Name: _____ **Date:** _____

Section: _____

Cell Diffusion Explorer Activity

The Cell Size Challenge: Surface Area vs. Volume

Phase 1: ENGAGE (5 minutes)

Getting Started: Open peebedu.com and navigate to Cell Diffusion Explorer

Read the introduction popup about diffusion and SA/V ratio.

The Big Question: Why don't we have cells the size of basketballs? What stops cells from growing huge? _____

Quick Think: List 3 things cells need to take in: _____, _____, _____ List 2 things cells need to get rid of: _____, _____ How do these materials get in/out? _____

Prediction Time:

If you have cells with the same volume but different shapes, which would survive better?

Round cell Star-shaped cell Long thin cell

Phase 2: EXPLORE (20 minutes)

Investigation: Shape Matters!

Part A: Testing Basic Shapes

Drag these 4 shapes into the beaker:

- Circle (like a sphere)
- Star
- Tall Rectangle
- T-Shape

Before starting, record the data shown:

- —— 100

Click '`Start/Resume All`' and watch the diffusion!

Observation Data:

- _____

Part B: Extreme Shapes

Reset and try these shapes:

- Amoeba
- Crescent
- Squiggle

Quick Analysis:

- Fastest shape: _____

- What's different about them? _____

Part C: Finding Patterns

Graph your results:

- Draw a bar graph with Shape on X-axis and Time on Y-axis
- Add SA/V ratios below each bar

Pattern Check with Partner: Compare your results. Do you see the same pattern? The pattern is: _____

Phase 3: EXPLAIN (15 minutes)

Making Sense of Surface Area and Volume

The Key Patterns (Identify 3):

- Pattern 1: Higher SA/V ratio = _____ diffusion

- Pattern 3: Round shapes have the _____ SA/V ratio

Why This Matters:

Draw arrows to show cause → effect:

More surface area → ? → Faster diffusion Less volume → ? → Shorter distance to center High SA/V → ? → Better survival

The Growth Problem: When a cell doubles in size:

- Surface area increases ___X

- SA/V ratio _____ (increases/decreases)

Real Cell Solutions: Match the adaptation to its benefit:

Cell Adaptation: Benefit:

- Microvilli • Increases reach
- Flat shape • Adds surface area
- Long projections • Minimizes volume
- Staying small • Maintains high SA/V

Phase 4: ELABORATE (12 minutes)

Connecting to Real Biology

Cell Type Analysis: Look at these real cells and explain their shapes:

Red Blood Cell (disc-shaped):

- Why not spherical? _____

Nerve Cell (long with branches):

- How does shape help function? _____

Root Hair Cell (elongated):

- Purpose of the '`hair`': _____

Design Challenge:

You're engineering a cell for maximum nutrient absorption. Sketch your design:

[Drawing space]

Explain 3 features that maximize SA/V: _____ _____ _____

Population Thinking: Start with one cell. It grows and divides.

- Option A: One cell doubles in size
- Option B: Cell divides into two small cells

Which option maintains better diffusion? _____ Why? _____

Phase 5: EVALUATE (8 minutes)

Show What You Know

Explain the Paradox:

Elephants are huge but their cells are the same size as mouse cells. Why?

Problem Solving: A cell is dying because it can't get nutrients fast enough. List 3 ways to save it:

- _____

- _____

Pattern Application: You observe two unknown cells under a microscope:

- Cell A: Takes 2 minutes to absorb dye
- Cell B: Takes 8 minutes to absorb dye

What can you infer about their shapes? _____

Make a Claim: Complete with evidence from your data: _____ "Cells must stay small because _____. My evidence is _____. This matters because _____."

Model Check:

- One thing this model shows well: _____

Key Concepts:

- **SA/V Ratio:** Surface area divided by volume
- **Diffusion:** Movement from high to low concentration
- **Size Constraint:** Cells must stay small for efficient exchange

- **Shape Adaptations:** Projections and flat shapes increase SA/V