PLANARIA REGENERATION BACKGROUND READING

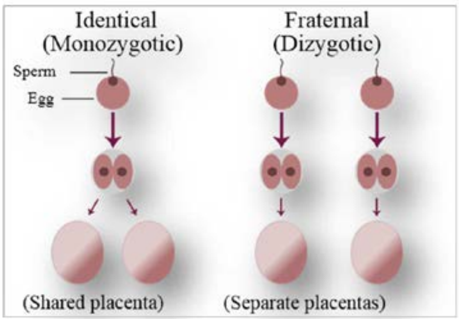
Name:____**Date:**________________**Period:**_________

Background Reading for Planaria Regeneration Lab

Identical Twins

Do you know any identical twins? The way that identical twins form is an amazing process that can teach us something about **regeneration**. Early in development, the embryo splits in half, and then each part grows into a whole embryo; each embryo grows into a whole baby. These babies are always the same sex because they are identical—they came from one fertilized egg and share all the same genetics.

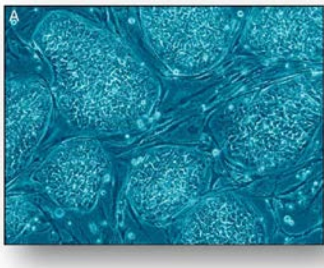
In humans this process is only possible in the first three days after **conception**. Human embryos are only flexible enough to divide in half and become twins in the first three days after conception. Older embryos, newborn babies, and adults cannot do this—because our cells are no longer so flexible! Once our cells start to differentiate into different cell types, in most cases they have "committed to their fate" and can't become a different type of cell. So later in development, if you divide the embryo in two, each half cannot regenerate the other half. And certainly, in adults and kids, we can't just cut ourselves in half and watch each half grow into a twin of the other half. But this is what planaria do!



Amazing Regenerators

Planaria are amazing regenerators. You can cut an adult planarian in half and it will grow into two whole identical planaria. Even more amazing, you can cut a tiny fragment off of a planarian and that tiny piece will regenerate a whole new planarian. Because planaria are easy to keep in the laboratory and have this amazing regenerating ability, they are used as **model organisms** to learn about regeneration. Model organisms are non-human organisms that scientists study to better understand something. The hope is that discoveries made on this organism can be used to help understand other organisms, including humans.

Research with Stem Cells



One thing that scientists have learned by studying planaria is that they are such good regenerators because they have a lot of special **stem cells** (the photo below shows human stem cells). Stem cells are undifferentiated cells that can make more of themselves and develop into different cell types (**differentiate**)—but may not be able to differentiate into all cell types.

The stem cells in planaria are called **omnipotent stem cells** because they can become ***any*** other type of cell and thus can grow into an entire organism! Humans have omnipotent stem cells only in the first three days after conception—and this is the only time that you can divide a human in half and it will regenerate into two humans, creating identical twins. Planaria are such good regenerators because they have omnipotent stem cells throughout their entire lives and they have a lot of them—20-30% of all planaria cells are these omnipotent stem cells.

Scientists are currently studying planaria and other model organisms to learn how stem cells can promote health and lead to therapies for disease. Right now, scientists are exploring how to use stem cells to grow new organs for transplantation, to treat neurological diseases, and to help repair spinal cord injuries.

For example, stem cells may be able to help treat Parkinson's disease. Inside the brain of a person with Parkinson's, the nerve cells that normally produce a neurotransmitter called **dopamine** die off. Without dopamine to act as a messenger between the brain and the body, there is a breakdown in communication about muscle activity and movement. This causes tremors, shaking, and stiffness.

Stem cells can be made to differentiate into nerve cells, including neurons that makes the neurotransmitter **dopamine**. These neurons have been transplanted into the brain of model animals with a Parkinson's-like disease; the neurons survive, continue to make dopamine, and reduce symptoms of Parkinson's disease (Barker et. al 2013). Stem cells and model organisms may help us find cures for additional nervous system disorders.

Plants that Heal

Traditional healers around the world use plants to speed healing of cuts, scrapes, and broken bones. Some well-known plants used by different cultures to help the body heal include:

- Astragalus (Huan Qi)
- *Centella* (Gotu kola or ji xue cao)
- Comfrey (called "boneknit" or "healing blade")
- *Ginkgo biloba* (bai guo)
- Hawthorne (Shan zha)
- St. John's wort
- Arnica
- Aloe vera

You may have used one of these plants yourself—perhaps your family has an aloe vera plant in the kitchen. After burning your hand on a hot pan, you quickly tear off a leaf and use the liquid inside to help heal the burn. Or perhaps an acupuncturist has prescribed some of these herbs to help you heal from an accident. You might also think about how stimulants and depressants might affect regeneration. Stimulants (such as coffee, tea, ginger, or ginseng) speed the metabolism and thus may increase the speed of regeneration. However, these may also slow down regeneration by stimulating other body functions and thus taking nutrients and energy away from regeneration.

Scientists are only now studying the effects of some of these plants on healing. In this lesson, you will use one of the decoctions or infusions that you previously made to examine the speed of regeneration in planaria. Perhaps one of the plants you extracted will speed up or slow down the regeneration rate in planaria. Either of these effects could be helpful to scientists as they research ways to use stem cells to cure disease. Your experiment might lead to new information that could be used in treating neurological disease or helping people recover from accidents!

In your lab notebook, respond to these prompts:

1. As a group, choose one plant extract to test during this lab. You will be choosing from the extracts that your class produced during the previous *Infusions and Decoctions Lab*. Your teacher will provide you with specific instructions on how to choose the extract. Record the name of your chosen extract.

1. As a group, develop a hypothesis for your plant extract as to how you think it might affect the speed of regeneration of a planarian. Write down your hypothesis using the "If, Then" format.