

Name _____

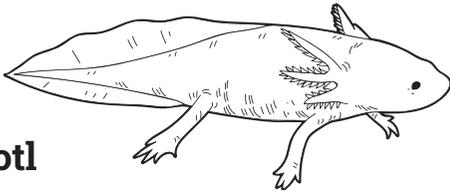
Research the Curious World of Regeneration

Find out what we know so far about regeneration, then think like a scientist and come up with your own research questions.

Planarian

Type of organism: Flatworm

Regenerative abilities: It can regrow its entire body—including its head—from a tiny bit of tissue. If one planarian is cut into 20 pieces, in three weeks you'll have 20 planarians. Cells called neoblasts are activated and re-create missing tissue, including nerves, guts, and muscles.



Axolotl

Type of organism: Aquatic salamander

Regenerative abilities: It can regenerate its tail, limbs, heart, spinal cord, pancreas, and kidney. The cells near the damaged spot transform to stem cells, which then form bones, skin, and tissue. Researchers study axolotls to investigate whether humans can one day regenerate in similar ways.

Human

Type of organism: Mammal

Regenerative abilities: Humans have limited regenerative capabilities. We can usually regrow lost hair. Our skin, bone marrow, liver, and the insides of our intestines can grow back when they're damaged, but our limbs can't. Researchers have helped develop ways to grow back fingertips.

Idea Starters for Research Questions

Brainstorm good investigative questions by asking yourself:

How does...

What would happen if...

What is the difference between...

What conditions would cause...



Now Build Your Own Questions

Brainstorm a research question you want to ask about each organism.

1. Planarian

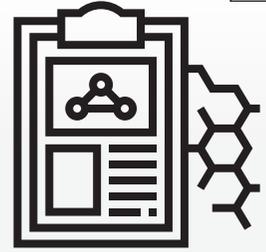
2. Axolotl

3. Human

Extra Credit

BUILD YOUR EXPERIMENT Choose one of your research questions and design an experiment to find out more. (You may have to narrow your question's focus when you form and test your hypothesis.) As you summarize your experiment on the back of this sheet, be sure to isolate your variable (what will you change? will you have a control?) and explain how you will measure and collect data.

Name _____



From Curiosity to Hypothesis

Go out on a limb to develop a research hypothesis about regeneration, animal behavior, disease, or something else you're curious about!

CREATING A HYPOTHESIS

1 On separate paper, brainstorm or research a few organisms that regenerate (or some other topic that you are interested in knowing more about). Circle the one you are most curious about.

2 Imagine you are going to conduct research on this organism/topic. Consider what you already know vs. what you want to know. Write down ideas for narrowing your focus. Circle your favorite.

3 Set a main objective for your research. Then write it as a hypothesis you can test:

I hypothesize that if

_____ ,

then

_____ .

REFLECTING & REVISING

- ▶ Could my hypothesis help me learn something I didn't know before?
- ▶ Is it testable? Consider independent and dependent variables. Will I be able to observe and measure a change?
- ▶ Am I using math to measure my outcomes?
(Example: percent of change over time, how many _____, by how much did _____ change?)

4 Based on the reflections above, revise your hypothesis to:

I hypothesize that if

_____ ,

then

_____ .

CHALLENGE ZONE

On separate paper, develop a summary of the steps needed to test your hypothesis. Be sure to consider:

- independent and dependent variables
- constant(s)
- control group
- repeated trials
- experimental conditions/setting
- data collection

Predict the outcomes: Imagine your hypothesis was disproved. What happened, and what could you learn from that? If you made observations consistent with your hypothesis, what would you expect to find out?

What's another question you could study to go further, after you have found out the results of your initial hypothesis?

VOCABULARY LIST



Despite its self-healing qualities, the **axolotl** is an endangered species.



Look! No wrinkles! **Hydras** don't get old!



The **three-banded panther worm** can regrow its head!



The acorn worm is a **hemichordate**.

axolotl (*noun*): a type of salamander that lives in the mountain lakes of Mexico and the western U.S. Axolotls are commonly 9 to 12 inches long and can regrow limbs.

blueprint (*noun*): a detailed plan of how to do something.

cartilage (*noun*): a tough but flexible tissue that covers the ends of long bones at a joint and gives shape and support to other parts of the body, such as ears, nose, and windpipe.

circulatory system (*noun*): a network consisting of blood, blood vessels, and the heart. Among its various roles, this network delivers nutrients to every cell in the body.

digestive system (*noun*): the body system that breaks down food, absorbs nutrients, and gets rid of solid food waste.

DNA (*noun*): the molecule found in cells that carries instructions for cell structure and processes in the

body. DNA contains genes that are passed on from parents to offspring and gives living things their inherited characteristics. The letters DNA stand for deoxyribonucleic acid.

gene (*noun*): a small section of DNA that contains the instructions for making a specific protein. Proteins control the processes that occur in the body's cells.

hydra (*noun*): a small invertebrate organism about one inch long that lives in fresh water. Its body is a hollow cylinder with a mouth and tentacles at the top. Hydras do not appear to age and have an amazing ability to regrow their bodies.

hemichordate (*noun*): a small wormlike invertebrate found along the shores of the Caribbean and other warm waters. It can regrow a body part within a few days of amputation.

keloid (*noun*): a thick scar resulting from excessive growth of scar tissue.

nervous system (*noun*): a network which transmits signals between the brain and the rest of the body, including internal organs. The nervous system's activity controls the ability to move, breathe, see, think, and more.

planarian (*noun*): a type of flatworm common to many parts of the world, living in both saltwater and freshwater ponds and rivers. Planarians can regrow any part of their bodies after amputation.

regeneration (*noun*): regrowth after being lost or damaged (particularly forming new animal or plant tissue).

statistics (*noun*): a field of study that concerns the collection, organization, displaying, analysis, interpretation, and presentation of data.

three-banded panther worm (*noun*): a small organism that can regrow any missing body part and named for its three stripes and its carnivorous appetite for live prey.

EXPERIMENT CORNER

EXPERIMENT VOCABULARY

independent variable (*noun*): the variable that is changed or controlled in a scientific experiment. It represents the cause or reason for an outcome.

dependent variable (*noun*): the variable in an experiment that is being measured or tested. The dependent variable responds to the independent variable.

control group (*noun*): the group in an experiment that doesn't experience the independent variable. Scientists can compare the control group to the experiment group to see the independent variable's effects.

VOCABULARY IN ACTION: SAMPLE RESEARCH QUESTION

How do air temperatures cooler than room temperature impact plant growth (height) during germination?

For this experiment, scientists will adjust the independent variable of air temperature to see what effect it has on the dependent variable of plant height. They will create three experimental groups allowing planted seeds to germinate at 20°F, 40°F, and 60°F. The scientists will also create a control group where seeds are allowed to germinate at standard room temperature (72°F). The control group helps scientists to measure experiment results and determine whether the air temperature (independent variable) does indeed impact plant height (dependent variable).