Name: **Date:** **Section:**

Cell Diffusion Explorer Activity: Transport Across Membranes

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:**

1. List 2 things cells need to get rid of: _______, _______

- *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**

1. Drag these 4 shapes into the beaker:

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

1. **Before starting**, record the data shown:

Shape	Volume	Surface Area (SA)	Your SA/V Calculation
Circle	100		
Star	100		
Tall Rectangle	100		
T-Shape	100		

1. Click "Start/Resume All" and watch the diffusion!

- *Observation Data:**

Shape	Time to Turn Completely Blue	Rank (1=fastest)
Circle		
Star		
Tall Rectangle		
T-Shape		

- *Part B: Extreme Shapes**

1. Reset and try these shapes:

- Amoeba
- Crescent
- Squiggle

- *Quick Analysis:**

- Slowest shape: ________

- *Part C: Finding Patterns**

1. Graph your results:

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

1. **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**

1. **The Key Patterns (Identify 3):**

- Pattern 2: Shapes with extensions have _______ SA/V

1. **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

1. **The Growth Problem:**

When a cell doubles in size:

- Surface area increases ___X
- SA/V ratio _______ (increases/decreases)

1. **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:

1. **Red Blood Cell** (disc-shaped):

- Advantage for oxygen transport: ________

1. **Nerve Cell** (long with branches):

- Trade-off: ________

1. **Root Hair Cell** (elongated):

- How this helps the plant: ________

- *Design Challenge:**

You're engineering a cell for maximum nutrient absorption.

Sketch your design:

[Drawing space]

Explain 3 features that maximize SA/V:

1. ________

2. ________

- *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**

1. **Explain the Paradox:**

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

1. **Problem Solving:**

A cell is dying because it can't get nutrients fast enough.

List 3 ways to save it:

- _______
- _______

1. **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? _______

1. **Make a Claim:**

Complete with evidence from your data:

"Cells must stay small because _______.

My evidence is _______.

This matters because _______."

- *Model Check:**

- One limitation of this 2D model: _______

- *Extension Challenge:**

Research "surface area adaptations" in one system:

- Lungs (alveoli)
- Intestines (villi)
- Kidneys (nephrons)
- Plant roots

How do they maximize SA/V? _______

- --

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