Name _____

Equip Your Science Lab

Design an experiment to answer one of the questions below. Then choose the research tools you'd need to conduct your experiment.

Research questions

- Which surfaces in the classroom have the most bacteria?
- Is there a way to slow the molding and decay of fruit?
- Is there a correlation between my body temperature and the time of day?

My question

_____

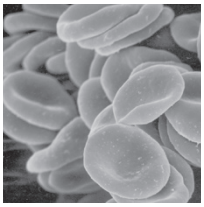
_____

Gather information What do you already know? What don't you know? Do some research into existing experiments.	
Form a hypothesis Create an informed prediction. Use an if/then statement. Example: If I increase ambient temperature, then enzymes will work more quickly.	
Design your experiment What procedure will you follow? How do you plan to measure, observe, and analyze outcomes?	
Tools at school Which tools would you use if you were asked to conduct research at school? Example: Tools and materials that are readily available with low to no cost. How will each of the tools be used in your experiment?	
Design your dream lab Which tools would you use if you were asked to conduct research in your "dream" lab? How would each of the tools be used in your experiment?	

Uncover the Secrets of Cells

Read these passages below. Then answer the critical-thinking question at the end.

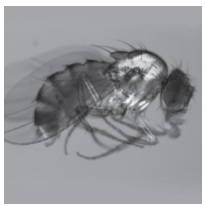
Humans have more than 200 types of cells.



Red blood cells carry oxygen. White blood cells defend against germs. Intestinal cells release molecules that help digest food. Nerve cells send messages that produce thoughts and movement, and heart cells contract in unison to pump blood. A person's genes help create proteins that carry out specialized tasks for each cell. But sometimes things malfunction. If the genes inside a cell change or "mutate," a cell may have difficulty dividing, making proteins, removing waste, or performing its job properly. These mutations can lead to defects and diseases.

Fruit flies heal wounds with supersize cells.

If a human falls and scrapes their knee, cells around the injury divide and grow until a scab forms to cover the injury. Fruit flies on the other hand, heal with the help of polyploid cells, giant cells that grow to cover the entire site of the injury. Research scientists are interested in the fruit fly's strategy for healing because it may help humans who suffer from non-healing wounds.



Flatworm cells have superpowers.

Humans have the capacity to repair and regenerate some parts of their bodies with the help of a few types of cells. Though we can regenerate blood and skin cells and regrow cells to repair our intestinal lining, we are not able to replace a limb or regrow an organ that has been severed. The flatworm, however, has dividing cells called neoblasts which allow it to regrow an entire body from a single cell. If a flatworm is cut in half, the tail end can grow a new head and the head end can grow a new tail! Research scientists are interested in the flatworm's regenerative powers to see if something similar might help humans recover from physical damage.

Lamprey cells take out the trash.

Though human cells turn genes "on" or "off" to regulate their function, every cell in the human body will maintain its particular genes from birth to death. This is not the case for the lamprey fish, which discards 20 percent of its DNA while still at the embryo stage and continues to undergo programmed genome (the complete set of genetic information in an organism) rearrangement throughout its lifetime. Research scientists are interested in the lamprey's ability to discard DNA from its cells because it may be protecting the animal from disease. Lamprey cell function may hold clues about how to cure human diseases like cancer.

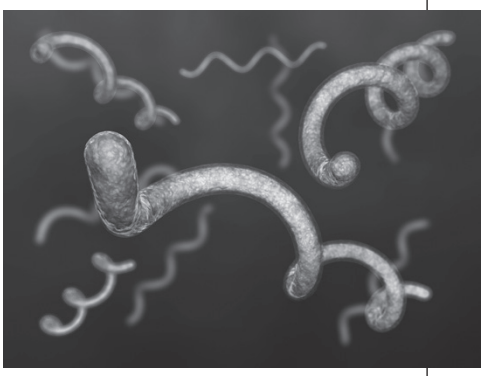
Think It Through

On a separate piece of paper, give a focused and detailed response to the following question: **Why do scientists study cells?** Your answer should include evidence from the text.

Name _____

Try on a Science Career

Follow the instructions to explore the roles of three careers in science research.



Above: Spirillum bacterium

1. Molecular Animator (creates animated visualizations of the inner workings of cells) Using the description below, draw three images in sequence to create a storyboard that shows how you imagine spirillum bacterium looks and moves.

The spirillum has a long, spiral body. It has tufts of flagellum (thread-like tails) at each end that it often uses to swim in a corkscrew-like fashion.

2. Lab Coordinator (responsible for coordinating activities in a science lab)

Create a schedule to manage the equipment requirements for this week's experiments.

Experiment A needs: centrifuge twice a week in the afternoon; autoclave every morning

Experiment B needs: autoclave three times a week in the afternoon; centrifuge every morning; incubator 1/2 day a week

Experiment C needs: autoclave 1/2 day Fridays; incubator all day Monday to Thursday

Experiment D needs: autoclave 1/2 day Wednesdays; centrifuge Wednesday, Thursday, and Friday afternoons; incubator Friday morning

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Autoclave pressure chamber	AM	AM	AM	AM	AM
	PM	PM	PM	PM	PM
Incubator	AM	AM	AM	AM	AM
	PM	PM	PM	PM	PM
Centrifuge	AM	AM	AM	AM	AM
	PM	PM	PM	PM	PM

3. Microbiologist (a scientist who studies microscopic organisms including bacteria, algae, and fungi)

Look at the illustrated sample the microscope is magnifying. Identify the irregular cell or cells. Describe the irregularities.

_____

_____

_____

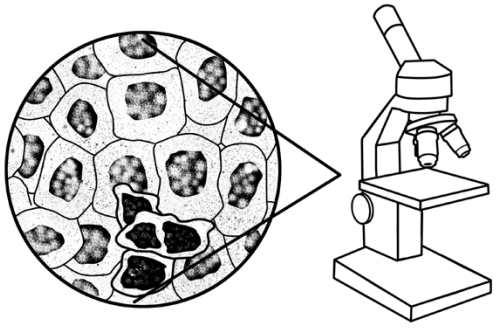


Photo: petersimoncik/iStock

PATHWAYS

VOCABULARY LIST

autoclave *(noun)*: a machine that can be set to a certain pressure and temperature for various applications.

bacteria *(noun)*: one-celled organisms that can be found everywhere. They can be dangerous, such as when they cause infection, or beneficial, such as in the process of fermentation (making cheese or vinegar) and decomposition.

centrifuge *(noun)*: a machine that spins samples at high speeds to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

chromosome *(noun)*: a cellular structure in the nucleus containing genes. Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure.

circadian rhythms *(noun)*: the physical, mental, and behavioral changes that follow a daily cycle. They are important in determining the sleeping and feeding patterns of all animals, including humans.

colorimeter *(noun)*: a device that measures the absorbance of particular wavelengths of light by a specific solution.

confocal microscopy *(noun)*: an imaging technique that uses laser light to scan dyed samples and shows the magnified image on a computer screen. These images can be used to create two- or three-dimensional structures.

cryo-electron microscopy *(noun)*: an imaging technique that captures images of a rapidly frozen sample (e.g., a virus), then creates clear images of the molecular structure of the sample.

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.

epithelial *(adjective)*: relating to the thin tissue forming the outer layer of a body's surface and lining the throat, intestines, blood vessels, and all internal organs.

gel electrophoresis *(noun)*: a laboratory method that uses an electrical current to separate molecules of different sizes by pushing them through a gel. Colored stains in the gel allow the molecule to be seen.

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.

genome *(noun)*: the complete set of genetic information in an organism. It provides all of the information the organism needs to function.

graduated cylinder *(noun)*: a container for measuring the volume of liquid. It has straight sides, two circular ends, and a base. Each marked line on the graduated cylinder represents the amount of liquid that has been measured.

hypoglycemia *(noun)*: a condition caused by an abnormally low level of blood sugar.

incubator *(noun)*: a device that provides a controlled environment to grow and maintain microbiological cultures or cell cultures.

membrane *(noun)*: a semi-fluid layer that encloses cells and organelles and controls passage of materials into and out of them.

mitochondria *(plural noun)*: organelles found in large numbers in most cells that convert food and oxygen into energy to fuel the cell.

organelle *(noun)*: a specialized, membrane-bound structure (e.g., the nucleus) that has a defined function in the cell.

pipette *(noun)*: a slender tube with a bulb to suction and transfer or measure out small quantities of liquid.

spirillum *(noun)*: a bacterium with a rigid spiral structure, found in stagnant (nonflowing) water and sometimes causing disease.

vacuum *(noun)*: an empty space in which there is no air or other gas.

vortex mixer *(noun)*: a simple device used commonly in labs to mix small vials of liquid. The mixer has a rubber cup that spins rapidly in a circle and, when the vial is pressed into the cup, the motion swirls and mixes the liquid.