individual than others, but all of them are hereditary. The geneticist is interested not only in the traits of man but in those of all other organisms as well. The study of inheritance depends on the differences as well as the similarities between parents and offspring over several generations. Heredity is very complex, and a geneticist cannot possibly analyze all the traits of an organism at once. Instead, he studies only a few traits at a time. Many other traits are present.

As the geneticists work out the solution to each hereditary mystery, the geneticist must not forget that all organisms live in a complexenvironment. The environment may affect the degree to which a hereditary trait develops. The geneticist must try to find out which of the many parts of the environment may affect his results. The factors must be kept as constant as possible by using controlled experiments. Only then can he tell that the differences observed are due to heredity. Heredity determines what an organism may become, not what it will become. What an organism becomes depends on both its heredity and environment.

The modernscienceof genetics started with the work of Gregor Mendel. He found that a certain factor in a plant cell determined the traits the plant would have. Thirty years after his discovery this determines was given the name gene. Of the traits Mendel studied, he called dominant those at showed up in the offspring and recessive those The question I will ask is: how much of the variability observed between different individuals is due to hereditary differences between them, and how much to differences in the environments under which the individuals developed?

In most organisms, including man, genetics information is transmitted from mother to daughter cells and from one generation to the next by deoxyribonucleic acid (DNA). Knowledge of the heredity or inheritance of plants and animals is important in many phases of our life. The question I will ask is: How much of the variability observed between different individuals is due to hereditary differences between them, and how much to differences in the environments under which the individuals developed?

The purpose of designing a unit on ? Heredity And Environment? is to help students learn more about themselves. They will learn why they develop into the kind of individual they are. The unit will discuss heredity traits and environmental conditions, chromosomes, DNA, studies of identical twins, and several diseases linked to heredity and environment. The students will do some hands on activities by constructing a model which represents DNA. They will explore plants with the exact same heredity and plants with different heredity.

They will change the conditions in the environment to see the way the plant organisms with the same heredity may develop differently in different environments and why organisms with different heredity develop in the matter in which they do. Heredity is not the only thing that effects development. The environment also has an important effect. The unit can be taught to students in grades five through eight. The science and math teachers are encouraged to use a team teaching approach. Other features that will be included in the unit are content, lesson plans, resources, reading list and a bibliography.

Genes and DNA DNA, short for deoxyribonucleic acid, makes up the genes that transmits hereditary traits. The DNA molecule looks like a long, twisted rope ladder. This is called the double helix. The ladder is made up of two coiled strands with rungs between them. The rungs are composed of pairs of chemicals in different combinations. Each combination carries instructions like the dot and dashes of the Morse Code. Each gene in the body is a DNA section with full set of instructions for guiding the formation of just one particular protein. The different proteins made by the genes direct the body? functions throughout a person? s life. DNA is made of six parts: a sugar, a mineral (phosphate), and four special chemicals called bases. These bases are represented as A; T; C; and G. Sugar and phosphate form the chains, or sides, of the staircase. The A; G; C and T bases form the steps. See figure 1. Each step is made of two pieces, which are always paired the same way. The A base always pairs with the T base. And the G base always pairs with the C base. Figure 1. DNA Structure (figure available in print form) DNA Reproduces Itself Two new identical DNAs are immediately formed.

The A, G, C, and T bases on each chain attract loose bases found floating within the nucleus. Ts attract As and Cs attract Gs. The two new DNAs are just like the original DNA. Each strand directs the synthesis of a complementary strand. The replication of DNA is the key to heredity, the passing of traits from parents to offspring. DNA replication results in the formation of new reproductive cells. It also results in the formation of new cells, which is important for the growth of an organism. See Fig. 2. Figure 2. (figure available in print form) Watson-Crick?

DNA Replication-Redrawn from version in Levine, Genetics, Holt, Rinehart, Winston, 1968. Chromosomes Genes and chromosomes provide the genetic link between generations. Chromosomes are strands of DNA and protein found in the nucleus of virtually every cell, but with few exceptions seen only during the process of cell division. The number of chromosomes in a cell is characteristic of the species. Some have very few, whereas others may have more than a hundred. Ordinarily, every cell in the body of an organism contains the same number of chromosomes.

The most important exception is found in the case of gametes where half the usual number is found. Human beings have 46 chromosomes in each cell, with the exception of the spermatozoa in males and the ova in females, each of which has 23 chromosomes. Human chromosomes occur in pairs, the total 46 consisting of 23 pairs; 22 pairs of autosomes which are non-sex determining chromosomes. The member of a pair are essentially identical, with the exception of sex chromosomes in males, and each pair is different from any other pair. Plants and animals inherit chromosomes from their parents.

Each plant and animal cell has a set of chromosomes. Chromosomes, then, control the heredity of an organism. They carry the blueprint that determines what kind of organism will develop. Some Relationship Between Heredity And Environment Organisms can transmit some hereditary conditions to their offspring even if the parents do not show the trait. In the small, familiar fruit fly. Drosophila, there is a hereditary trait in which the wings curl up sharply if the files are raised at a temperature of 25 degrees Celsius. If, however, the files are raised at a lower temperature, such as 16 degrees Celsius then the trait rarely appears.

The wings seem to be straight, and the flies look normal. The genetic trait is there, however, and will reappear in the next generation if the temperature returns to 25 degrees Celsius. See fig. 3. A similar type of inheritance appears in plants. In some types of corn the kernels will remain yellow until they are exposed to sunlight. Once exposed, the kernels become various shades of red and purple. Some traits do not appear to be affected by the environment. One of the first hereditary traits studied in humans was polydactyly. An individual with polydactyly has more than ten figures or toes.

See fig. 4. This trait does not seem to be affected by the environment at all. Other human traits like color blindness, baldness, blood type, skin color, the ability to taste certain substances, the presence or absence of hairs on the middle of the fingers, and free or attached ear lobes do not seem to be influenced by the environment. (figure available in print form) Figure 3? This diagram shows how temperature affects curly-wing trait in Drosophila. If the third generation of curly-winged flies had been raised in 16? C environment.

Source: Redrawn from Biological Science, Houghton, Mifflin Co. , Boston, 1963, p. 379. Figure 4? An example of polydactyly. Extra digits on either hands or feet are almost always abnormal in structure. (figure available in print form) Source: Biological Science, Houghton Mifflin Co. , Boston, 1963. p. 380. A common cited example of an environmental effect on phenotype is the coloring of Siamese Cats, although these cats have a genotype for dark fur, the enzymes that produce the dark coloring function best at temperatures below the normal body temperature of the cat.

Siamese Cats are noted for the dark markings on their ears, nose, paws, tail, and all areas that have a low body temperature. If the hair on the cat? s belly is shaved and an ice pack is applied, the replacement hair will be dark. Likewise, a shaved tail, kept at higher than normal temperatures, would soon be covered with light colored fur. These changes are temporary, however, unless the ice pack or heat source is maintained permanently. The most celebrated effect of an environmental agent directly affecting the unborn, is that produced by the rubella virus.

This German measles virus is capable of crossing the placenta from mother to child, and the prenatal infection, if it occurs early enough, may result in deafness and other damage to the child. Similarly, maternal infection with the rare protozoan parasite Toxoplasma can cause serious congenital defects in the fetus, and the same has been suspected for Asian influenza. Another environmental factor is anoxia. Anoxia is a natural hazard of childbirth, and in most cases the infant makes a normal adjustment to it.

When infants suffer from delayed respiration or asphyxia during birth, it is widely accepted that this is responsible for later difficulties such neurologic abnormalities. Warburton and Fraser have emphasized that the development of a fetus depends on a precise and extremely intricate system of interactions between two sets of hereditary factors and two environments, all acting at the same time on the growing baby. The mother and the fetus each have their own environment and their own genotype.