FUTURELAB+

BIOMED

Behind the Scenes of Scientific Breakthroughs

Therapeutic Cloning and Embryonic Stem Cells

Developed in partnership with:

Discovery Education and Ignited

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This document is separated into two sections, For Teachers [T] *and* Student Resources [S]*, which can be printed independently.*

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Cover Image
This is a conceptual illustration of genetic engineering.

BIOMED / BEHIND THE SCENES OF SCIENTIFIC BREAKTHROUGHS

Therapeutic Cloning and Embryonic Stem Cells

DRIVING QUESTION

How can the use of therapeutic cloning and embryonic stem cells improve human health?

OVERVIEW

Cloning may invoke images of sheep and science fiction films, but the work being done in labs is both very real and very promising for individuals suffering from diseases for which there is no cure. Stem cell therapies have long been thought of as a possible treatment for degenerative illnesses, such as Parkinson's and multiple sclerosis, and permanent injuries caused by spinal cord damage. However, the ethics of stem cell usage has complicated and long delayed work in this field. Now, through therapeutic cloning, there may be a new pathway to moving stem cell therapies out of the lab and into the medical setting.

Students will begin this lesson by being introduced to the uses of cloning. They will then learn about the different types of stem cells and their potential applications. The class will explore the problems with reproductive cloning, engage in a cloning interactive, explore therapeutic cloning as a means of producing tissue and organs, and complete their study by creating a presentation on the ethics of cloning.

ACTIVITY DURATION

Five class sessions
(45 minutes each)

ESSENTIAL QUESTIONS

What may be some of the ethical considerations when discussing cloning?

How might cloning and stem cell research be interrelated?

How might cloning extend the human lifespan?

OBJECTIVES

Students will be able to:

Investigate potential applications of cloning.

Differentiate varieties of stem cells.

Compare reproductive and therapeutic cloning.

Explore different applications of tissue regeneration.

Create a presentation on the ethical considerations regarding cloning.

BACKGROUND INFORMATION

Did you know that cloning happens in nature all the time? For instance, bacteria can make exact copies of themselves through a process called asexual reproduction. Identical twins are another type of clone that form when one fertilized egg splits into two embryos with almost exactly the same DNA. Humans have also taken on the challenge of cloning organisms artificially, with varying degrees of success. The three types of artificial cloning practiced today are gene cloning, reproductive cloning, and therapeutic cloning. Gene cloning reproduces DNA sequences, reproductive cloning creates copies of whole organisms, and therapeutic cloning produces embryonic stem cells for experiments that are aimed at replacing damaged tissue, such as spinal cord tissue. There is heated debate about each of the three types of cloning, and the issues related to cloning have pushed the scientific community to think about what constitutes life. Furthermore, some scientists fear that it is dangerous to work with cells that proliferate rapidly, as embryonic stem cells do, because they may cause conditions similar to cancer. As students learn about the techniques and issues surrounding cloning, they are exploring a current frontier of bioscience.

Materials

- **Cloning Walk Around Survey**
- **Cloning One-Pager Rubric**
- **The History of Cloning Timeline Template**
- **The History of Cloning Rubric**
- **Stem Cell Scenario Capture Sheet**
- **Therapeutic vs Reproductive Cloning T-Chart**
- **Therapeutic vs Reproductive Cloning Written Response**
- **Therapeutic vs Reproductive Cloning Venn Diagram**
- **Reproductive Cloning vs Therapeutic Cloning Rubric**
- **Cloning Facts Presentation Guidelines**
- **Cloning Facts Presentation Rubric**
- **Lab Grown Organoids Capture Sheet**
- **Biotechnology Professions Recruitment Poster Rubric**
- **Ethic of Cloning Presentation Rubric**
- **Sticky Notes**
- **Design Journal**

Pedagogical Framing

Instructional materials are designed to meet national education and industry standards to focus on in-demand skills needed across the full product development life cycle—from molecule to medicine—which will also expose students and educators to the breadth of education and career pathways across biotechnology.

Through this collection, educators are equipped with strategies to engage students from diverse racial, ethnic, and cultural groups, providing them with quality, equitable, and liberating educational experiences that validate and affirm student identity.

Units are designed to be problem-based and focus on workforce skill development to empower students with the knowledge and tools to be the change in reducing health disparities in communities.

SOCIAL-EMOTIONAL LEARNING

The topics covered in this lesson may lead to strong emotions from students as they can intersect with religious and cultural beliefs. Students will need to demonstrate self-awareness and emotional control when discussing these controversial topics. The topics of cloning and stem cell research may feel complicated and overwhelming for some and they may need to demonstrate perseverance when struggling through difficult topics. Students will create a presentation on the various ethical concerns that arise from cloning. As this may be a heated topic for some, students will need to demonstrate self-control and empathy, and actively work to maintain positive relationships in the face of different ideas.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

The lesson broaches complicated topics that will have very different cultural and religious beliefs associated with them. Students will respond to a video from the perspective of people suffering from severe disease and injury, which many cultures handle differently in terms of perception, privacy, and personal responses. Instruction in this lesson is often student driven, which allows for peer support and cooperation to share information and teach findings to others. Students will create a presentation on the ethical considerations of cloning, which may incorporate different students' cultural and religious beliefs and will require classmates to respond with understanding and empathy.

COMPUTATIONAL THINKING PRACTICES

In this lesson, students use the computational thinking practice of analyzing data as they research stem cell therapies in order to decompose problems by comparing reproductive and therapeutic cloning. They collect data and apply their knowledge of reproductive cloning to develop a proposed scenario that details their findings. Finally, students work in groups to analyze ethical dilemmas surrounding the topic of cloning and apply their decomposition skills to present their arguments.

CONNECTION TO THE PRODUCT LIFE CYCLE

This lesson focuses on the **discovery** and **development** phases of the product life cycle of medicine. On Days 1 and 2, the class will learn about the variety of stem cells available for research and their benefits and limitations as well as different research applications for cloning. Students will be learning about different laboratory techniques related to cloning and stem cell usage while engaging in an interactive where they reenact cloning through somatic nuclear cell transfer technique on Day 3. On Day 4, the lesson will also include healthcare applications for these therapies that are currently in development or at different levels of clinical testing.

Have you ever wondered…

Is human cloning possible?

While theoretically possible, it is thought that there has yet to be any incidents of human cloning. Most cloning efforts have been concentrated on cells to produce tissues and organs, or animal reproductive cloning with applications to agriculture and scientific inquiry.

Do all stem cells come from embryonic tissue?

No, in fact stem cells can be found in adult tissues as well. However, adult tissues are not able to develop into any type of tissue like embryonic stem cells can, but only those related to their location. There are also induced pluripotent cells, which use cloning techniques to create more versatile stem cells from ordinary cells like skin and blood cells.

MAKE CONNECTIONS!

How does this connect to the larger unit storyline?

The use of cloning and stem cell therapies offers potential treatments and cures to individuals suffering from many previously untreatable illnesses and injuries. When we look at expanding and improving the human lifespan, we must consider emerging technologies, especially those with as much potential as cloning and stem cell therapies. Developing these therapies has been complicated by the expansive ethical considerations that are so intricately tied to this research. However, with the development of induced pluripotent stem cells and through cloning techniques, these developments may move to the forefront of reproductive and reconstructive treatments.

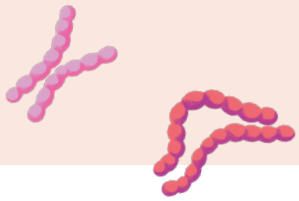
How does this connect to careers?

Developmental biologists study how single cells work together, develop, and differentiate to form complex tissues, organs, and organisms. They may conduct research on cell signaling that produces structural changes, or errors that cause developmental and physical disabilities.

Molecular biologists work to understand how molecules and cells function to impact the larger organism. They look at how cooperation between molecules and cells leads to changes and gives direction to the formation and function of tissues, organs, and organisms.

How does this connect to our world?

Cloning and stem cell therapies are widely contested scientific lines of inquiry. They are riddled with ethical dilemmas and provoke strong emotions. Perhaps part of their controversy is that they are generally misunderstood by the public. By learning more about these emerging therapies, students will be better prepared for future therapies that may be applicable to them and their loved ones. They will be able to make informed decisions that weigh the potential benefits with ethical concerns.



Day 1

LEARNING OUTCOMES

Students will be able to:

Investigate potential applications of cloning.

COMPUTATIONAL THINKING IN ACTION

Interviews are an important way to practice the computational thinking strategy of collecting data. This is data that is not specific or measurable in nature. Rather, it allows for complexity and is a useful tool for collecting feedback or recounting experiences.

Procedure

Teacher Note > *In this session, students will activate prior learning by performing a walk around survey on the topic of cloning. Next, they will read about different applications for cloning and complete a one-pager before creating a timeline detailing the history of cloning.*

Whole Group (10 minutes)

1 Explain to students that, in this lesson, they will be learning about cloning and stem cells. The students will begin by completing a walk around survey using the *Cloning Walk Around Survey* guide. Students will interview each other about any prior knowledge they may have on the topics of cloning and stem cell research. The interviewer will record the interviewee's name and three facts.

2 At the five-minute mark, the teacher will signal for students to stop their interviews and transition to sharing the information they have collected. This can be done by pairing with other students and discussing, or through whole class discussion.

Small Group (15 minutes)

Teacher Note > *Distribute the Cloning One-Pager Rubric to students and review the guidelines with them.*

1 In small groups of three or four, students will take turns reading aloud a section of *Why Clone?*, while the rest of the group follows along silently. Each student will then select a section of the *Why Clone?* article that interests them the most and create a one-pager on the information in that section.

Teacher Note > *You may want to provide students with a template for the one-pager, such as these tips. Allowing students to add doodles, questions, and connections will create a space for more creativity and greater retention.*

2 When completed, students can post their one-pagers around the classroom, for other students to review.

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Day 1

Continued

Procedure

COMPUTATIONAL THINKING IN ACTION

Here, students use the computational thinking strategy of abstraction as they key-in on the most significant details. They use algorithmic thinking in laying out a timeline about the history of cloning.

Small Group (20 minutes)

1	In groups of four, have students read *The History of Cloning*.
2	Distribute the History of Cloning Rubric and review it with students. Then, they will create a timeline featuring eight to ten events they found most significant using *The History of Cloning Timeline Template*. Each event highlighted should include a brief synopsis and image or symbol.

Teacher Note > *Have students reflect on how their thoughts or ideas about cloning or stem cell research has changed, since the beginning of the class period. Do their thoughts differ from their initial thoughts shared during the "Cloning Walk Around Survey?" Have students record their thoughts and ideas in their journal.*

Day 2

LEARNING OUTCOMES

Students will be able to:

Create research scenarios involving stem cell therapies.

Compare reproductive and therapeutic cloning.

Differentiate among varieties of stem cells.

Procedure

Teacher Note > *Students will investigate sources and applications for stem cells in addition to comparing reproductive and therapeutic cloning.*

Whole Group (5 minutes):

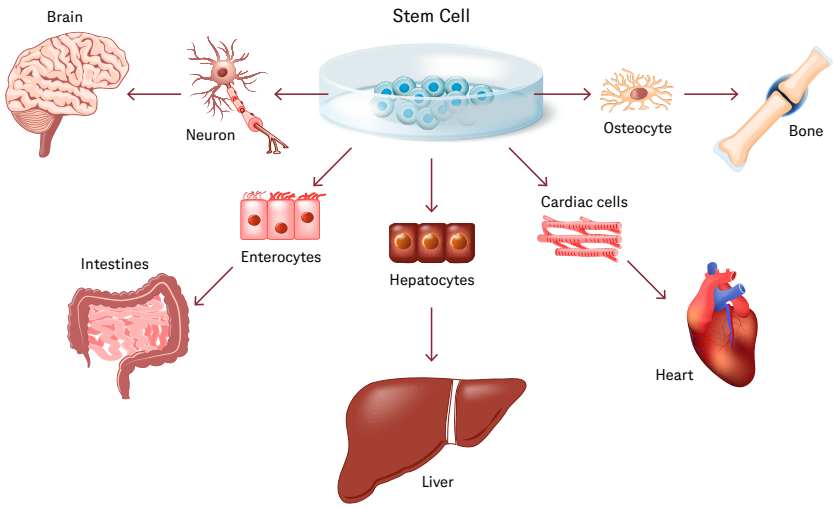
1 Introduce students to stem cell therapies by projecting this video on *Reversing Spinal Paralysis* (3:45 min).

2 Allow students to react to the video with a *Turn and Talk*. *What were their impressions? Does the video seem biased? Do they believe these are avenues of research that should be explored?*

Small Group (20 minutes)

1 In groups of three to four, students should each read a portion of the article *Alternate Stem Cell Sources* aloud, while the others follow along silently. After completing the article, groups should invent four scenarios that would require a specific type of stem cell using the *Stem Cell Scenario Capture Sheet, Part 1 and Part 2*—some scenarios may work with different types of stem cells.

2 After students create their scenarios, allow them to meet with other groups and swap. This allows students the opportunity to solve other scenarios and also receive feedback about their own.



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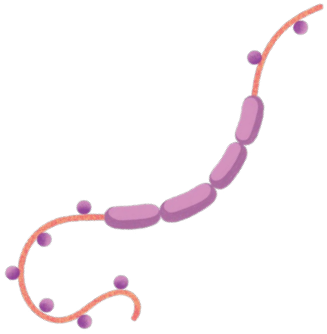
Day 2

Continued

Procedure



Small Group (10 minutes)

1 In the same groups, students will read an article discussing *Are Embryonic Stem Cells and Artificial Stem Cells Equivalent?*

2 Students will each write a question that can be answered by the reading on a piece of blank paper and ball it up. When all students have done so, they will have a *Snowball Fight*. Students will then collect one "snowball" near them. The teacher will call on students to read the question written on the paper and attempt to answer it.

Small Group (10 minutes)

Groups will read the "Reproductive Cloning," "Embryonic Stem Cells and Therapeutic Cloning," and "Therapeutic Cloning" sections of *Cloning and Stem Cells*. Groups will create a comparison of the two techniques using either a T-chart, written response, or Venn diagram. The groups will use the *Therapeutic vs Reproductive Cloning T-Chart*, *Therapeutic vs Reproductive Cloning Written Response*, or *Therapeutic vs Reproductive Cloning Venn Diagram* template for this task. Distribute a copy of the *Therapeutic vs Reproductive Cloning Rubric* for each group.

Day 3

LEARNING OUTCOMES

Students will be able to:

Apply their knowledge of reproductive cloning to a proposed scenario.

Conduct an interactive cloning exercise.

Procedure

Teacher Note > *The class will read an article that explains the struggles of reproductive cloning before creating a short presentation on basic cloning information. They will then use an online interactive to attempt to clone their own mouse.*

Small Group (30 minutes)

1	In pairs, students will read the article *Cow Gene Study Shows Why Most Clones Fail*.
2	After reading the article, introduce the following scenario—Some people want to clone winning racehorses to produce future winners. Have students discuss in their pairs whether they believe this to be a viable idea or not, and then call on groups to discuss their thoughts. Students may bring up the low success rate of clones or that racehorses are influenced by more than genetics (environment, diet, disease, etc.).
3	Teachers will distribute the *Cloning Facts Presentation Guidelines* and *Cloning Facts Presentation Rubric*. In the same pairs, students will explore the NIH site, *Cloning Fact Sheet*. Pairs will create a short online presentation to detail their findings.

Small Group (15 minutes)

In pairs, students will work to attempt Somatic Nuclear Cell Transfer to create their own clone of a mouse using *Click and Clone* .

Teacher Note > *As an exit ticket, ask students to reflect on their impression of cloning on a T-Chart with Pros and Cons. Also leave a space for students to share any questions they have.*

Day 4

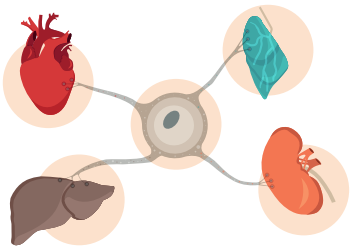
Procedure

LEARNING OUTCOMES

Students will be able to:

Explore different applications of tissue regeneration.

Research professions necessary for the construction of new organs.



Teacher Note > *Students will learn about cloning's potential for producing replacement tissues and organs. The class will complete a Jigsaw on different aspects of lab grown organoid research and research biotechnology careers that would be needed to work together in these endeavours—creating a recruitment poster to attract others to this field.*

Whole Group (5 minutes)

1 The teacher will introduce this video highlighting the work of developmental biologists and other researchers at UCSF, working to understand how organs and tissues are constructed and perhaps how, in the future, we could create these tissues ourselves—*Self-Organizing Multicellular Structures* (2:05 min).

2 The teacher will ask the class how they believe this research may eventually contribute to longer lifespans and healthier living. Have the students add any ideas they have to their **Design Journal**.

Whole Group (20 minutes)

1 Assign every student in class a number, one to six. Demonstrate how the article *Lab Grown Organoids Hold Promise for Patient Treatments* can be broken down in the six main sections including the introduction, but excluding the text and image box titled "The Bone Printer." Students will read their corresponding numbered section and write a summary in the *Lab Grown Organoids Capture Sheet*. Once students have been given some time to complete their sections, they may move around the room looking for students with other sections and quietly exchanging summaries.

Teacher Note > *Assigning sections could be random, or could be a means of differentiating the text for different leveled readers. Early finishers could additionally read the section on printing bone or explore the videos.*

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Day 4

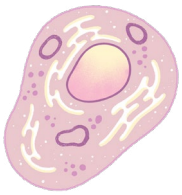
Continued

Procedure

INDUSTRY AND CAREER CONNECTION

Students will be learning how it takes a mixed group of professionals to achieve research goals. They will be researching a variety of biotechnology and computer science careers, and sharing their findings with the class and potentially the school.

Small Group (20 minutes)	
1	In the same groups, students should read the article and watch the associated video on *Engineering a Kidney*. The article features a team using nuclear medicine engineering, and computer science to 3D print functional kidney prototypes.
2	After reading, groups should brainstorm at least three biotech careers that would need to be involved with this group to help them achieve their goal of 3D printing organs and tissues.
3	Groups will select one career, research basic facts on the profession, and create a recruitment poster to encourage others to enter the field. Posters can be displayed in the classroom or hallways for others to see. Finished groups should peruse their classmates' posters and leave comments, questions, or compliments using sticky notes. Use the *Biotechnology Professions Recruitment Poster Rubric* as a guide.



Day 5

Procedure

LEARNING OUTCOMES

Students will be able to:

Create a presentation on the ethical considerations regarding cloning.

Teacher Note > *On this final day, students will research ethical considerations on the topic of cloning. Students will create a presentation to display their findings. Classmates will read and comment constructively on each other's presentations.*

Small Group (15 minutes)

In groups of three to four, students will explore this overview of college-led debate on *The Ethics of Human Cloning and Stem Cell Research*. This debate focused on four perspectives: science and biotechnology, religious, ethical, and legal.

Small Group (25 minutes)

1 Groups will conduct their own Internet research on the topic of ethics as it relates to cloning and stem cell usage. Each group member should assume one of the four perspectives overviewed in the article (biotechnology, religious, ethical, and legal). Groups should underline an argument or quote they believe essential or important to each perspective of this debate.

2 The teacher will distribute the *Ethics of Cloning Presentation Rubric* as a guide for students. In their groups, students will create a presentation to present their research on the ethical issues involved with cloning and stem cell usage. The presentation should include one to two pages focused on each perspective and a final slide citing resources.

Whole Group (5 minutes)

When presentations are completed, they should be posted online for the rest of the class to explore. This can be accomplished on sites, such as *Padlet* where presentations can be shared through links posted to a discussion board. Students should individually post on three presentations, commenting on points raised, expressing their personal opinions, or providing respectful responses to their peers.

Teacher Note > *This project also presents an opportunity to connect with families and communities. Teachers may also plan a presentation or project fair date for students to share with either peers and/or families/community partners.*

National Standards

Next Generation Science Standards

Science and Engineering Practices

Obtaining, evaluating, and communicating information

Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

Crosscutting Concepts

Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Scale, Proportion, and Quantity

Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Career and Technical Education (CTE)

A5.1

Use the Internet and World Wide Web to collect and share scientific information.

A5.2

Use a variety of methods, including literature searches in libraries, computer databases, and online for gathering background information, making observations, and collecting and organizing data.

Stem Cell Scenario Capture Sheet, Part 1

ANSWER KEY — **Do not share with students**

Directions

In your group, create four research scenarios that would require the use of stem cells. Record your scenarios below. On the second page, indicate which type of stem cells you believe would be most appropriate and why. When you are finished, find another group and swap only your scenario page. Are they able to determine which type of stem cells would be appropriate? Are you able to determine the stem cells for their scenarios?

	Scenario
1	A laboratory team is attempting to grow skin cells to aid burn patients.
2	Scientists are attempting to clone a mouse.
3	A research team wants to study how bone cells develop and mature.
4	Scientists want to study how cells differentiate and develop into complex organisms.

Stem Cell Scenario Capture Sheet, Part 2

ANSWER KEY — **Do not share with students**

Directions

Indicate which type of stem cells you believe would be most appropriate and why. When you're done, find another group and swap only your Stem Cell Scenario Capture Sheet, Part 1. Are they able to determine which type of stem cells would be appropriate? Are you able to solve their scenarios?

Scenario	What type of stem cell would be most appropriate?	Why is this type of stem cell most appropriate? *Note: Student scenarios will be unique. These responses are examples of the type of answers students should give.*
1	Adult	Adult stem cells can convert into one type of related tissues and are easier to acquire than embryonic stem cells, therefore they are appropriate for this scenario.
2	None	This would be an appropriate scenario for Somatic Cell Nuclear Transfer which requires a normal body cell and an egg cell into which DNA can be transferred.
3	Adult	Adult stem cells can convert into one type of related tissues and are easier to acquire than embryonic stem cells, therefore they are appropriate for this scenario.
4	Embryonic/Induced Pluripotent	Embryonic stem cells are capable of differentiating into any type of tissue and are often used when studying development. Induced pluripotent cells would also be appropriate as they behave in a similar manner to embryonic cells.

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Cloning Walk Around Survey

Directions
Interview other students on what they know (or think they know about cloning). Record three statements for each student you interview.

Student Interviewee	Statement 1	Statement 2	Statement 3

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Cloning One-Pager Rubric

	Score	3	2	1
	Appearance	One-pager takes up the entirety of the page. Includes color and design that makes it interesting to look at and eye catching.	One-pager takes up most of the page. Includes some color and design that makes it interesting to look at and eye catching.	One-pager lacks color or design, does not fill the page.
	Quotes	Quotes and phrases inform the observer about the topic.	Quotes or phrases inform the observer about the topic.	Does not include any quotes or phrases related to the reading.
	Images	Presentation enhanced by several images and designs that educate the audience about the reading.	Presentation enhanced by some images and designs that educate the audience about the reading.	No images or designs included.
	Personal Reaction	One-pager includes personal response to the reading, which demonstrates a solid understanding of the material and connects to the student's prior learning or experiences and opinions.	One-pager includes some personal response to the reading, which demonstrates a partial understanding of the material and connects to the student's prior learning or experiences and opinions.	One-pager does not include any personal response to the reading.
	Final Score			

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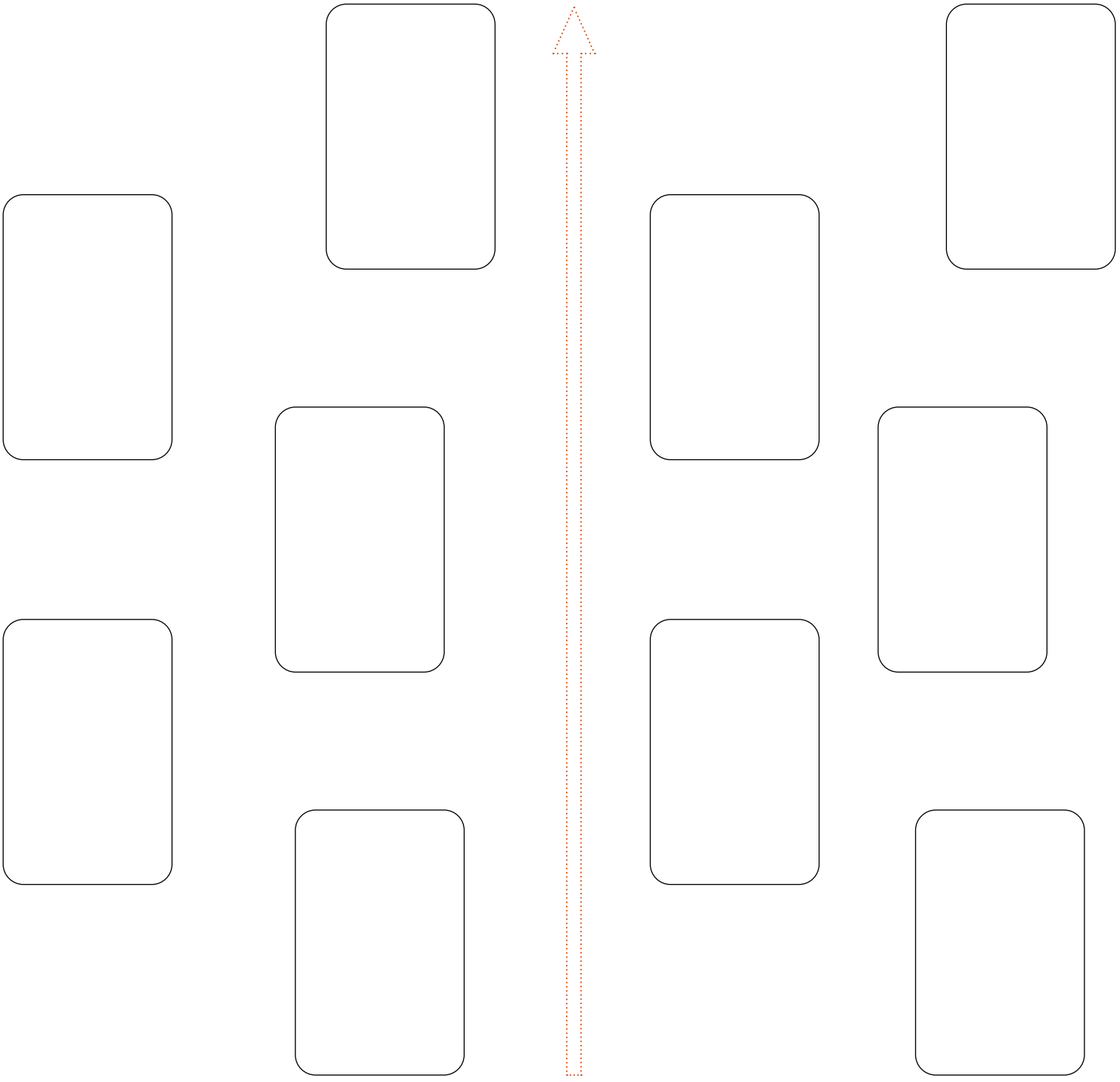
The History of Cloning Timeline Template

Directions

Create a timeline featuring eight to ten events you found most significant based on The History of Cloning article.



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The History of Cloning Rubric

	Score	3	2	1
	Events	8–10 important events selected, they are in correct sequential order.	Some events present but not 8–10, events may be out of order.	Missing most events.
	Synopsis	Every event includes a brief and accurate synopsis that highlights why this event was important.	Synopses present for some events, may not correctly characterize event.	No synopses included.
	Symbol/Image	Every event includes a symbol or image that characterizes the event.	Present for some events, may not be related to the event described.	No symbols or images included.
	Final Score			

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Stem Cell Scenario Capture Sheet, Part 1

Directions

In your group, create four research scenarios that would require the use of stem cells. Record your scenarios below. On the second page, indicate which type of stem cells you believe would be most appropriate and why. When you are finished, find another group and swap only your scenario page. Are they able to determine which type of stem cells would be appropriate? Are you able to determine the stem cells for their scenarios?

Scenario

1

2

3

4

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Stem Cell Scenario Capture Sheet, Part 2

Directions

Indicate which type of stem cells you believe would be most appropriate and why. When you're done, find another group and swap only your Stem Cell Scenario Capture Sheet, Part 1. Are they able to determine which type of stem cells would be appropriate? Are you able to solve their scenarios?

Scenario	What type of stem cell would be most appropriate?	Why is this type of stem cell most appropriate?
1		
2		
3		
4		

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Therapeutic vs Reproductive Cloning T-Chart

Directions
Create a comparison of the two types of cloning techniques after reading the assigned section of Cloning and Stem Cells.

Therapeutic Cloning	Reproductive Cloning

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Therapeutic vs Reproductive Cloning Written Response

Directions
Respond to the prompt after reading the assigned section of Cloning and Stem Cells.

1. How are therapeutic cloning and reproductive cloning similar?

2. How are therapeutic cloning and reproductive cloning different?

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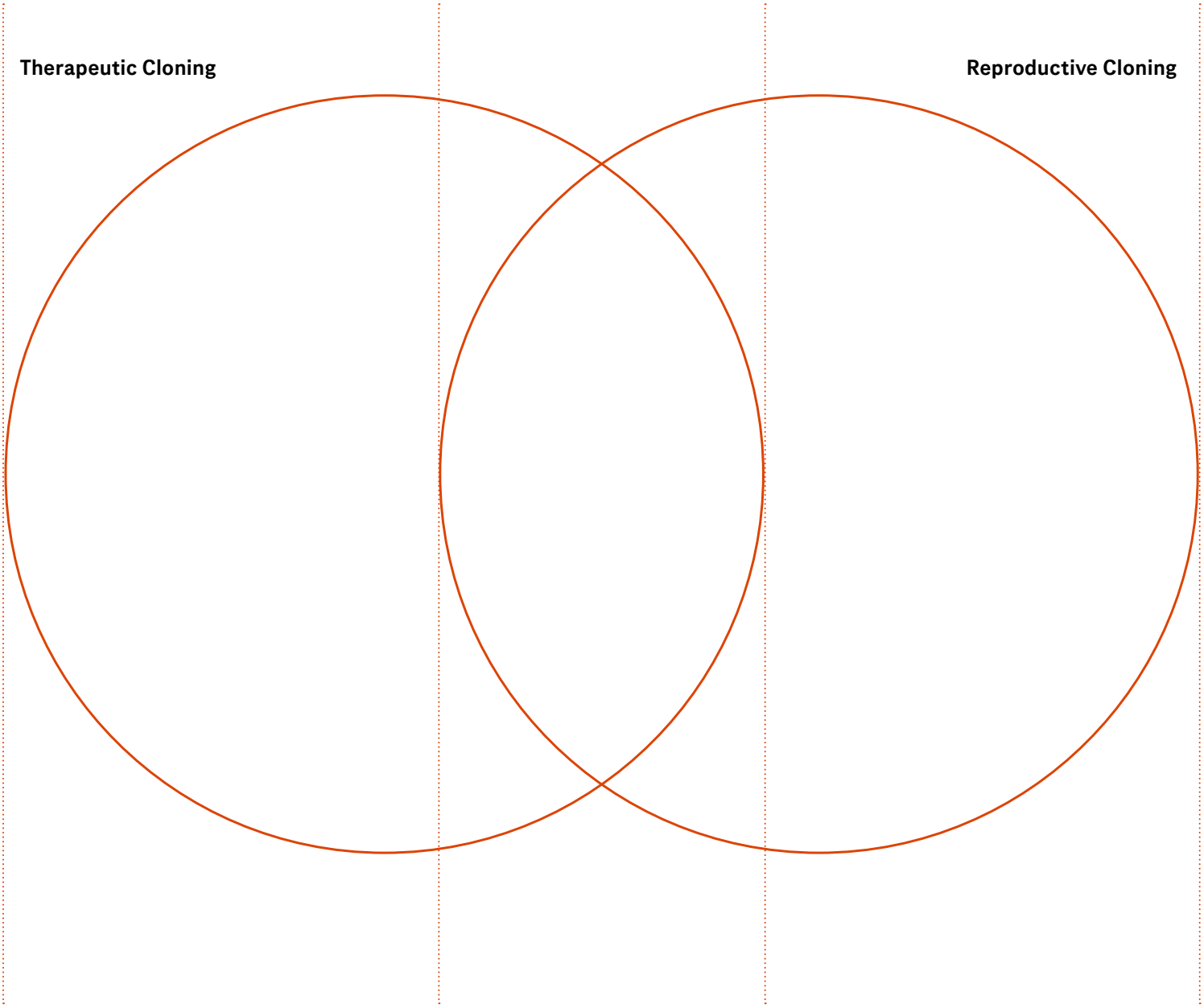
Therapeutic vs Reproductive Cloning Venn Diagram

Directions
Create a comparison of the two types of cloning techniques after reading the assigned section of Cloning and Stem Cells.



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Reproductive vs Therapeutic Cloning Rubric

	Score	3	2	1
	Appearance	Comparison is complete, easy to read and find important information.	Comparison is mostly complete but difficult to read or navigate.	Comparison is mostly incomplete.
	Reproductive Cloning	Thorough and accurate information on features specific to reproductive cloning.	Incomplete or partially incorrect information on what makes reproductive cloning unique.	No information on what makes reproductive cloning unique.
	Similarities	Thorough and accurate information on specific shared features.	Incomplete or partially incorrect information on similarities.	No information on similarities between the two types of cloning.
	Therapeutic Cloning	Thorough and accurate information on features specific to therapeutic cloning.	Incomplete or partially incorrect information on what makes therapeutic cloning unique.	No information on what makes therapeutic cloning unique.
	Final Score			

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Cloning Facts Presentation Guidelines

Directions
In your groups, review the *Cloning Fact Sheet* from the NIH. Use the site as a guide to create a short online presentation using PowerPoint, Google slides or similar programs. Your presentation should consist of five slides.

Slide	Description
1	Title Slide—should include a catchy title and the names of your group members.
2	What fact from the website surprised you the most and why?
3	What is the purpose of gene (molecular) cloning?
4	What aspect of cloning do you think is most misunderstood by the public?
5	Explain the ethical concerns related to cloning.

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Cloning Facts Presentation Rubric

Score	4	3	2	1
Presentation Elements	Presentation has a professional appearance and utilizes images and color. All prompts are answered and supported by numerous details and facts from the article.	Presentation is complete and some effort made toward including color, images, and design elements. All prompts are answered, but could use supporting details and facts from the article.	Presentation consists of two to three slides, but lacks color or design elements. Prompts answered but lack detail or supporting information from the article.	Pair did not complete a presentation of most aspects of the project.
Final Score				

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Lab Grown Organoids Capture Sheet

Directions
Write a summary for your assigned section. When finished, swap summaries with classmates until you have completed the rest of the reading.

Introduction:

Create:

Regenerate:

Maintain:

Reconstruct:

Consider:

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Biotechnology Professions Recruitment Poster Rubric

	Score	3	2	1
	Appearance	Engaging and eye-catching poster, utilizes color, design and images.	Attempts at design, images, or color. Empty space, feels incomplete.	Poster lacks key elements, design, and/or color.
	Explanation	Provides detailed explanation about how this profession contributes to biotechnology.	Explains a little about the role of this profession.	Does not explain the role of this profession.
	Skills	Clearly explains the skills required, both innate and learned, to function in this role.	Gives some skills necessary to function in this role.	Does not detail the skills required for this job.
	Education	Explain educational requirements for this role with detail—may include where one could find this training or continuing education requirements.	Minimal information on required education or how to join this profession.	Does not mention necessary schooling.
	Final Score			

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Ethics of Cloning Presentation Rubric

	Score	3	2	1
	Presentation	Presentation is complete, includes color and design, attractive to look at.	Presentation is partially completed, lacks design aspects or color.	Presentation is mostly incomplete.
	Biotechnology Perspective	Information for this perspective is complete and accurate, considers multiple points.	Information on this perspective present, but incomplete or partially inaccurate.	Biotechnology perspective missing.
	Religious Perspective	Information for this perspective is complete and accurate, considers multiple points.	Information on this perspective present, but incomplete or partially inaccurate.	Religious perspective missing.
	Ethical Perspective	Information for this perspective is complete and accurate, considers multiple points.	Information on this perspective present, but incomplete or partially inaccurate.	Ethical perspective missing.
	Legal Perspective	Information for this perspective is complete and accurate, considers multiple points.	Information on this perspective present, but incomplete or partially inaccurate.	Legal perspective missing.
	Resources	Resources are complete, from reputable sources, and well cited.	Some resources included, incomplete, incorrectly cited.	Resources missing.
	Final Score			

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