

## Teacher Guide: Cloning in Focus Web Quest

### ACTIVITY OVERVIEW

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**Abstract:**

Students navigate the *Cloning in Focus* module to learn about cloning while completing a web quest.

**Module:**

Cloning in Focus

**Prior Knowledge Needed:**

None

**Key Concepts:**

Cloning, embryo twinning, somatic cell nuclear transfer

**Materials:**

Computers with Internet access, student handouts

**Appropriate For:**

Ages: 12 - 18

USA grades: 7 - 12

**Prep Time:**

15 minutes

**Class Time:**

30 minutes

**Activity Overview Web Address:**

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=cloningquest>

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Other activities in the *Cloning in Focus* module can be found at:

<http://gslc.genetics.utah.edu/teachers/tindex/>

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### I. PEDAGOGY

#### A. Learning Objectives

- Students will learn about different cloning techniques.
- Students will learn about the history of cloning research.
- Students will learn about potential uses of cloning technology.

#### B. Teaching Strategies

##### 1. Timeline

- 2-3 weeks before activity:
  - Reserve a computer lab with Internet access
- 1 day before activity:
  - Make copies of the student pages (S-1 – S-2), one for each student
- Day of activity:
  - Take students to the computer lab and pass out student handouts for them to complete

##### 2. Classroom Implementation

- Hand out the *Cloning in Focus* web quest (student pages S-1 – S-2)
- Bring your class to the computer lab and have them log on to:  
<http://gslc.genetics.utah.edu/> and click on the *Cloning in Focus* module.
- Instruct your students to use this module to answer the questions on the *Cloning in Focus (pages S-1 – S-2)* web quest.

##### 3. Assessment Suggestions

- Use the completed web quest as an assessment.

##### 4. Extensions

- See Additional Resources for more activities covering cloning.

### II. ADDITIONAL RESOURCES

#### A. Activity Resources linked from the online Activity Overview at:

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=cloningquest>

- Website: Classroom Activities Index: *Cloning in Focus* - Online and Print-and-Go™ activities covering cloning techniques, history and bioethics.

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### III. MATERIALS

#### A. Detailed Materials List

- Computers with Internet access
- Student handouts (S-1 – S-2)

### IV. STANDARDS

#### A. U.S. National Science Education Standards

##### Grades 5-8:

- Content Standard C: Life Science - Reproduction and Heredity; every organism requires a set of instructions for specifying its traits.
- Content Standard F: Science in Personal and Social Perspectives - Science and Technology in Society; social needs, attitudes and values influence the direction of technological development.

##### Grades 9-12:

- Content Standard C: The Molecular Basis of Heredity; in all organisms, the instructions for specifying the characteristics of the organism are carried in DNA.
- Content Standard F: Science in Personal and Social Perspectives - Science and Technology in Local, National, and Global Challenges; science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen. The latter involves human decisions about the use of knowledge.
- Content Standard F: Science in Personal and Social Perspectives - Science and Technology in Local, National, and Global Challenges; progress in science and technology can be affected by social issues and challenges.
- Content Standard G: History and Nature of Science - Historical Perspectives; usually, changes in science occur as small modifications in extant knowledge.

#### B. AAAS Benchmarks for Science Literacy

##### Grades 6-8:

- The Nature of Technology: Issues in Technology - societies influence what aspects of technology are developed and how these are used. People control technology (as well as science) and are responsible for its effects.

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### Grades 9-12:

- The Human Organism: Human Development - the development and use of technologies to maintain, prolong, sustain, or terminate life raise social, moral, ethical, and legal issues.
- The Nature of Technology: Issues in Technology - social and economic forces strongly influence which technologies will be developed and used. Which will prevail is affected by many factors, such as personal values, consumer acceptance, patent laws, the availability of risk capital, the federal budget, local and national regulations, media attention, economic competition, and tax incentives.
- The Designed World: Health Technology - knowledge of genetics is opening whole new fields of health care. In diagnosis, mapping of genetic instructions in cells makes it possible to detect defective genes that may lead to poor health. In treatment, substances from genetically engineered organisms may reduce the cost and side effects of replacing missing body chemicals.
- The Designed World: Health Technology - biotechnology has contributed to health improvement in many ways, but its cost and application have led to a variety of controversial social and ethical issues.

### **C. Utah Secondary Science Core Curriculum**

#### *Intended Learning Outcomes for Ninth to Twelfth Grade Science*

Students will:

5. Demonstrate Awareness of Social and Historical Aspects of Science
  - a. Cite examples of how science affects human life.
6. Demonstrate Understanding of the Nature of Science
  - i. Understand that science and technology may raise ethical issues for which science, by itself, does not provide solutions.

### Biology (9-12)

STANDARD IV: Students will understand that genetic information coded in DNA is passed from parents to offspring by sexual and asexual reproduction. The basic structure of DNA is the same in all living things. Changes in DNA may alter genetic expression.

Objective 3: Explain how the structure and replication of DNA are essential to heredity and protein synthesis.

- Research, report, and debate genetic technologies that may improve the quality of life (e.g., genetic engineering, cloning, gene splicing).

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### V. CREDITS

**Activity created by:**

Molly Malone, Genetic Science Learning Center

Pete Anderson, Genetic Science Learning Center (illustrations)

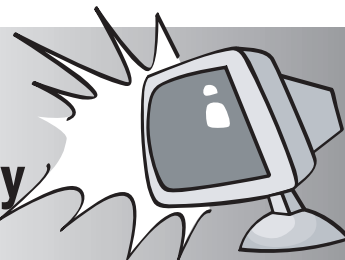
**Funding:**

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# Cloning in Focus

## Web Quest - Answer Key



**Log on to: <http://gslc.genetics.utah.edu/units/cloning> and explore this module to find the answers to the questions below.**

1. Compare and contrast the following methods of Cloning:

	<b>Embryo Twinning</b>	<b>Somatic Cell Nuclear Transfer</b>
<b>Similarities</b>	<p><i>Answers may include:</i></p> <ul style="list-style-type: none"> <li>• an exact genetic copy is made</li> <li>• a surrogate mother is used</li> </ul>	<p><i>Answers may include:</i></p> <ul style="list-style-type: none"> <li>• an exact genetic copy is made</li> <li>• a surrogate mother is used</li> </ul>
<b>Differences</b>	<ul style="list-style-type: none"> <li>• cells of an embryo are manually divided</li> </ul>	<ul style="list-style-type: none"> <li>• genetic information is inserted into an enucleated egg cell</li> </ul>

2. How does Somatic Cell Nuclear Transfer (SCNT) differ from the natural way of making an embryo?

*A complete set of chromosomes comes from one source (the somatic cell nucleus) as opposed to two different sources (egg and sperm).*

3. “Click and Clone” to create a mouse clone.

Write the steps involved in cloning your mouse below( continue on back if necessary):

*Answers will vary but should include: 1) isolating donor somatic and egg cells, 2) enucleating the egg cell, 3) transferring the nucleus of the somatic cell into the enucleated egg cell, 4)chemically stimulating the new cell to divide until it becomes a morula, 5) implanting the morula into a surrogate mother.*

What color coat will your mouse clone have?

*Brown*

4. Briefly explain the medical reasons for cloning.

*Cloning animal models of disease, cloning stem cells for research, “pharming” for drug production*

5. List reasons, other than medical, for cloning.

*Reviving endangered or extinct species, reproducing a deceased pet, cloning humans*

6. What was the first organism to be cloned? How was it done? In what year did this take place?

*The first organism to be cloned was a sea urchin, in 1885. The procedure was to shake a two-celled embryo until the cells separated.*

7. What was the first organism to be cloned using nuclear transfer?

*A frog.*

8. How were the first cows cloned?

*An electric shock was used to fuse embryonic cells to enucleated egg cells.*

9. What organism helped prove that cloning could be done using cells from males (up to this point all cloning experiments had been carried out using cells from females)? What was the organism's name?

*A mouse named Fibro.*

10. In what year was the first human clone created and what stage of development did it reach before it stopped growing?

*In 2001 Advanced Cell Technology (ACT) produced the first cloned human embryo. The embryo reached the six cell stage and then stopped dividing.*

11. Give at least two reasons why a clone might not necessarily be a carbon copy of the donor organism.

*Answers might include: different environmental factors, the organisms would be raised differently, personalities and behaviors would be different, differences in gene activation, X inactivation*

Name the two animals (they are the same species) that serve as an example.

*The cats Rainbow and CC.*

12. Test your knowledge in "Is it Cloning or Not?". What was your score and prize?

*Answers will vary.*

13. List and briefly explain the risks of cloning.

*High failure rate - compatibility problems between the egg and nucleus, developmental problems, or problems with the pregnancy itself affect the success rate of cloning.*

*Problems during later development - larger organs than normal can lead to problems  
Abnormal gene expression patterns - transferred nuclei must be reprogrammed to behave as if they were early embryonic cells following the normal pattern of gene activation.*

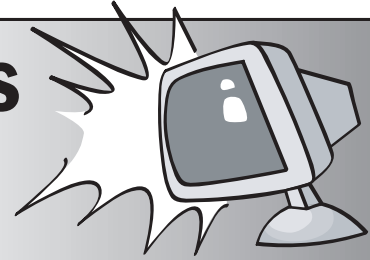
*Telomeric differences - the normal process of aging shortens the telomere lengths of chromosomes. This may have an affect on cloning if older organisms are used as somatic cell donors.*

14. Choose one of the questions raised in "What Are Some Issues In Cloning?". Write the question and your response to it below.

*Answers will vary.*



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Similarities		
Differences		

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