

Measure the Invisible

Plan fair microscope measurements with metric tools.

LS.1.b.iii "planning and carrying out investigations take metric measurements using appropriate tools and technologies including the use of microscopes"

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each metric measurement or unit, circle each tool, and number the actions Mina takes to make her comparison fair.

A Careful Cell Comparison

- ① To investigate whether cell length differs between onion bulb layers, Mina writes a plan before touching a slide. She will compare cells from the inner, middle, and outer layers of one onion. The bulb layer is the variable she changes. She will keep the onion, stain, cover slip, microscope setting, and slide-preparation method the same. For each layer, she will prepare three slides and measure ten cells per slide. This repeated sampling can show whether a pattern is dependable rather than caused by one unusual cell.
- ② Before measuring cells, Mina calibrates the microscope at the magnification she will use. She places a stage micrometer, a slide with marks 0.01 millimeter apart, under the lens. Five eyepiece divisions match one 0.01 mm mark, so each eyepiece division represents 0.002 mm, or 2 micrometers. She then replaces the micrometer with an onion slide. A cell that spans seven eyepiece divisions measures 0.014 mm, or 14 micrometers. She records every length with its unit in a data table.
- ③ Mina uses a graduated cylinder to pour 12 mL of water into each labeled sample cup before preparing slides. She uses a stopwatch to give each sample the same 5-minute wait. Labels on the slides show the bulb layer and trial number. After measuring, she calculates the mean cell length for each layer and compares the three means. If the outer layer has longer cells, she will repeat the investigation with fresh pieces from the same onion before making a claim. Repeating the procedure helps test whether the result is consistent.

2

ANSWER WITH EVIDENCE

Use the passage

1

What variable does Mina change? Name two conditions that she keeps the same.

2

Why does Mina prepare three slides for each layer and measure ten cells on each slide?

3

A cell spans seven eyepiece divisions. What is its length in micrometers? Show how you know.

4

Which tool measures 12 mL of water, and which tool helps Mina keep the waiting time the same?

3

YOUR TURN

Your own words

Plan a microscope investigation of whether cell length differs at the base, middle, and tip of one green onion leaf. Fill in the table with a fair preparation, constants, and a metric measurement plan for each location. Then with your teacher, use a calibrated microscope to measure three cells on one supplied prepared slide. Record actual eyepiece divisions, the scale in micrometers per division and each calculated length on extra paper. Have a partner re-read one cell and compare. Keep this observed measurement record separate from your three-location plan; do not assume the passage calibration fits your microscope.

LEAF LOCATION	PREPARATION AMOUNT AND TIME	CONSTANTS	MEASUREMENT PLAN

PART 1 • READ AND MARK

Underline each metric measurement or unit, circle each tool, and number the actions Mina takes to make her comparison fair. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	What variable does Mina change? Name two conditions that she keeps the same.	She changes the onion bulb layer. She keeps conditions such as the onion, stain, cover slip, microscope setting, or slide-preparation method the same.
2	Why does Mina prepare three slides for each layer and measure ten cells on each slide?	Repeated measurements make the pattern more dependable and reduce the effect of one unusual cell.
3	A cell spans seven eyepiece divisions. What is its length in micrometers? Show how you know.	14 micrometers. Each eyepiece division is 2 micrometers, so $7 \times 2 = 14$ micrometers.
4	Which tool measures 12 mL of water, and which tool helps Mina keep the waiting time the same?	A graduated cylinder measures 12 mL, and a stopwatch keeps the waiting time the same.

PART 3 • YOUR TURN (SAMPLE ANSWER)

LEAF LOCATION	PREPARATION AMOUNT AND TIME	CONSTANTS	MEASUREMENT PLAN
Base	10 mL water, 5 minutes	same leaf, stain, cover slip, and magnification	Calibrate with a stage micrometer. Measure 8 cells on each of 3 slides in micrometers.
Middle	10 mL water, 5 minutes	same leaf, stain, cover slip, and magnification	Calibrate with a stage micrometer. Measure 8 cells on each of 3 slides in micrometers.
Tip	10 mL water, 5 minutes	same leaf, stain, cover slip, and magnification	Calibrate with a stage micrometer. Measure 8 cells on each of 3 slides in micrometers.

Accept equivalent controlled conditions and accurate metric measurement plans. For the open task, students should identify the three leaf locations, keep comparison conditions constant, use microscope calibration, and include repeated cell measurements with units. Teacher setup: supply a microscope with an eyepiece scale, stage micrometer and prepared plant-cell slide. Demonstrate calibration at the actual magnification and provide access to three distinct cells. Teacher handles glass and any preparation/stain; learners begin at low power and keep liquids away from electrical parts. Require actual tool use and three real readings with $\text{length} = \text{divisions} \times \text{the measured scale}$, plus a repeat-read check. The passage scale $0.01 \text{ mm} / 5 = 0.002 \text{ mm} = 2 \text{ micrometers}$ and $7 \times 2 = 14 \text{ micrometers}$ remain correct, but are not universal calibration values.