# Why Bigger is Not Necessarily Better

**SCIENCE NSPIRED**

**TEACHER NOTES**

## Science Objectives

- Students will determine the relationship between the surface area and the volume of a sphere.
- Students will use an understanding of surface area and volume to explain cellular membrane dynamics.
- Students will use a graph to interpret and analyze a biological principle.
- Students will analyze data numerically, graphically, and symbolically.
- Students will apply the relationships between the radius of a sphere and its circumference, surface area, and volume.

## Vocabulary

- radius
- surface area
- volume
- circumference
- cell membrane

## About the Lesson

- This lesson involves examining the relationship between surface area and volume.
- As a result, students will:
  - Use two separate .tns files—the first for simulation, the second for data collection.
  - Draw conclusions based on the simulation and their own data collection about the Surface Area to Volume relationship and why biological cells must remain small.

## TI-Nspire™ Navigator™

- Use Class Capture to monitor student progress.
- Use Live Presenter to allow students to show their graphs to the class.

## Activity Materials

- Latex balloons
- Tape measure (or meter sticks and string)
- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software


**Tech Tips:**

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

**Lesson Files:**

*Student Activity*

- Why_Bigger_is_Not_Necessarily_Better_Student.pdf
- Why_Bigger_is_Not_Necessarily_Better_Student.doc

*TI-Nspire document*

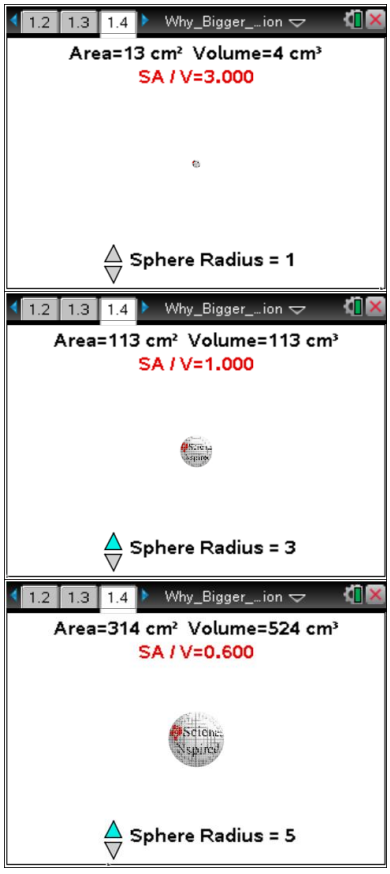
- Why_Bigger_is_Not_Necessarily_Better_Simulation.tns
- Why_Bigger_is_Not_Necessarily_Better_Collection.tns

## Discussion Points and Possible Answers (Simulation.tns)

**Tech Tip:** To watch the animation, select **Menu > Why Bigger is Not Better > Start Animation**. To stop the animation, select **Menu > Why Bigger is Not Better > Stop Animation**.

**Tech Tip:** To watch the animation, select **> Why Bigger is Not Better > Start Animation**. To stop the animation, select **> Why Bigger is Not Better > Stop Animation**. Students may need to back-out to the main Tools Menu to see the desired menu option.

**Move to page 1.4.**




Q1. What is the SA/V ratio when the radius is 1?

**Answer:** 3

Q2. What is the SA/V ratio when the radius is 3?

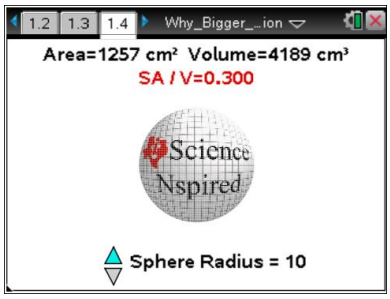
**Answer:** 1

Q3. What is the SA/V ratio when the radius is 5?

**Answer:** 0.6

Q4. What is the SA/V ratio when the radius is 10?

**Answer:** 0.3




Q5. As the radius of the sphere (cell) increased, what happened to the surface area AND the volume of the sphere (cell)?

**Answer:** They increased

Q6. If the sphere were a model for a cell, what would the "surface area" represent?

**Answer**: The plasma membrane

Q7. As the radius of a sphere (cell) _____, the SA/V ratio of that sphere (cell) _____.

**Answer**: increases; decreases

## Discussion Points and Possible Answers (Collection.tns)

**Tech Tip:** To enter data into the spreadsheet on Page 1.5, select a cell twice. The keyboard will appear. Enter the value and then select Enter.

**Tech Tip:** To create a best fit line, select **Menu** or > **Analyze > Regression**. Then, select the appropriate model. Students may need to back-out to the main Tools Menu to see the desired menu option.

Q8. As your balloon got bigger, what happened to the surface area?

**Answer:** It got bigger

Q9. As your balloon got bigger, what happened to the volume?

**Answer**: It got bigger

Q10. As your balloon got bigger, what happened to the SA/V ratio?

**Answer**: It got smaller

Q11. If you know the circumference of a circle or a sphere, how can you calculate the radius?

**Answer**: Divide the circumference by 2 π

Q12. Measurements for _____ are expressed as units$^2$, while measurements for _____ are expressed as units$^3$.

**Answer**: surface area; volume

Q13. The formula for the SA of a sphere is $4\pi r^2$. The formula for the volume of a sphere is $(4/3)\pi r^3$. Plug these individual formulas into the fraction: SA/V. Then simplify the resulting fraction.

**Answer**: 3/r

Q14. Two people are 6'3" tall. One weighs 170 pounds, while the other weighs 270 pounds. Which of these two people has a greater SA / V ratio?

**Answer**: The one weighing 170 pounds

Q15. In really hot weather, which of the two people from the previous question would have a tougher time cooling off by getting rid of body heat?

**Answer**: The one weighing 270 pounds

Q16. Mammals that live in the desert tend to be "lanky" with large, thin ears. Those that live in the arctic tend to be "round" shaped with very small, hair-covered ears. Why?

**Answer**: Managing body temperature is critical to survival in both environments

**TI-Nspire Navigator Opportunity**

Class Capture can be used to monitor students.

## Wrap Up

Be sure to discuss the “reality” that is not inherent in this activity. That is, very few cells are actually “spherical”. It’s true that most animal cells are of a round-ish shape, but they tend to be flattened out, and often have projections from the membrane surface. This serves to dramatically increase surface area while having a negligible effect on the volume of the cell.

## Assessment

Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is collected. The Slide Show can be utilized to give students immediate feedback on their assessment.