

## Antarctic Adaptation Series

Focus Organism: Weddell Seal, *Leptonychotes weddellii*

### Scientific Question:

How do seal pups survive the cold temperatures in Antarctica?

### Introduction:

Seals and humans are both classified as mammals. Both maintain an internal body temperature of 37° C. Yet, for people to survive in Antarctica, they must rely on their ingenuity to make and use wool, down, and synthetic clothing to avoid freezing to death. How do seals, especially small ones, survive these harsh conditions?



Weddell Seals, mother and pup, on sea ice

### Preliminary Hypothesis:

Before reading scientific data described later in this lesson, write a hypothesis (based on what you already know (or think you know) about seals) describing how you believe seal pups are able to survive in the harsh environment of Antarctica.

Hypothesis #1:

Now, consider these facts:

1. The internal body temperature of a Weddell Seal: 37° C (98.6° F)
2. The ambient air temperature range in coastal Antarctica: -50° to 15° C.
3. The year round sea water temperature: ~ -1.9° C

To figure out the surface area to volume ratios for a mother seal and for her pup, you will need to divide the surface area by the volume to get the correct ratio\*.

*\*Authentic data from Antarctica*

Weddell Adult body

Surface Area = 3.53 m<sup>2</sup>

Volume = .49 m<sup>3</sup>

SA to V ratio = \_\_\_\_\_

Weddell Pup body

Surface Area = 1.83 m<sup>2</sup>

Volume = .162 m<sup>3</sup>

SA to V ratio = \_\_\_\_\_

***REMEMBER: A high surface area to volume ratio provides more exits and entrances proportionately into a body which would increase heat loss.***

**Stating the Problem:**

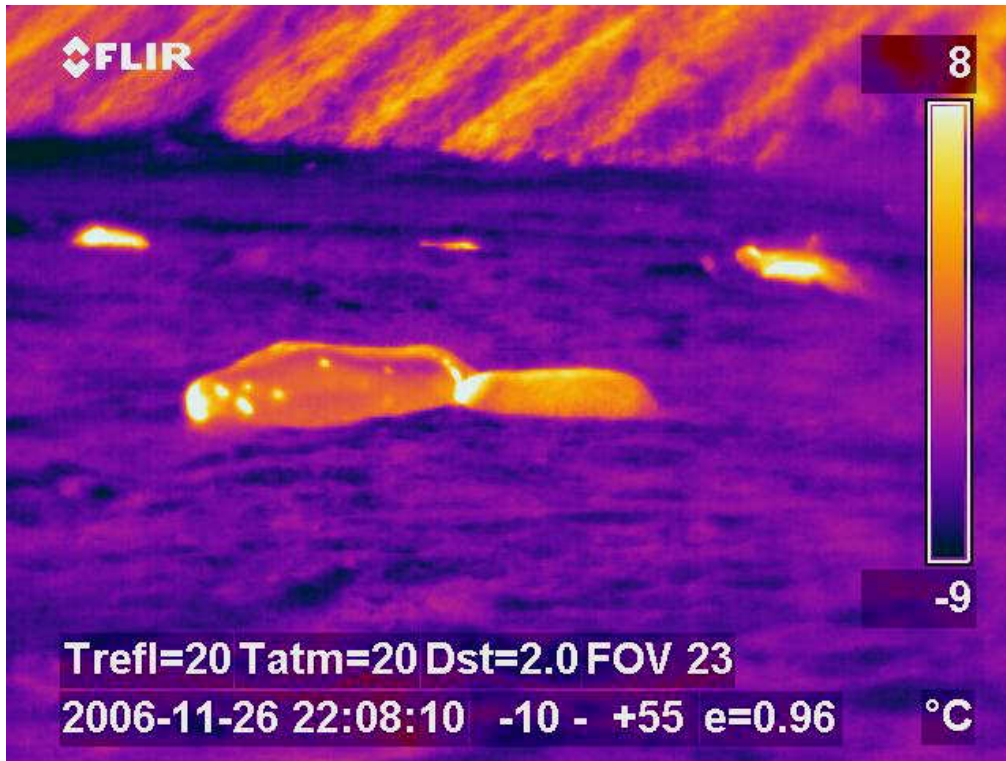
Compare the results of your SA to V ratios for the mom and the pup. Write a problem the pup has as a consequence of this ratio.

Problem:

**Gathering Data:**

Next you will find an infrared photo of the same mom and pup pictured in the previous photograph followed by an excerpt from a scientific journal describing an encounter with a seal. Look carefully at the photograph, read the excerpt, and then answer the questions that follow.

## A. PHOTO



## B. EXCERPT

*“The first seal I examined was a male who had recently emerged from a hole in the ice. At first the camera didn't even distinguish the wet animal from its frozen surroundings; the entire image was dark blue. Assuming the camera was working, the seal's skin temperature was the same as that of the ice--otherwise the batteries in the camera had failed in the cold.*

*Then the seal turned his head toward me and yawned; his hot open mouth glowed bright red in the image. Subtle surface temperatures soon became apparent. Hot nostrils intermittently popped into the picture each time he breathed. The skin around his eyes glowed as well, suggesting that surface blood vessels prevent the eyes from freezing as he hunts for fish in the chilly waters beneath the ice. The rest of the seal's thermal image was a ghostly blue, a testament to the quality of his blubber insulation.” Terrie M. Williams Natural History, October, 2003*

### Questions:

1. What do the different shades in the photo represent?
2. Compare the skin temperatures of the mom **versus** the pup. Describe what the IR picture reveals.

3. The air temperature on the day the picture was taken was +3° C. How would the picture of the seals differ from the seal pictures taken by Terrie in the Natural History excerpt?

4. In which environment would a seal lose more heat, in -1°C air (on land) or in -1°C water (in the ocean)? Explain your answer.

### More Data:

Measurements by seal scientists using ultrasound technology reveal an interesting pattern. As a seal's body length increases, its blubber thickness increases. Blubber thicknesses ranged from 2.2 cm to 5.2 cm.

So here is the question scientists must answer: How can the adult seal's internal temperature be maintained at about 37° C and its skin be at 2° - 4° C?

### Adult Seal Hypothesis:

Form a hypothesis on how the adult seal survives in such a cold climate.

Hypothesis #2:

### More Data:

- Mitochondria produce ATP (energy).
- Pups have higher levels of muscle tissue mitochondria as compared to adults.
- Pups are born with a thick fur coat called **lanugo**, measuring 5 – 8 cm in length.
- The lanugo is shed after one **month**, resulting in a 1 cm thick coat.
- Weddell Seal milk is 40% fat (cow milk is 3.8% fat).
- Pups must nurse almost immediately after birth.
- Pups nurse frequently, increasing their weight rapidly.
- Many pups born during severe storms fail to survive.

### Final Hypothesis:

Now YOU become the seal scientist. Using the data presented throughout the lesson, form a well supported hypothesis on how Weddell Seal pups survive their extremely cold environment. Be sure to point out physical (body) and behavioral (actions) adaptations that enhance survival.

Hypothesis #3:

**Final Project:** Make a survival flyer for Weddell seal pups. Sketch and color a seal pup. On the flyer have two major headings entitled “Survival Do’s” and “Survival Don’ts.” List advice for these categories on the flyer in bulleted phrases using the information you learned in the Weddell seal lesson. (Suggested web site with good seal sketch for reference is [www.enchantedlearning.com](http://www.enchantedlearning.com) . Click Animal printouts; click “W”; click Weddell Seal picture.

Note: Thank you to Dr. Marcus Horning, Dr. Jo Mellish, and Dr. Shawn Noren, seal scientists in Antarctica.