Standard 4. 4: Attributes of two- and three- dimensional objects are measurable and can be quantified.

Question 1: How might surface area and volume be used to explain biological differences in animals?

Assessment tier 1: (Local)

Describe how to compute surface area and volume of any 3-dimensional shape.

- Compute the surface area of any 3-dimensional shape.
- Computer the volume of any 3-dimensional shape.
- Give an example of a figure that has the same volume and surface area.
- Describe how to increase the surface area and decrease the volume of a particular shape.

Assessment tier 2: (Coherence)

Display an understanding of how to manipulate the measurements of a shape in order to change the surface area of volume.

- When designing a book shelf, describe how to increase the number of books that can be place in the shelf, without increasing the size of the book shelf.
- Analyzing the volume and surface area of different cakes, depending on the size of the cake pan.

Assessment tier 3: (Rigor)

Display an understanding of how to manipulate the measurements of a 3-dimensional shape to make it more effective and efficient.

- How can the dimensions of a trash can be manipulated to give the most volume of trash for the smallest surface area of the container.
- In packaging design, how can you manipulate the dimensions of a package to best suit the objectives of the packages.
- Describe circumstances when an engineer may want to manipulate the measurements of an object to best meet the purpose of the figure.

Questions 2: How is the area of an irregular shape measured?

Assessment tier 1: (Focus)

Describe the steps in finding the area of a irregular shape.

- Compute the area of any regular shape.
- Divide any irregular shape into regular shapes, find the area of regular shapes, and thus the sum of the regular shapes is equal to the area of the irregular shape.
- Demonstrate an understanding of how best to divide up the irregular shape to make the computation simpler.

Assessment tier 2: (Coherence)

How can finding the area of an irregular shape be helpful in different disciplines?

- Computer the amount of material that is needed to construct any 2-dimensional or product.
- How much construction paper is needed to draw the map of Spain?

Assessment tier 3: (Rigor)

Display an understanding of how to manipulate the measurements of a 3-dimensional shape to make it more effective and efficient.

- Knowing the about of bushels of corn produced per acre, be able to figure the area of an irregular field to find amount of total product produced.
- How much area is need for a county fair, given the dimensions of each booth and the space needed between each booth?
- Using Adobe Photoshop, how can the dimensions of each figure in a picture be proportioned to enhance the picture.

Essential Question3 – How can surface area be minimized while maximizing volume?

Tier 1 – Focus

Given the surface area of an object determine the volume

Given the volume of an object determine the surface area

Given a desired volume determine the minimum necessary surface area needed to achieve it
Give a maximum surface area determine the maximum volume of an object

Tier 2 – Coherence

How does the surface area of a bird's wings impact the ability to achieve lift?

How would the greatest possible error effect the surface area and volume of an object?

Tier 3 – Rigor

Why would someone want to minimize surface area but maximize volume? What purpose would this serve?

How would it impact cost from an economic viewpoint if everything were shipped in spheres and not boxes? How do you know this?

What traits do surface area and volume share? How does this impact their relationship?

Essential question 4 – What are the differences between area, surface area, and volume in different objects?

Tier 1 – Focus

What 2-dimensional measure seeks to explain the same trait as surface area?

Given an object identify its area or surface area and volume

Given a formula describe the property of the geometric shape

Tier 2 – Coherence

How is a 3-dimensional object “unfolded” into 2-dimensions?

What is the relationship between the formulas for a cylinder and the formulas for a cone? What shapes do both objects share, what are their differences?

Tier 3 – Rigor

Why do area formulas return unit^2 while volume formulas return unit^3?

*what does the square or cube refer to?

What kind of information can be derived from the formulas for area versus the formulas for volume? How can this kind of information be applied from an economic viewpoint?

Essential Question 5 – How do the formulas differ between two- and three-dimensional objects?

<u>Tier 1 – Focus</u>

Given a formula for a 2-dimensional object create a 3-dimensional object

* given the formula for the area of a cube determine the formula for the volume of a cube

Given a formula for a 3-dimensional object determine what 2-dimensional objects combine to create it

*Given the volume for the surface area of a pyramid determine what objects combine to create it.

Given a 3-dimensional object determine the formulas for 2-dimensional objects that are used to determine surface area

Tier 2 – Coherence

How can 3-dimension objects be projected onto 2-dimensional spaces?

What is the relationship between graphs of 2 and 3 variable functions?

How does a planar structure for carbon differ in tensile strength from 3-dimensional structures for carbon?

Tier 3 - Rigor

What is the similarity between the formula for area of a 2-dimensional object and the volume of a 3-dimensional object

Why do area formulas return unit^2 while volume formulas return unit^3?

*what does the square or cube refer to?

Explain how formulas for 2-dimensional objects relate to formulas for 3-dimensional objects.

Essential Question 6 – How does the relationship between surface area and volume affect the efficiency in manufacturing

Tier 1 – Focus

There is no entry for tier 1 as the question reflects real-world applications (tier 3)

Tier 2 – Coherence

There is no entry for tier 2 as the question reflects real-world applications (tier 3)

Tier 3 – Rigor

The surface area of an object relates to the materials that are used to construct it in manufacturing. How does this relationship impact manufacturer's desires in regards to production?

Volume corresponds to what can be contained within an object. How does this relate to a manufacturer's profits?

How would the volume of containers effect the kinds of objects that can be placed within them?

* What kind of objects are favored during shipment and why?