

### Activity 1: Insulation (part A)

#### Results

room temperature (°C) .....

water temperature (°C) .....

TIME (minutes)	BAG WITH SHORTENING TEMPERATURE (°C)	BAG WITHOUT SHORTENING TEMPERATURE (°C)
2		
4		

#### Questions

1. What do you notice about changes in temperature between the two pairs of bags?

.....  
.....  
.....  
.....

2. What does vegetable shortening represent in this experiment?

.....  
.....  
.....  
.....

3. What advantages would a thick fat layer provide the emperor penguin in the Antarctic environment?

.....  
.....  
.....  
.....

## Activity 1: Insulation (part B)

### Results

room temperature (°C) .....

water temperature (°C) .....

submersion time

bag 1 (seconds) .....

bag 2 (seconds) .....

### Questions

1. Did you detect a clear difference in temperature when submerging both hands in the water? Explain any differences noted.

.....  
.....  
.....  
.....

2. What does vegetable shortening represent in this experiment?

.....  
.....  
.....  
.....

3. What advantage would a thick fat layer provide emperor penguins in the Antarctic environment?

.....  
.....  
.....  
.....

## Activity 2: Huddling

### Results

room temperature (°C) .....

TIME (MINUTES)	TEMPERATURE OF TEST TUBE GROUP (°C)	TEMPERATURE OF SINGLE TEST TUBE (°C)
0		
2		
4		
6		
8		
10		

### Questions

1. What did you notice about temperature changes in the single test tube, compared to the group of test tubes? Suggest reasons for any differences.

.....  
.....  
.....

2. The group of test tubes filled with hot water is representative of huddling behaviour observed in male emperor penguins during the incubation period. How does engaging in huddling benefit emperor penguins?

.....  
.....  
.....

3. Why is it important to turn off any fans, air-conditioning or heating appliances in the room prior to conducting this experiment?

.....  
.....  
.....

### Activity 3: Diving reflex

#### Results

average resting heart rate (bpm) .....

water temperature (°C) .....

TIME (SECONDS)	RESTING HEART RATE (BPM)	BREATH-HOLD HEART RATE (BPM)	IMMERSION HEART RATE (BPM)
0			
15			
30			

#### Questions

1. What happened to the heart rate during breath-hold without immersion during the experiment? How does this compare to average resting heart rate?

.....  
 .....  
 .....

2. What happened to the heart rate during breath-hold with immersion during the experiment? How does this compare to average resting heart rate?

.....  
 .....  
 .....

3. Why is the diving reflex evident in humans?

.....  
 .....  
 .....

4. Explain how the diving reflex, specifically a decline in heart rate (bradycardia), would assist emperor penguins during foraging dives.

.....  
 .....  
 .....