Course Learning Outcomes for Unit III

1. Evaluate concepts of basic biological sciences.
   1.1 Apply scientific processes to real-world situations.
   1.2 Apply extensions of Mendelien genetics.

2. Explain processes that occur across various levels of organization.
   2.1 Describe protein synthesis.

8. Apply lab simulations and activities for further scientific understanding.

Reading Assignment

Chapter 8: DNA Detective: Complex Patterns of Inheritance and DNA Fingerprinting

Chapter 9: Genetically Modified Organisms: Gene Expression, Mutation, and Cloning

Unit Lesson

This is a very important unit because all aspects of this unit directly affect you and your family. This unit includes materials from Chapters 8 and 9. In Chapter 8, “DNA Detective”, you will discover more about genetics and what determines the gender of offspring. You have probably heard tales from history where a male became outraged when his spouse did not provide a son to carry on his name. Is it the mother’s fault? Who determines the gender? Is it the mother or is it the father?

We have all watched crime shows on TV and read about criminal investigations in the newspaper. How can scientists take a single shred of evidence and determine who did or did not commit a crime. In TV shows, the crime is investigated, the evidence is analyzed, and the crime is solved. Is it really that easy? Is DNA fingerprinting a time-consuming process? You will also learn how forensic scientists can take a sample of DNA and figure out who committed a crime, and you will learn how paternity can be determined. With this new advancement in technology, could “the perfect crime” ever be committed?

Before DNA was discovered and before it was used to solve crimes and determine paternity or identification, blood types were commonly used. Can we be 100% certain when we only use blood types? Every person, besides identical twins or multiples, has their own unique set of DNA; however, there are only four main blood groups. You will learn whether or not parents that have type A and B blood can give birth to a child with type O. You will learn about which blood types can receive and give blood to others. What happens if you are given the wrong type of blood? You will conduct a virtual lab in your homework in which you will have to type the blood of three patients, and you will have to give them a transfusion of the right type of blood. Make sure you pay close attention when reading the chapters—you do not want to “kill” your virtual patients.

Would you eat a GMO? Would you want to be cloned? Should research be conducted using stem cells? Some of these words and terms sound more like science fiction instead of science. Well, a few years ago they were. Today, these terms are commonly used in society. We hear them on the news. We hear politicians use them. Should we vote for that person? In Chapter 9, you will learn who is involved in genetic engineering, how and what types of organisms are being genetically engineered, and what effects modifying various organisms may have on the environment. Should we genetically modify plants and animals? Will it hurt us if we eat animals that receive hormones or whose genes have been altered? What is a clone? Will they act like me?

Will they look just like me? Are developing embryos being destroyed just to perform stem cell research? You will find the answers to these and many more questions in this unit.

In 2013, the world population was 7,024,070,434. Do we have room for more? Can we provide food on a global scale to our current population? With increasing population, there is a need for more food. When populations increase, the land available to grow food decreases because people have to have a place to live. How do we provide enough food for more people when we have less land? Scientists think they have an answer: GMO. A GMO is a genetically modified organism. Scientists have figured out how to modify the genes of plants, animals, and other organisms. How does this help with our food supply? If we can genetically modify a corn plant to grow double or triple the number of ears per stalk, we can decrease the amount of land required to grow corn. If we can genetically modify a plant to be pest resistant, we can use fewer pesticides, and we will have a larger yield. Is this the best solution? Are there consequences to genetically modifying an organism? What about a GMH (genetically modified human)?

In 1990, a 13-year project called the Human Genome Project began. It was coordinated by the U.S. Department of Energy and the National Institutes of Health. The project goals included (Enterprise Ireland, n.d.):

- identify all the approximately 20,000-25,000 genes in human DNA,
- determine the sequences of the three billion chemical base pairs that make up human DNA,
- store this information in databases,
- improve tools for data analysis,
- transfer related technologies to the private sector, and
- address the ethical, legal, and social issues (ELSI) that may arise from the project.

A genome includes the entire DNA in an organism. If the DNA could be identified, this could result in being able to cure diseases, understand evolution, and even clone a human. At first glance, this would seem great; however, there are numerous ethical issues to consider.

- Who should have access to all of the information, and how should the information be used?
- Who, should regulate and own the information?
- How does genetic information affect members of society?
- How reliable is the information, and how safe is genetic testing?
- Should genetic testing be conducted when there is no cure for the genetic disorder or disease?

Where do we draw the line? Yes, we all wish for optimal health for our own body, our family, our friends, and everyone; however, when is enough, enough? Can we support an increasing population if more people live longer?

The current population is a result of natural births and natural deaths. Considering that our population is increasing, should we even be thinking about cloning? What is a clone? Does cloning occur naturally? Would a cloned person be able to think, feel, cry, love, and so on, or would they simply be a robot that exists in a laboratory?

Cloning is a hot topic in today's society. We hear about cloned cells, cloned plants, cloned animals, and cloned bacteria, and there is even mention of cloning humans? Do we need cloned humans? What about cloned organs? Do you know anyone that has ever received an organ transplant or needed one? How great would it be to have extra organs housed in a laboratory just in case we need them later in life? What about stem cells? What is a stem cell?

Over the past few years, you may have noticed that stem cells are a pretty interesting and controversial topic. Most people have an opinion of whether or not we should be conducting stem cell research; however, few people actually understand what stem cells are, where they are harvested, and what they can be used for. You will learn about the significance of stem cell research. You will learn about the various types of stem cells, how they are formed, and about some of the current issues concerning stem cell research.

If you have never seen the movies *Gattaca* (1997) or *A.I.* (Artificial Intelligence, 2001), you should watch them. If you watched *Gattaca* in 1997, you probably thought it was far-fetched. A great deal of what was represented in the movie can now be accomplished. Considering the science fiction movies that you watch today, it could be scary to think that some of those things could really happen in the future.

This unit includes a great deal of information about current topics. Technology is moving at a tremendous pace, and technology no longer just includes things like computers, automobiles, and other machines. Technology includes humans. We are humans, and we need to understand how advancements in technology affects us, other organisms, and the environment in which we live.

Reference

Enterprise Ireland. (n.d.) Getting personal: Biotechnology moving towards tailor-made medicines. *Science and Technology in Action, 2*(37). Retrieved from http://editions.sciencetechnologyaction.com/lessons/2/37/EI-Biotech-Lesson.pdf

Suggested Reading

Please see the chapter presentation links in Blackboard to download and view Chapter 8 and 9 presentations. This will summarize and reinforce the information from these chapters in your textbook.

Learning Activities (Nongraded)

Paternity Testing Using VNTR Polymorphisms

Estimated time to complete: This activity will take approximately 10–15 minutes.

Introduction: This exercise provides a practical but simplified demonstration of how variable number tandem repeat (VNTR) polymorphisms are used to determine paternity. It also gives you a chance to see what those rows of bars on an electrophoresis gel represent. The exercise uses only three VNTR loci; forensic analysis typically looks at a minimum of 10 loci, and often many more.

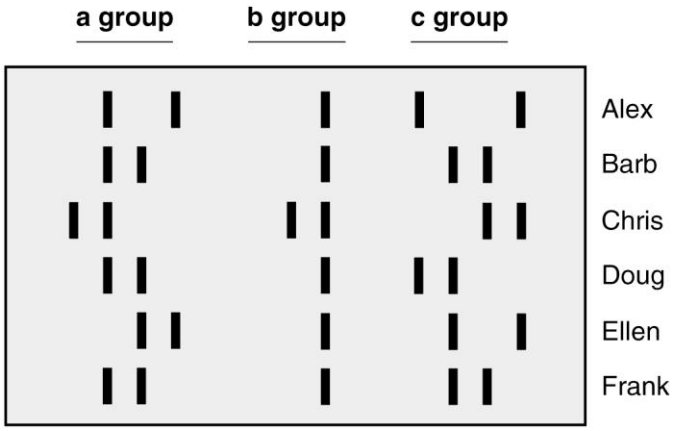
Procedures:

1. Review VNTRs in Chapter 8 of the textbook. Half of a child's chromosomes and alleles that a child carries are inherited from each of his or her parents.

2. In the example provided, you can see that the bands are clustered into three groups: The b group shows everyone being homozygous for a single allele, except for Chris. Everyone is heterozygous for the a and c groups.

3. Consider the following scenario:
   - Alex and Barb are a separated couple.
   - Chris is Barb's new boyfriend.
   - Doug and Ellen are children born to Alex and Barb when they were still together.
   - Frank was born after Alex and Barb separated. Barb wants Alex to pay child support.
   - Alex does not believe that Frank is his child. He asked for a genetic analysis to support his case.

This gel shows the results of the VNTR analysis for Alex, Barb, Chris, and the children:



1. Can Alex be Frank's father? _____ Why, or why not?

2. Can Chris be Frank's father? _____ Why, or why not?

3. Does this test prove conclusively that either man is Frank's father? _____ Why, or why not?

4. Does this test prove conclusively that either man is excluded from being Frank's father? _____ Why, or why not?

Answer key:

1. Can Alex be Frank's father? Why, or why not? No, Frank does not have a c-group fragment that could have come from Alex.

2. Can Chris be Frank's father? Why, or why not? Yes, Frank has a VNTR pattern consistent with inheriting one of each group from Barb and the other from Chris.

3. Does this test prove conclusively that either man is Frank's father? No, it does not exclude others who might have a similar VNTR pattern to Chris.

4. Does this test prove conclusively that either man is excluded from being Frank's father? Why, or why not? Not completely, Alex could possibly be Frank's father if a mutation changed the VNTR pattern that Frank inherited from Alex.

Nongraded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.