uBEATS Teacher's Guide:

Cloning

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Cloning" module for grades 11-12.

To help students develop the knowledge necessary for an incredible future in health care, we created UNMC Building Excellence in Academics Through STEM (uBEATS), an online health science resource for Nebraska students.

UNMC uBEATS modules are short (15 minutes or less), interactive online health science modules to supplement curriculum taught in grades 6 – 12. These do not replace curriculum but are a supplement for teachers and students incorporating evidence-based information and UNMC expert guided material. Each module is chunked into sections with formative and summative assessments with immediate feedback provided.

Tips on how to utilize uBEATS modules:

- Internet access is required to view uBEATS modules.
- For those who have access to one-to-one technology, modules can be used in or outside of the classroom as a topic introduction, extension, or review.
- For classrooms without individual student devices modules can be used in whole group instruction. Formative assessment questions can use the teacher's preferred call and response method and summative assessment questions can be displayed on the board and answered individually by students or printed and distributed to students after viewing the module.

Objectives

- Define the meaning of artificial human cloning.
- Distinguish between therapeutic cloning and reproductive cloning.
- Contrast two cloning methods: somatic-cell nuclear transfer and pluripotent stem cell induction.

ubeats@unmc.edu

Introduction

How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world?

Science fiction and misinformation can make the thought of cloning seem scary, but it is a fact that cloning already happens frequently in nature. Asexual reproduction produces offspring that are genetically identical to the parent. Creatures such as bacteria, hydra, aspen trees and whiptail lizards can produce offspring without combining genetic material from two parents. And even when sexual reproduction unites a sperm and an egg to create a fertilized egg (a zygote), sometimes natural twinning results in clones, which are identical twins that have the same genomes.

In this module you will learn about efforts to artificially produce clones. Artificial cloning is the kind of cloning that is attractive to science fiction and misinformation. However, this module explains the real scientific efforts to duplicate genetic instructions for medical and research purposes and discusses some of the controversies that accompany cloning research.

Prior Knowledge

Before beginning this module, the student should understand the Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning.

Core Idea ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World. A Framework for K-12 Education

- All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of both people and the natural environment. The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.
- Thus technology use varies from region to region and over time. Technologies that are beneficial for a certain purpose may later be seen to have impacts (e.g., health-related, environmental) that were not foreseen. In such cases, new regulations on use or new technologies (to mitigate the impacts or eliminate them) may be required.

Science and Engineering Practices **NGSS**

- Analyzing and interpreting data
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Crosscutting Concepts **NGSS**

- Patterns
- Cause and effect

Key Terms/Vocabulary

Genome, clone, sperm, egg, zygote, sexual, asexual, genetic cloning, therapeutic cloning, reproductive cloning, somatic cell, nucleus, mitosis, morula, totipotent, pluripotent, embryo, stem cell, trophoblast, differentiation, restriction enzyme, insulin, plasmid, bacterium, cytoplasm, uterus, organism, in-vitro fertilization, transcription factors.

Science Standards

Nebraska's College and Career Ready Standards for Science 2017 Nebraska Science Standards

Engineering in Health Sciences: SC.HSP.17.1.B

- Design a solution to a complex real-world problem affecting body systems that can be solved through engineering. Solutions could include prosthetics, mobility enhancement, engineered body parts, treatment processes, and disease control.

Extensions of the lesson

- To help students become more familiar with the Key Terms of this module, the teacher can use the vocabulary list for a classroom Word Wall or integrate the vocabulary into classroom word games during review sessions.
- The National Human Genome Research Institute (NHGRI) offers a Cloning Fact Sheet.
- An explanation of gene cloning is presented by the University of Nebraska-Lincoln: Gene Cloning.
- For a lab activity, use an online search engine to find "high school lab activity stem cells."
- To help the students see personal relevance, it is suggested that they have a private family conversation about In-vitro fertilization (IVF).
- The teacher may need to address student misconceptions by emphasizing these important concepts:
  - Identical twins are natural human clones, but artificial human cloning is controversial.
  - The controversy over human cloning has passionate advocates on both sides.
  - If an embryo is created artificially through cloning methods, that embryo can either be allowed to develop into a new complete organism (reproductive cloning, which has never been done with humans) or the embryo's stem cells can be harvested (for therapeutic cloning and stem cell research).
  - Some states have passed laws that either prohibit human cloning or prohibit the use of state funds for cloning or cloning research. See State Laws on Human Cloning.

- Both reproductive cloning and therapeutic cloning are well-established practices in animal research.
- Stem cells can be found in various somatic cells throughout the body--such stem cells are multipotent, meaning they can produce several different cell types. For example, stem cells in bone marrow can give rise to a variety of different blood cells, including red cells, white cells and platelets. However, blood stem cells are not pluripotent because they cannot differentiate into nerve cells, muscle cells, etc.
- If human cloning ever happens, the clone will not be a “carbon copy” of its donor. Although both organisms would have identical DNA, the clone would develop from the embryo stage. For example, if a 24-year-old athlete wanted a clone, the clone would forever be 24 years younger than the athlete would. Furthermore, during that clone’s development, unique experiences would make the clone unique.

Enrichment

- For information about Healthcare Career Opportunities, see UNMC Health Career Book.
- To make connections in your community, contact science programs at local universities, university extension services, breeders' associations, local hospitals, healthcare clinics, nurses, doctors.
- Encourage students to check current events for the latest news regarding cloning and/or stem cell research.