TITLE:

Cloning, DNA, Stem Cells

PREPAREDBY:

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DCPS STANDARDS:

7.4.3

Explain that in those cells that contain a nucleus, the nucleus is the main repository for genetic information

7.5.1

Describe that heredity is the passage of information for developing and maintaining the organism's body from one generation to another, and that genes are the basic units of heredity; genes are made of DNA, consisting of very long molecules located in the chromosomes of each cell.

7.5.3

Explain how, in sexual reproduction, a single reproductive cell from a female merges with a specialized cell from a male to make a fertilized egg. This carries genetic information from both parental gametes and multiplies to form the complete organism.

GOALS:

1. Scholars will understand how genetic material is used in cloning techniques.
2. Scholars will learn how genetic material is inherited.
3. Scholars will learn the location of genetic material in the cell and its structure.

OBJECTIVES:

1. Scholars will differentiate between myths and truths of cloning
2. Scholars will predict how the body will respond to cloned cells (accept or reject)
3. Scholars will debate the advantages and disadvantages of cloning
4. Scholars will define DNA, chromosome, somatic cell nuclear transfer, artificial twinning

PREREQUISITE KNOWLEDGE:

Students need to have knowledge of the cell and its organelles. They should know that DNA is the genetic material and that it is located in the nucleus. Also, students need to have an understanding of antigens and

antibodies (self vs. non-self) in order to understand the benefit of cloning for therapeutic purposes. Background information on cloning was obtained from:

What is Cloning?

Have you ever wished you could have a clone of yourself to do homework while you hit the skate park or went out with your friends?

Imagine if you could really do that. Where would you start?

What exactly is cloning?

Cloning is the creation of an organism that is an exact genetic copy of another. This means that every single bit of DNA is the same between the two!

You might not believe it, but there are human clones among us right now. They weren't made in a lab, though: they're identical twins, created naturally. Below, we'll see how natural identical twins relate to modern cloning technologies.

How is cloning done?

You may have first heard of cloning when Dolly the Sheep showed up on the scene in 1997. Cloning technologies have been around for much longer than Dolly, though.

How does one go about making an exact genetic copy of an organism? There are a couple of ways to do this: artificial embryo twinning and somatic cell nuclear transfer. How do these processes differ?

1. Artificial Embryo Twinning

Artificial embryo twinning is the relatively low-tech version of cloning. As the name suggests, this technology mimics the natural process of creating identical twins.
In nature, twins occur just after fertilization of an egg cell by a sperm cell. In rare cases, when the resulting fertilized egg, called a zygote, tries to divide into a two-celled embryo, the two cells separate. Each cell continues dividing on its own, ultimately developing into a separate individual within the mother. Since the two cells came from the same zygote, the resulting individuals are genetically identical.

Artificial embryo twinning uses the same approach, but it occurs in a Petri dish instead of in the mother's body. This is accomplished by manually separating a very early embryo into individual cells, and then allowing each cell to divide and develop on its own. The resulting embryos are placed into a surrogate mother, where they are carried to term and delivered. Again, since all the embryos came from the same zygote, they are genetically identical.

2. Somatic Cell Nuclear Transfer

Somatic cell nuclear transfer, (SCNT) uses a different approach than artificial embryo twinning, but it produces the same result: an exact clone, or genetic copy, of an individual. This was the method used to create Dolly the Sheep.

What does SCNT mean? Let's take it apart:

Somatic cell: A somatic cell is any cell in the body other than the two types of reproductive cells, sperm and egg. These are also called germ cells. In mammals, every somatic cell has two complete sets of chromosomes, whereas the germ cells only have one complete set.

Nuclear: The nucleus is like the cell's brain. It's an enclosed compartment that contains all the information that cells need to form an organism. This information comes in the form of DNA. It's the differences in our DNA that make each of us unique.

Transfer: Moving an object from one place to another.

To make Dolly, researchers isolated a **somatic cell** from an adult female sheep. Next, they **transferred** the **nucleus** from that cell to an egg cell from which the nucleus had been removed. After a couple of chemical tweaks, the egg cell, with its new nucleus, was behaving just like a freshly fertilized zygote. It developed into an embryo, which was implanted into a surrogate mother and carried to term.

The lamb, Dolly, was an exact genetic replica of the adult female sheep that donated the somatic cell nucleus to the egg. She was the first-ever mammal to be cloned from an adult somatic cell.

How does SCNT differ from the natural way of making an embryo?

The fertilization of an egg by a sperm and the SCNT cloning method both result in the same thing: a dividing ball of cells, called an embryo. So what exactly is the difference between these methods?

An embryo is composed of cells that contain two complete sets of chromosomes. The difference between fertilization and SCNT lies in where those two sets originated.

In fertilization, the sperm and egg both contain one set of chromosomes. When the sperm and egg join, the resulting zygote ends up with two sets - one from the father (sperm) and one from the mother (egg).

In SCNT, the egg cell's single set of chromosomes is removed. It is replaced by the nucleus from a somatic cell, which already contains two complete sets of chromosomes. Therefore, in the resulting embryo, both sets of chromosomes come from the somatic cell.

ESSENTIAL QUESTIONS:

1. What is cloning and how is it done?
2. What are the benefits of cloning? What are the risks?

LABORATORY MATERIALS:

Video showing the process of artificial twinning and somatic cell nuclear transfer

ACTIVITY

Students will be presented with a PowerPoint showing the process of cloning and some of the background behind it. They will observe video of cloning techniques and make predictions about the results of the experiments.

DIFFERENTIATING INSTRUCTION:

English Language Limited students should have no problems with this activity.

RATIONALE:

This activity is designed to raise awareness about cloning and stem cells. It serves as enrichment to their knowledge of the cell structure and DNA as the genetic material.

EVALUATION AND ASSESMENT:

Students will be assessed based on their ability to make predictions about cloning techniques as well as their ability to distinguish between cloning myths and truths.