MS-LS1-1

Name:_____ Period:_____ Date:_____

Plant, Animal, and Bacteria Lab

Objectives:

1. Students will observe onion, cheek, and bacteria cells under the microscope.
2. Students will discover that onions and cheek tissue are made of cells.
3. Students will observe the size relationship between eukaryotic and prokaryotic cells.

Materials:

Light microscopes, 3 blank slides with cover slips, water and dropper, iodine stain, methylene blue stain, onion, a toothpick, and yogurt.

Key Ideas to keep in mind:

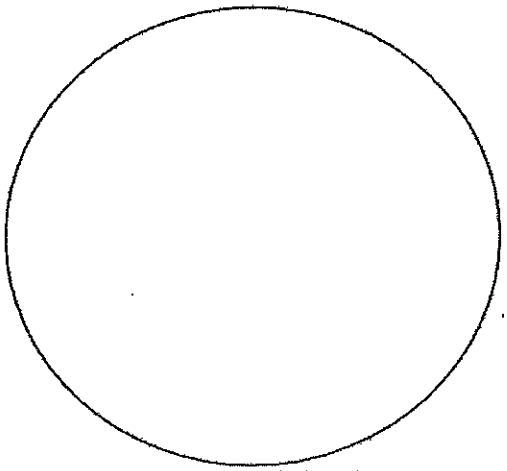
1. What exactly are cells and why are they so important to organisms?
2. How are plant and animal cells like parts of a building?
3. How are animal cells different from plant cells?
4. How are bacteria different from the plant and animal cells?

Procedures:

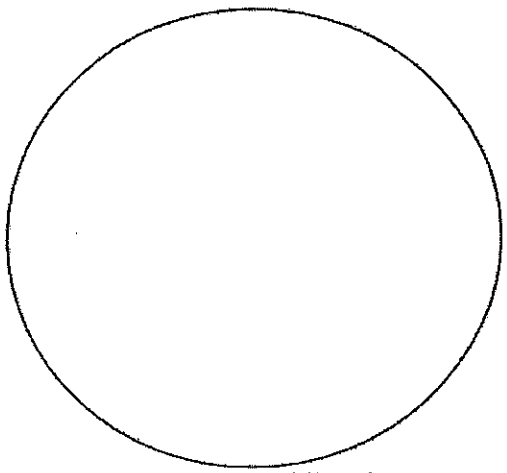
1. Go to one station at a time, and allow other groups space when waiting for a station.
2. Let every group member have a look with the microscope.
3. Make a drawing of what you see under low and high magnification.

Observations:

Plant Cells (Onion)



40x Magnification



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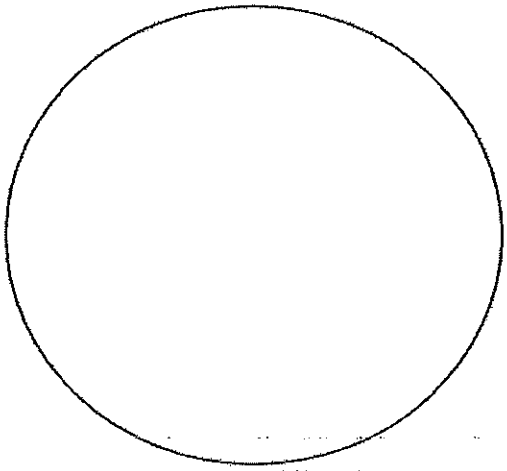
Animal Cells (Human Cheek)



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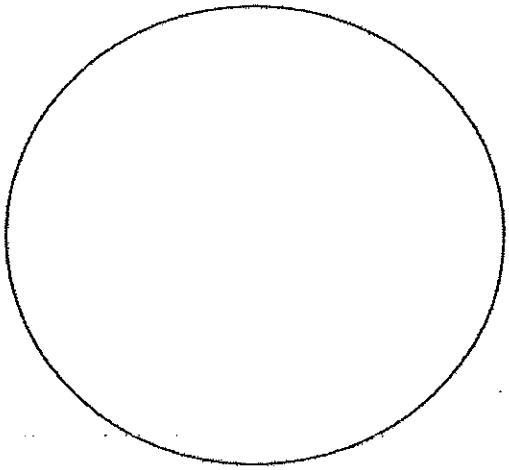

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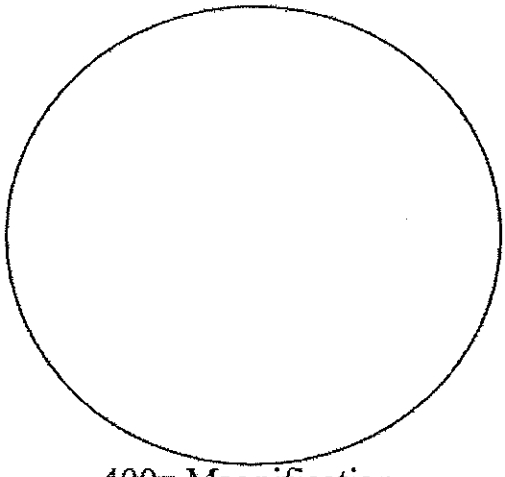
Prokaryotic (Yogurt Bacteria)



400x Magnification

Conclusion and Questions:

1. Complete the following chart.

Cell Organelle	Found in plant, animal, or both	Function
Nucleus		
Cell Wall		
Chloroplast		
Cytoplasm		
Cell Membrane		

More questions on back…

2. Why do we stain the animal and plant cells?

3. Why must the specimen you observe be very thin?

4. Onion cells are plants, why don't they have any chloroplasts?

MS-LS1-2

2D Cell Project

Name: _____ Due Date: Friday January 18th, 2019

Project Guidelines:

- Project must be two-dimensional and colored. (No edible materials).
- The organelles must be made in a creative way that symbolizes the organelle's job. The picture may be made as a drawing of an institution which labels the tasks/rooms/objects as the organelles.
- All cell parts must be clearly labeled on the drawing and defined/described (in key/report). Students may use flags or numbers and a key for identification.
    - Function of each organelle must be described, in writing on the KEY/REPORT.
- Project must be made big enough for labels to be read clearly. Project may be chosen to be done on a large poster board paper.

Choose to do either an animal cell or a plant cell:

- **Organelles require for animal cell models:** nucleus, nucleolus, DNA (chromatin), nuclear envelope, vesicles, mitochondria, cell membrane, cytoplasm, lysosomes, ribosomes, small vacuoles, Golgi bodies, centrioles, smooth E.R. and rough E.R.
- **Organelles required for plant cell models:** cell wall, cell membrane, chloroplast, large central vacuole, vesicles, nucleus, nucleolus, DNA(chromatin), nuclear envelope, mitochondria, cytoplasm, ribosomes, Golgi bodies, smooth E.R. and rough E.R.

PROJECT RUBRIC:

CATEGORY	25	20	15	10
Construction-Materials	Creative and unique concepts were selected and creatively modified.	There was an average effort at creative and unique concepts and creatively modified.	There was a slight attempt at creative and unique concepts and creatively modified.	There was little attempt at creative and unique concepts and creatively modified. The cell's picture is/ almost a copy of a labeled cell online or in the textbook.
Organelles size and shape	Each organelle is a characteristic size and shape that represents the organelle's structure and function.	1-2 organelles are designed inappropriately or may have disproportionate shapes. Or 1-2 organelles may be missing from model.	3-6 organelles are designed inappropriately or may have disproportionate shapes. Or 3-6 organelles may be missing from model.	Construction appears careless or haphazard. Man details need refinement for a strong or attractive product. More than 7 organelles missing from model.
Organelle structure and function spelling	No spelling errors exist.	1-2 spelling errors exist in organelle names and functions.	3-6 errors in spelling exist in organelle names and functions.	7 or more spelling errors exist on cell model projects.
Neatness	The drawings and labelings are clearly written and drawn. There is no mistake as to what is says or which organelle was drawn.	The drawings and labelings are somewhat clearly written and drawn. There there can be some difficulty reading what is says or which organelle was drawn. 1-3 organelles or labelings are difficult to read.	The drawings and labelings are not clearly written and drawn. There there can be difficulty reading what is says or which organelle was drawn. 4-6 organelles or labelings are difficult to read.	7 or more labels or organelles are difficult to interpret. Handwriting or drawing skills are indecipherable.

MS-LS1-2

3D Cell Project

Name: _____ Due Date: Friday January 18th, 2019

Project Guidelines:

- Project must be three-dimensional and may be made from any safe household materials. (No edible materials).
- All cell parts must be clearly labeled (on model) and defined/described (in key/report). Students may use flags or numbers and a key for identification.
    - Function of each organelle must be described, in writing on the KEY/REPORT.
- Project must be no larger than a half sheet of poster board.

Choose to do either an animal cell or a plant cell:

- **Organelles require for animal cell models:** nucleus, nucleolus, DNA (chromatin), nuclear envelope, vesicles, mitochondria, cell membrane, cytoplasm, lysosomes, ribosomes, small vacuoles, Golgi bodies, centrioles, smooth E.R. and rough E.R.
- **Organelles required for plant cell models:** cell wall, cell membrane, chloroplast, large central vacuole, vesicles, nucleus, nucleolus, DNA(chromatin), nuclear envelope, mitochondria, cytoplasm, ribosomes, Golgi bodies, smooth E.R. and rough E.R.

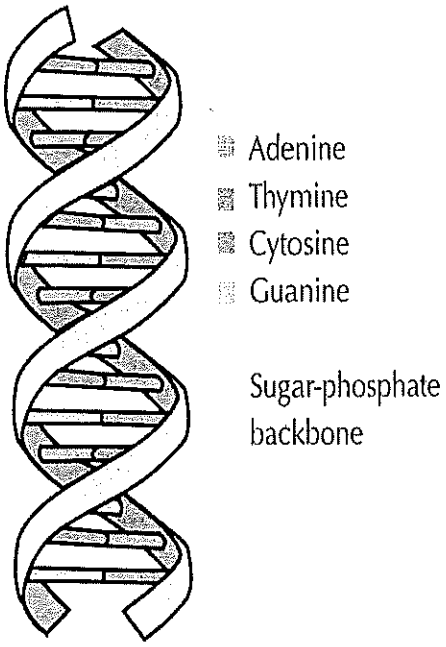
PROJECT RUBRIC:

CATEGORY	25	20	15	10
Construction-Materials	Creative and unique materials were selected and creatively modified in ways that made them even better.	Creative and unique materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected and organelles' structure and function were somewhat represented.	Inappropriate materials were selected and contributed to a product that did not represent structure and function of organelles.
Organelles size and shape	Each organelle is a characteristic size and shape that represents the organelle's structure and function.	1-2 organelles are designed inappropriately or may have disproportionate shapes. Or 1-2 organelles may be missing from model.	3-6 organelles are designed inappropriately or may have disproportionate shapes. Or 3-6 organelles may be missing from model.	Construction appears careless or haphazard. Man details need refinement for a strong or attractive product. More than 7 organelles missing from model.
Organelle structure and function spelling	No spelling errors exist.	1-2 spelling errors exist in organelle names and functions.	3-6 errors in spelling exist in organelle names and functions.	7 or more spelling errors exist on cell model projects.
Flag construction	All organelles flags are correctly labeled with correct function. Flags are typed or neatly hand printed.	1-2 flags missing either name or organelle or function. 1-2 flags may be misplaced. Flags are neatly handwritten or typed.	3-6 flags missing either name or organelle or function. 3-7 flags may be misplaced. Flags are neatly handwritten or typed.	7 or more flags missing either name of organelle or function, 8 or more flags may be misplaced. Handwriting on flags is indecipherable.

MS-LS3-1

DNA Paper Model Lab

Name_____



DNA is found inside a special area of the cell, called the **nucleus**. Because the cell is very small, and because organisms have many DNA molecules in each cell, each DNA molecule must be tightly packaged. It is shaped like a twisted ladder called a helix, and then crumbled up into a bundle. This packaged form of the DNA is called a chromosome. DNA is made of chemical building blocks called nucleotides. The nucleotides are made up of three parts: a **phosphate** group, a **deoxyribose/sugar** group and one of four types of **nitrogen bases (A,T,G and C).** The nitrogen bases are the **rungs** of the ladder. To form a strand of DNA, nucleotides are linked into chains, with the phosphate and sugar groups alternating, forming the backbone of the DNA ladder.

The four types of **nitrogen bases** found in nucleotides are: **adenine (A), thymine (T), guanine (G)** and **cytosine (C).** The order, or sequence, of these bases determines what biological instructions are contained in a strand of DNA. For example, the sequence ATCGTT might instruct for blue eyes, while ATCGCT might instruct for brown. This letter sequence (ATCGTT) is also known as the genome.

Each DNA sequence that contains instructions to make a protein is known as a gene. The size of a gene may vary greatly, ranging from

DNA Paper Model Lab

about 1,000 bases to 1 million bases in humans. The complete DNA instruction book, or genome, for a human contains about 3 billion bases and about 20,000 genes on 23 pairs of chromosomes

Procedure:

1. Color each nucleotide piece/shape a different color.

   For example,

   a. Phosphate groups = **red**

   c. Adenine = **orange**

   e. Guanine = **purple**

   b. Deoxyribose sugar = **white**

   d. Thymine = **green**

   f. Cytosine = blue

2. Cut out each DNA shape above separately. You will need the following numbers. ***You can cut more if you'd like!***

   a. 12 Phosphate groups

   b. e. 3 Guanines

   c. d. 3 Thymine

   d. 3 Adenines

   e. 12 Deoxyribose sugar

   f. 3 Cytosines

3. Tape 2 pieces of construction paper together (the long way).

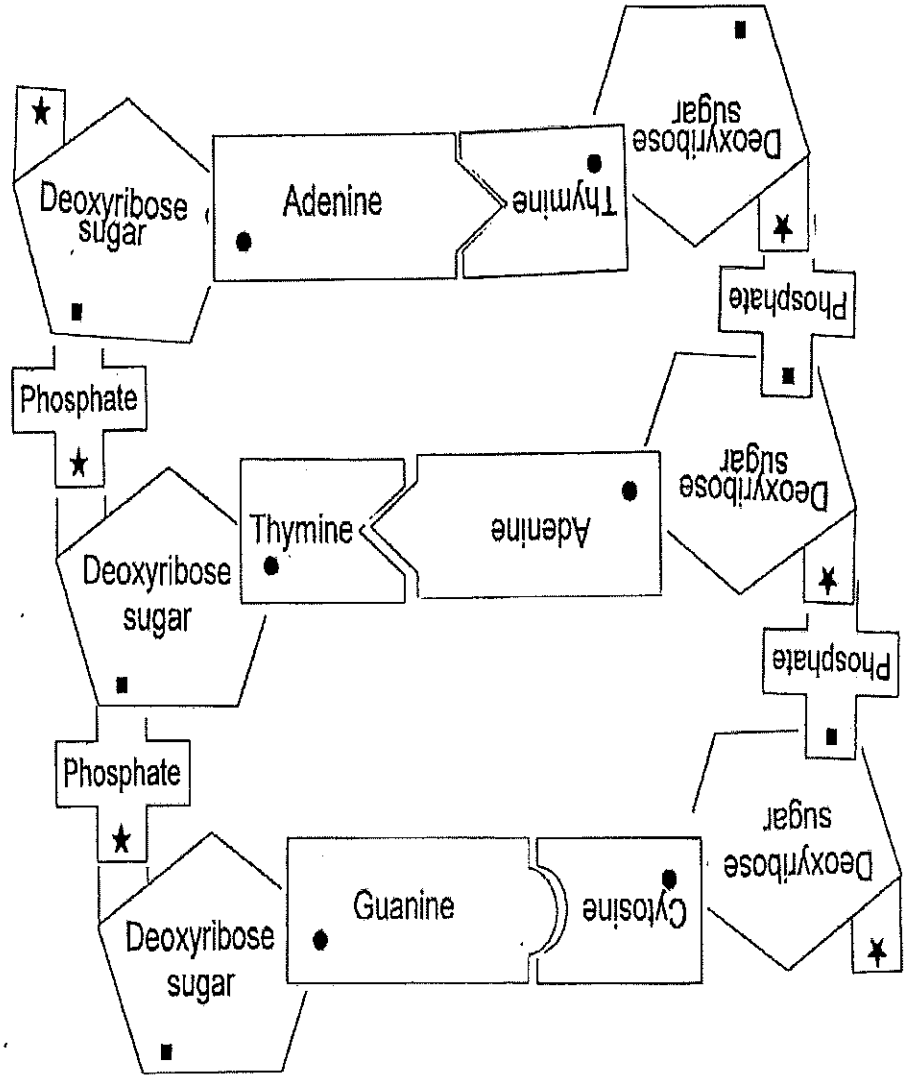
4. Using your cut out DNA nucleotide shapes, construct a two dimensional (2D) DNA model on your construction paper using the following gene sequence as your template (READING STRAND):

A T G A CG

DNA Paper Model Lab

5. Glue your model to the construction paper. Use the diagram below to help you. Remember the reading strand should be

A T G A CG



DNA Paper Model Lab

DNA Paper Lab Analysis Questions

1. What organelle is DNA located in, in the cell?

Answer_____

2.What are the three parts of a nucleotide?

1-_____ 2._____ 3._____

3. What two chemicals make up the sides or backbone of the DNA molecule?

Answer: _____and _____

4. How many nucleotides are in your DNA model?

Answer; _____ nucleotides

5. What molecules make up the rungs (steps of the ladder)?

Answer_____

6. What are the base pairing rules (Chargaff's rules) for DNA?

Adenine combines with Thymine
or
_____ combines with _____

Guanine combines with Cytosine
or
_____ combines with _____

DNA Paper Model Lab

7. What is the genetic code (genome) of the Reading strand?

Answer_____

8. What is the genetic code of the complimentary strand?

Answer_____

9. Are all the DNA models in the class exactly the same? Why or why not?

10. Your DNA now looks like a regular ladder, what do you need to do to your model to make it look like a real DNA molecule (double helix)?

Extra Insurance. Assume a 100 base pair DNA double helix contains 45 cytosine's, how many adenines are there in this double helix?
Explain how you got this number.

MS-LS4-5

Understanding Stem Cells

Every day, your hair grows a little longer, your bones become a little stronger, and your body churns out a fresh supply of red blood cells. These and countless other cellular processes originate in stem cells located throughout your tissues. When these stem cells receive the right signals, they divide and differentiate into new cells in your tissues and organs. Scientists say that because stem cells are the source of new cells, they have the potential to treat diseases caused by cellular malfunction, such as Parkinson's disease, sickle cell anemia, diabetes, and many others.

WEBSITES USED FOR THIS ACTIVITY

Human Development and Stem Cells
http://www.hhmi.org/biointeractive/media/human_emb_dev-lg.mov

Mapping Cell Fates
http://www.hhmi.org/biointeractive/media/differentiation-lg.mov

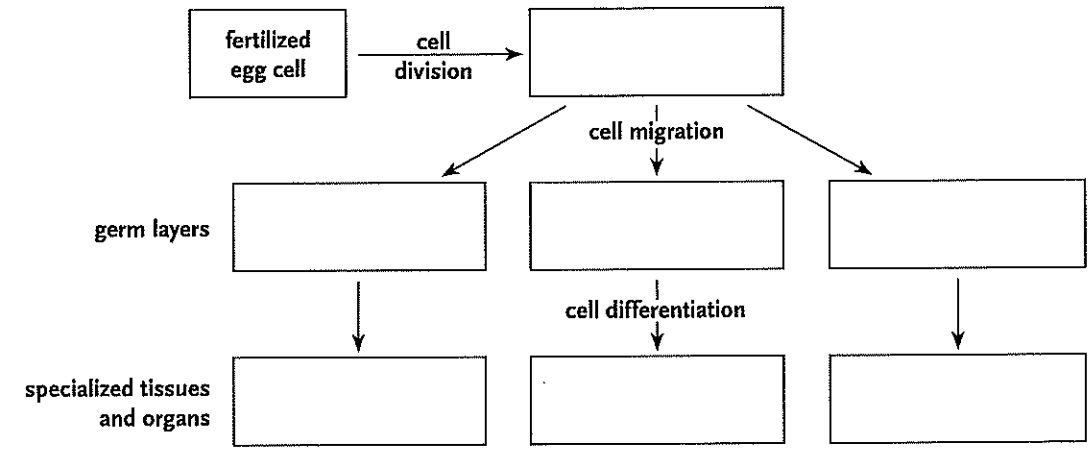
What is a stem cell?
http://learn.genetics.utah.edu/units/stemcells/whatissc/

What are some different types of stem cells?
http://learn.genetics.utah.edu/units/stemcells/sctypes/

Procedure

1 Visit the websites Human Development and Stem Cells and Mapping Cell Fates and watch the animations. Devise a flowchart that shows the process a fertilized egg cell goes through as it differentiates from a single cell into a multicellular organism. You may fill in the diagram below, or make up one of your own. Include the terms listed below:

- blastocyst
- mesoderm
- heart
- endoderm
- muscles
- gut tube
- ectoderm
- intestine
- skin and nervous system
- lungs



2 With your partner, build a clay model of the cell type your teacher assigns you. Use the websites What is a stem cell? and What are some different kinds of stem cells? as guides.

3 Write the name of your cell type in an appropriate place on the flowchart you made in Step 1. Add any additional information you think is necessary to explain how the process described in the chart could have led to your cell's formation.

4 As a class, discuss the similarities and differences you see between your work and that of your classmates.

Questions

Write your answers on a separate sheet of paper.

1 What is a stem cell? Where do stem cells come from?

2 How do stem cells differentiate?

3 What role does the cell you modeled out of clay play in the body? Which embryonic tissue layer did it come from? Where in the body would you expect to find the stem cells that produce these specialized cells?

4 Can the process you described in your flowchart run backwards to produce stem cells from specialized cells, such as the cells that make up your bones? Why or why not? What are some steps that would need to take place for this process to run backwards?

http://www.pbs.org/wgbh/nova/education/activities/0305_03_nsn.html

Students will create a brochure using a template. The project will gather and make sense of information to describe what stem cells are, what they can do or treat, and what the moral pathways of making the treatment possible . The end product will be a color, typed, and well-designed informative brochure on one stem cell treatment specific to an ailment. Projects will be graded based on a rubric.

Video: https://nj.pbslearningmedia.org/asset/nsn08_vid_stemcell2/

Need this webpage, modeling clay in different colors, and the student handout titled: Understanding Stem Cells

Activity Summary
Student teams research how stem cells become specialized cells. They summarize their findings with flowcharts and clay models.

Learning Objectives
Students will be able to:

- define the term "stem cell."
- demonstrate that specialized cells arise from stem cells.
- explain how embryonic stem cells form during early development.
- show how embryonic stem cells differentiate into distinct tissue layers.

Suggested Time
One class period

MATERIALS for each team ----------

- Modeling dough or clay in different colors
- Understanding Stem Cells student handout (PDF)

Background
While current controversy centers on human embryonic stem cells, your students may be surprised to learn there are stem cells in their bodies right now. From birth, all humans—infants, children, and adults—house populations of undifferentiated stem cells in the tissues of their bodies. These so-called "adult" stem cells (the name is something of a misnomer, as these cells are also present in infants and children) give rise to new specialized cells, such as neurons, blood cells, and muscle cells, as the body grows and repairs itself over time. Blood-forming stem cells in the bone marrow, for example, give rise to red blood cells, white blood cells, and platelets.

Adult stem cell research is a rapidly expanding field filled with many important, as yet unanswered, questions. What, for example, is the source of the stem cells found in adults? Are they leftover embryonic stem cells that never differentiated? Where in the body are they manufactured? How plastic

are they—that is, how many different kinds of structures can they differentiate into? As you discuss stem cell science with your students, remind them of the compelling questions remaining in this broad and emerging field.

To help students understand stem cells, it is useful to review the basics of fertilization and differentiation. When a sperm cell fertilizes an egg cell, the resulting fertilized egg, or **zygote**, has the potential to divide and differentiate into every single type of cell in the body.

The fertilized egg, then, is the ultimate **stem cell**, an unspecialized cell that divides repeatedly and, when the right set of signals is received, differentiates into the specialized cells that make up the body's heart, bones, skin, muscles, and other tissues and organs. Scientists sometimes call the fertilized egg **totipotent**, meaning it has the potential to differentiate into any cell type in the body. The term comes from the Latin roots *totus*, or "entire," and *potens*, "able."

Soon after fertilization, the egg cell begins to divide, and after about 4-5 days, the dividing cells take the shape of a hollow ball called a **blastocyst**. In animal development, the blastocyst is one of the first stages in the formation of an embryo. By the time the blastocyst forms, initial stages of differentiation are already taking place—some cells form the outer wall of the sphere, while a cluster of cells called the *inner cell mass* begins to assemble on one end inside the sphere. This cluster of inner cells eventually becomes an embryo and then, as development proceeds, a fetus; the outer cells ultimately differentiate into the placenta.

Inner mass cells, also called **embryonic stem cells**, have the ability to differentiate into almost any cell in the human body. Embryonic stem cells retain this potential early in development, but approximately two weeks after fertilization in humans, the cells begin to move, arranging themselves into three layers. The outermost layer, the **ectoderm**, eventually becomes the skin and components of the nervous system. The middle layer, or **mesoderm**, becomes the muscles, blood, bones, heart, and circulatory system, and the inner layer, or **endoderm**, becomes the lungs, digestive tract, bladder, and glands such as the pancreas and liver.

This differentiation process, called **gastrulation**, is an important step in development. Cells become successively bound to a particular destiny as development proceeds; when the cells of the inner cell mass migrate to the ectoderm, for example, they become committed to a pathway that will lead them to differentiate into skin or nerve cells, but not blood cells. Later steps in differentiation will lead some ectoderm cells to become skin cells, but not nerve cells, and so on. Differential gene expression—turning different genes "on" or "off"—drives this process. As students will learn in the NOVA scienceNOW segment Stem Cell Breakthrough, some scientists are trying to cause cells to revert to an earlier stage in differentiation, or to coax them to follow different pathways, by manipulating their genes. In this way, researchers hope to develop novel medical treatments, such as making new nerve cells to replace damaged ones.

Scientists investigating human embryonic stem cells obtain these cells from the inner cell mass of blastocysts at fertility clinics. The cells derived from these sources are obtained only with donor consent and the understanding that the fertilized egg will be used strictly for research. Still, research on human embryonic stem cells remains a hotly debated topic in the United States today. As of this writing, federal funding for research on human embryonic stem cells is limited to the cell lines produced prior to August, 2001.

In this activity, your students will make a flowchart to describe the early phases of embryonic development, from fertilization through gastrulation. Then they will model some of the specialized cells in the body and predict how undifferentiated cells begin to change into these specialized structures.

PROCEDURE

Before the Lesson

- Obtain enough modeling dough so that each pair of students will have ½ cup each of four different colors.
- Plan to have computer access for each pair or small group of students; this activity requires students to have access to several educational Web sites.
- Print a copy of the Understanding Stem Cells handout for each student.
- Bookmark the Web pages Stem Cell Breakthrough, Human Development and Stem Cells, Mapping Cell Fates, What is a stem cell?, and FIND VIDEOS ABOUT WHAT STEM CELLS ARE AND WHAT ARE THE DIFFERENT KINDS OF STEM CELLS
- You will need computer access for each pair of students in class; plan computer time accordingly.

The Lesson

Activity that integrates with technology: Have students create an educational brochure about STEM CELL RESEARCH.

How to make a brochure using google docs: https://www.youtube.com/watch?v=JdF5Ow0__xI

Students will create a flowchart of the path Stem Cells take in development.

1. As a class, watch the NOVA scienceNOW segment Stem Cell Breakthrough. https://nj.pbslearningmedia.org/asset/nsn08_vid_stemcell2/
2. Ask students what questions they have about the program, and explain that they will model some of the cell types and processes discussed in the segment.
3. Give each student a copy of the Understanding Stem Cells handout and divide the class into pairs. Have each pair view the Human Development and Stem Cells and Mapping Cell Fates animations.
4. Have students develop flowcharts ON THE COMPUTER to summarize the processes that take place as a fertilized egg cell becomes a multicellular organism. They should use both animations as guides. You may have student pairs develop flowcharts together, or have students develop them individually. A sample flowchart with answers is provided in the assessment section.
5. Next, have students use clay to model the kinds of cells that arise from adult stem cells in their own bodies. THEY WILL TAKE PICTURES OF THE DIFFERENT MODELS AND APPLY THEM TO THEIR FLOWCHART. Assign student pairs to model one of the following types of specialized cells: skin, bone, nerve, skeletal muscle, and red blood cell. Students may use the animations What is a stem cell? and What are some different types of stem cells? as references.
6. Have teams label their models and bring them to a central table where everyone can look at them. Ask students what structures these cells all have in common *(With the exception of red blood cells, they all have a nucleus, cell membrane, and organelles such as mitochondria and ribosomes)*. What makes these cells different? *(They are specialized to perform different functions, such as carrying nerve impulses or transporting oxygen)*. You also may ask students to identify from which germ layer the cell they modeled originated.
7. Lead a short discussion that relates to the original segment students viewed, Stem Cell Breakthrough. Return to the point made in the video about "turning back the clock" on skin cells. Recall and consider questions such as, "What can scientists learn by taking an adult cell back to a form that mimics a pluripotent embryonic cell?" and "What questions might this process help scientists answer?"

Extension

As an extension, lead a brainstorm session about the four genes that can make an adult cell pluripotent, as referred to in the segment. Talking points to consider could include the question, What might these genes do? One of them is known to be an oncogene, or a gene that causes the unchecked cell division that brings on cancer. Why might an oncogene be active in an undifferentiated stem cell?

As an additional extension, you can try having students use clay to model the formation of a fertilized egg, the blastocyst, and the division into germ layers during gastrulation. To help them remember which types of cells originate in each germ layer, have them watch the Video Extra at Stem Cells Breakthrough.

ASSESSMENT
Sample flowchart answer:
(*Student charts may vary. At some point, discuss with the class how each step, beginning with the formation of the blastocyst, is a "determining" step that commits cells to a particular pathway. Also be prepared to discuss differences in student charts; you may have one pair draw their chart on the board and ask if other students' charts looked similar or different*).

Student Handout

Questions

1. What is a stem cell? Where do stem cells come from?
   A stem cell is an undifferentiated cell. It can become many different types of specialized cells. Stem cells come from a variety of sources. A fertilized egg is a stem cell; embryonic stem cells come from early-stage embryos a few days after fertilization. Stem cells also exist in our tissues as we age—they too can give rise to new cells.
2. How do stem cells differentiate?
   The stem cell receives signals that tell its genes which proteins to make. Signals also tell some genes to turn off and not make proteins.
3. What is the role in the body of the cell you modeled out of clay?
   Bone cells: building scaffolding and renewing bone material; comes from mesoderm
   Nerve cells: transmitting signals throughout the body; comes from ectoderm
   Red blood cells: transporting oxygen to the body's cells; comes from mesoderm
   Skeletal muscle cells: moving the body; comes from mesoderm
   Skin cells: providing outer layer of protection for the body; comes from ectoderm
   Where in the body would you expect to find the stem cells that produce these specialized cells?
   Answers may vary; some answers are found in the What is a Stem Cell animation. Look for evidence that students have thought creatively about the tissues in the body that might serve as reservoirs for these specialized cells. From the animation, they learned that:
   Skin cells originate deep beneath the skin's surface.
   Red blood cells originate in the bone marrow

Nerve cells are made mostly before birth and so would originate in the embryonic tissue layers. The animation doesn't provide information about the origin of each cell type, however. In fact, scientists still don't know much about the origin of adult stem cells in the body's tissues. Some structure, such as blood, skin, and the brain, are known to house adult stem cells, but scientists are still learning about where these stem cells come from.

4. Can the process you described in your flowchart run backwards to produce stem cells from specialized cells such as the cells that make up your bones? Why or why not? What are some steps that would need to take place for this process to run backwards?
   Answers will vary. Look for evidence that students understand that different genes control the switches that regulate differentiation, and that by manipulating these, scientists may be able to "turn back the clock" on adult specialized cells.

Use the following rubric to assess each team's work.

	Excellent	**Satisfactory**	**Needs improvement**
Completing flowcharts and building cell models	• Students use Web resources effectively to answer questions, develop flowcharts, and build models. • Students show ability to independently integrate information from multiple resources. • Students raise questions showing critical thinking skills and creative thinking.	• Students need assistance while using resources. • Students have difficulty integrating information from more than one resource. • Students have difficulty building 3-D models based on Web resource materials. • Students raise only minimal questions.	• Students have difficulty connecting the Web resources to the model-building activity or make little effort to build models and answer follow-up questions. • Students cannot integrate information from multiple sources. • Students raise no questions and appear otherwise unengaged with the activity.

STANDARDS

The Stem Cell Breakthrough activity aligns with the following National Science Education Standards (see **books.nap.edu/html/nses**).

MS-LS4-3

Name: _____
Lab Partners Names:_____
Lab date:_____
Class Period:_____

Comparative Embryology

Arizona Science Standards:

- S4-C4-PO3, 5, 6

Ag Standards:

- 17.4 –Portray the scientific principles and processes involved with biological evolution

Objectives:

- Correctly identify vertebrate embryological stages
- Describe how comparative embryology shows change over time.

Background:

Even before Darwin proposed the theory of evolution through natural selection, Karl Ernst von Baer claimed that the most closely related any two species are, the more similar their development. His idea set the stage for linking the study of **ontogeny** (the development of the individual through a single life cycle) to **phylogeny** (the relatedness of species through descent from a common ancestor). When Darwin brought together the diverse lines of evidence to demonstrate that new species arose from pervious species, he included the findings from studies on embryos.

Von Baer, who discovered the mammalian egg as part of his detailed studies on animal development, observed that vertebrate animals, during the early stages of their embryological development, seem to have a common design, whereas the adult forms show differences. Arm buds from different species, for example, are virtually indistinguishable when they first form on the embryo, yet they may develop into a wing, an arm or a flipper.

In the early stages of growth when vital organs originate, the developmental sequences, or ontogeny, of all vertebrates are similar. As the fertilized egg transforms into an adult, the general vertebrate plan is modified during growth as each species acquires its adult species pattern.

It is your turn to be a scientist! Your group has 8 different organisms in the baggie in front of you and your group. It is your duty to correctly place the stages in order, and to identify what the organism is.

Pre-lab questions

1. What is ontogeny?

2. What is phylogeny? Describe two activities we have done to look at this concept

3. Who discovered that vertebrate animals have a common design during development?

Materials:

- Baggie with stages of embryo development

Procedure:

1. Take the pieces out of baggies
2. Place into groups based on stage
3. Figure out which stages go with which organism
4. Check final answer with teacher copy
5. Answer post activity questions

Post Activity Questions:

1. How does comparative embryology show change over time?

2. Which stage was the hardest to differentiate between? Why do you think this is so?

3. Which organism was the easiest to place in the correct order? Why do you think so?

4. Why do you think that species look similar at the earliest stages of embryonic development?

5. Could understanding comparative anatomy help agriculture in the fight against pests?

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THE VERTEBRATE BODY