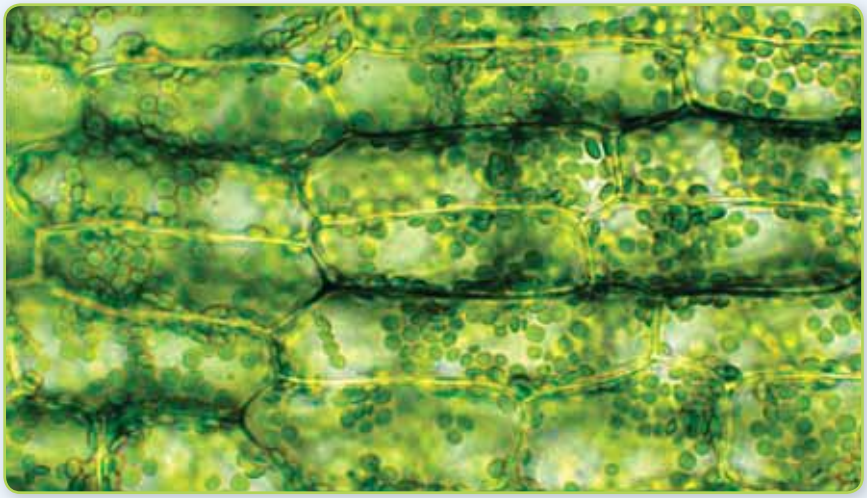
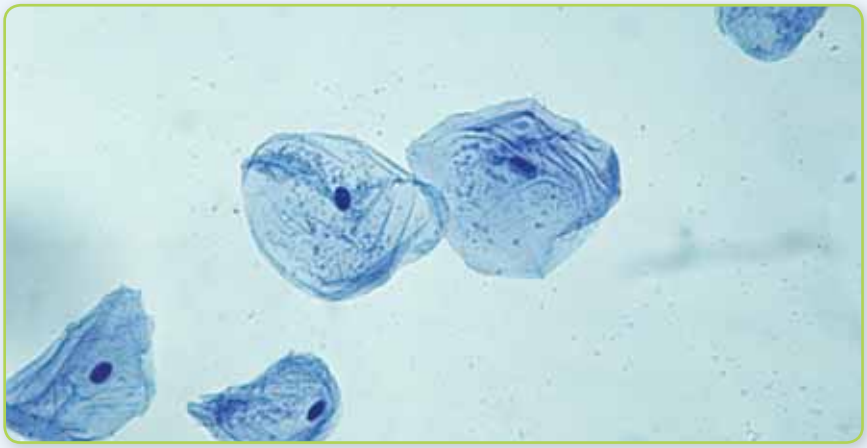
Inquiry Investigation 1-A

Examining Cell Structures

The light microscopes used today in high school and university laboratories are based on the same principles as those used by Hooke and van Leeuwenhoek. For many years, scientists had to rely on light microscopes to make discoveries about the structure and functions of cells.



Elodea leaf cells, 160×



Human skin cells, 100×

Skill Check

Initiating and Planning

✓ Performing and Recording

✓ Analyzing and Interpreting

✓ Communicating

Safety Precautions

- Be sure your hands are dry when you plug in or disconnect the cord of the microscope.
- The glass or plastic slides and cover slips used to mount specimens are fragile and can break easily. Handle them carefully to avoid getting a cut.

Materials

- compound microscope
- prepared slide of *Elodea* (or similar) leaf cells
- prepared slide of human skin cells

Science Skills

Go to **Science Skills Toolkit 8** for information about using a microscope and **Science Skills Toolkit 6** for information about making a labelled biological drawing.

Question

How do the cell structures of plants and animals differ?

Predictions

1. Predict what cell structures you will see in both the plant and animal cells.
2. Predict what cell structures you will see in only the plant cells or the animal cells.

Procedure

1. Set up a microscope.
2. Place the slide of the *Elodea* leaf cells on the microscope's viewing platform. Adjust the microscope on low power, and view the specimen. Do you see one cell, a few cells, or many cells?
3. Rotate the nosepiece until the medium power objective clicks into place. Again, adjust the microscope and view the specimen.
4. Repeat step 3 using the highest-power objective. Use extra caution when adjusting the focus. Even a slight turn of the fine-adjustment knob may crack the slide. Observe the specimen carefully. Is the entire specimen in focus at once, or do parts of it come in and out of focus as you adjust the knob? Make a proper biological drawing of one cell, remembering to include the magnification.
5. When you are done, turn the objective lenses so that the lowest power is again above the specimen and remove the slide from the stage.
6. Repeat steps 2 to 5 for the slide of human skin cells.

Analyze and Interpret

1. Consider the differences in what you see using the low, medium, and high-power objective lenses. Think about the level of detail you can see, the amount of the specimen that is visible (the whole specimen or a portion), and how much of the specimen you can focus on at once (without using the fine-adjustment knob). Which lens do you think gives you the best view of your specimens? Why?
2. Consult your drawings and recall the specimens under medium or high power, whichever you think gave you the clearest or most interesting view. Create a two-column table for each specimen. In the first column, write questions about what you see in the drawing. Your questions might start with phrases like "What is … ?" or "What does the _____ do?" These questions may be similar to questions asked by early microscopists.
3. In the second column of your table, answer your own questions as best you can. You are not expected to know all the answers.

Conclude and Communicate

4. Look back at the predictions you made at the beginning of this investigation. Did your observations support them? That is, what structures were you able to see inside the cells? How did the animal and plant cells differ?
5. Write a short statement that explains what you think you would need to improve your view of the contents of a cell.

Extend Your Inquiry and Research Skills

6. **Inquiry** How would the cell structures of other types of plants compare with the leaf cells you examined in this investigation? Use Science Skills Toolkit 8 to plan an investigation in which you make and examine your own slides of plant cells. If your teacher asks you to conduct your planned investigation, have it approved by your teacher before proceeding.
7. **Research** Research what other cell structures you can see in a human skin cell using an electron microscope. Do the following:
   - **a.** List organelles that can be seen with the electron microscope that you could not see with the compound light microscope.
   - **b.** Draw and label a magnified view of one organelle visible with the electron microscope.

Inquiry Investigation 1-B

Skill Check

Initiating and Planning

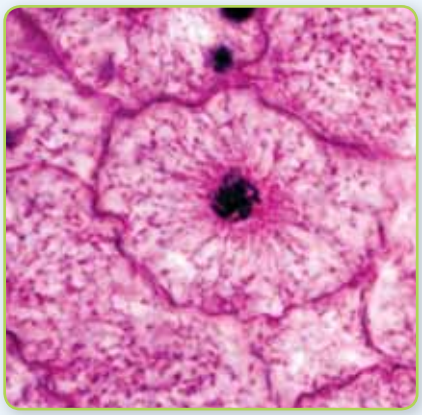
✓ **Performing and Recording**

✓ **Analyzing and Interpreting**

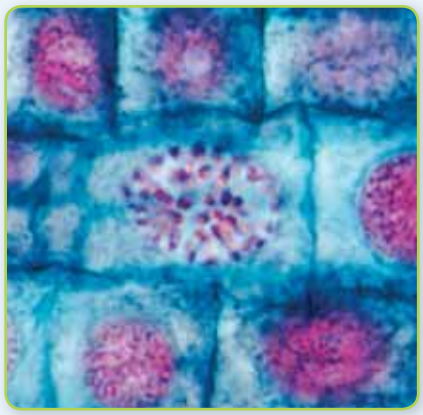
Communicating

Mitosis in Plant and Animal Cells

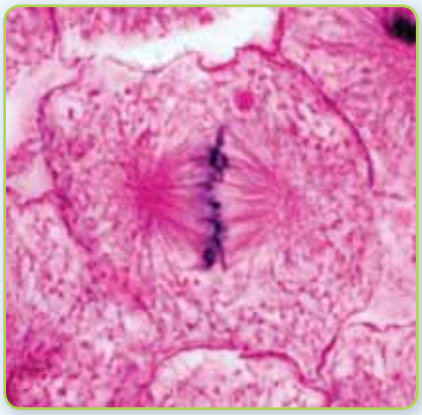
Plant and animal body cells reproduce by the process of mitosis. You will observe slides of the tip of an onion root and a whitefish embryo to see how mitosis in cells allows them to divide, producing new cells.



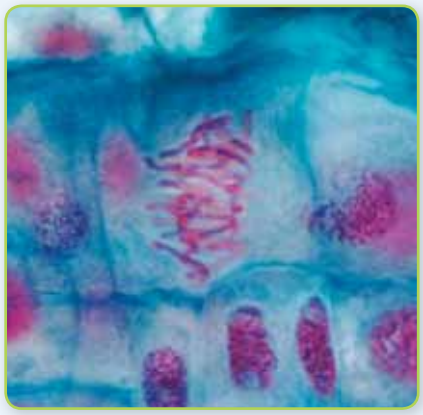
Prophase: whitefish embryo, 450×



Prophase: onion root tip, 630×



Metaphase: whitefish embryo, 450×



Metaphase: onion root tip, 630×

Safety Precautions

- Be sure your hands are dry when you plug in or disconnect the cord of the microscope.
- The glass or plastic slides and cover slips used to mount specimens are fragile and can break easily. Handle them carefully to avoid getting a cut.

Materials

- compound microscope
- prepared slide of an onion root tip
- prepared slide of a whitefish embryo

Science Skills

Go to **Science Skills Toolkit 8** for information about using a microscope and **Science Skills Toolkit 6** for information about making a labelled biological drawing.

Question

How does mitosis produce new cells, and how is mitosis the same and different in plant and animal cells?

Procedure

1. Set up a microscope.
2. Set your microscope on low power, and examine the onion root tip. Focus the microscope, and move the slide until you can see the area just behind the root tip. Carefully turn the nosepiece to medium power, refocus, and then turn to high power and refocus. Be careful when adjusting the fine-adjustment knob at high power. Even slight turns can crack the slide.

3. Use the photographs on page 48 to help you find a cell in prophase. While looking through the eyepiece of the microscope, you may have to gently move the slide to find a cell in prophase. Draw this cell, and label the parts of the cell you observe.
4. Repeat step 3 for metaphase, anaphase, and telophase.
5. Turn the microscope back to low power. Remove the slide of the onion root tip.
6. Place the whitefish embryo slide on the microscope stage under low power. Focus using low power, and find a region of dividing cells. Switch to medium power. If you need more detail, carefully switch to high power. Find a cell at prophase, and ensure that it is in the middle of your field of view. As with the onion root tip cell at this stage, draw what you see.
7. Repeat steps 3 and 4 using the whitefish embryo slide.
8. Return the nosepiece to low power. Remove the whitefish embryo slide from the microscope stage.

Analyze and Interpret

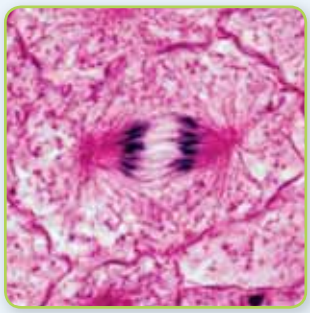
1. How do the cells in the region close to the end of the onion root tip compare to those farther back in the root tip? Compare the size of the cells, the number of cells undergoing mitosis, and the number cells in different phases of mitosis.
2. Look at your drawings of telophase from the root tip and whitefish embryo. How does the onion root tip cell look different from the whitefish embryo cells at this phase?

Conclude and Communicate

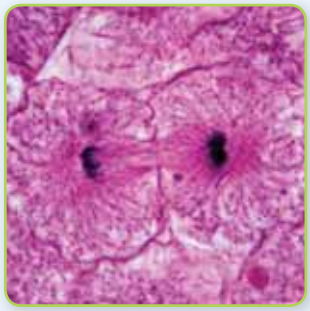
3. Infer why whitefish embryo cells and root-tip cells are used to study mitosis instead of cells in a human bone or plant leaf.

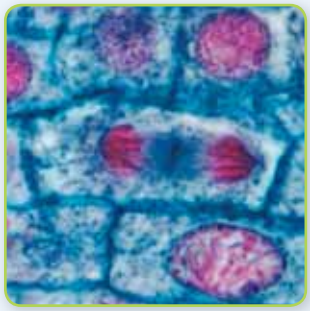
Extend Your Inquiry and Research Skills

4. **Inquiry** How do you think the tip of a live onion can be prepared so that you can observe it under a light microscope?
5. **Research** Research the stains that are used to view different organelles and any safety precautions or hazards associated with those stains.


Anaphase: whitefish embryo


Anaphase: onion root tip


Telophase: whitefish embryo


Telophase: onion root tip

Data Analysis Investigation 1-C

Skill Check

Initiating and Planning

Performing and Recording

✓ **Analyzing and Interpreting**

✓ **Communicating**

Does the Patient Have Cancer?

A physician supplied your laboratory with two samples of the same type of cells: one is normal, and the other is from a patient who may have a tumour. You were asked to culture the cells, record the cells' rates of division, and report back on any abnormalities. Your results are shown in the table below.

Number of Cells in Samples over Time

Time (days)	Normal Cells	Patient Sample
15	2	2
30	4	6
45	8	10
60	16	30
75	32	92
90	64	180

Question

What will you report back to the physician who requested the test?

Math Skills

Go to **Math Skills Toolkit 3** for information about making graphs.

Organize the Data

Draw a line graph showing the rate of cell division of normal cells and the patient's cells. Put time on the *x*-axis and population size on the *y*-axis.

Analyze and Interpret

1. Compare the rates of cell division in the patient sample and the normal sample. How would you interpret the graph?

Conclude and Communicate

2. Write a one- or two-sentence summary of your findings and your interpretation for the physician.

Extend Your Inquiry and Research Skills

3. Inquiry All cells, whether they are normal or cancerous, need energy. Cell division actually requires more energy than many other cell activities. Imagine that each cell in your sample needs two units of energy to divide.

a. Compare the amount of energy used by the cells in each sample at 90 days.

b. How might this energy requirement affect an individual who has a cancerous tumour?