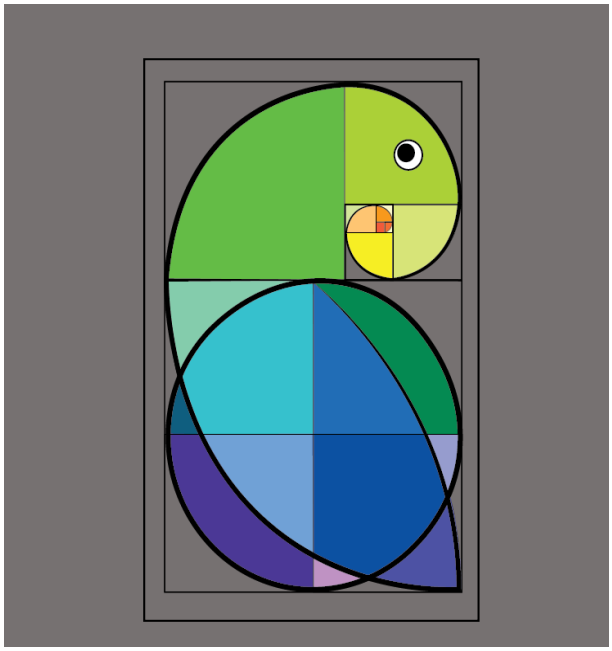


# BIRDEE UNIT 1

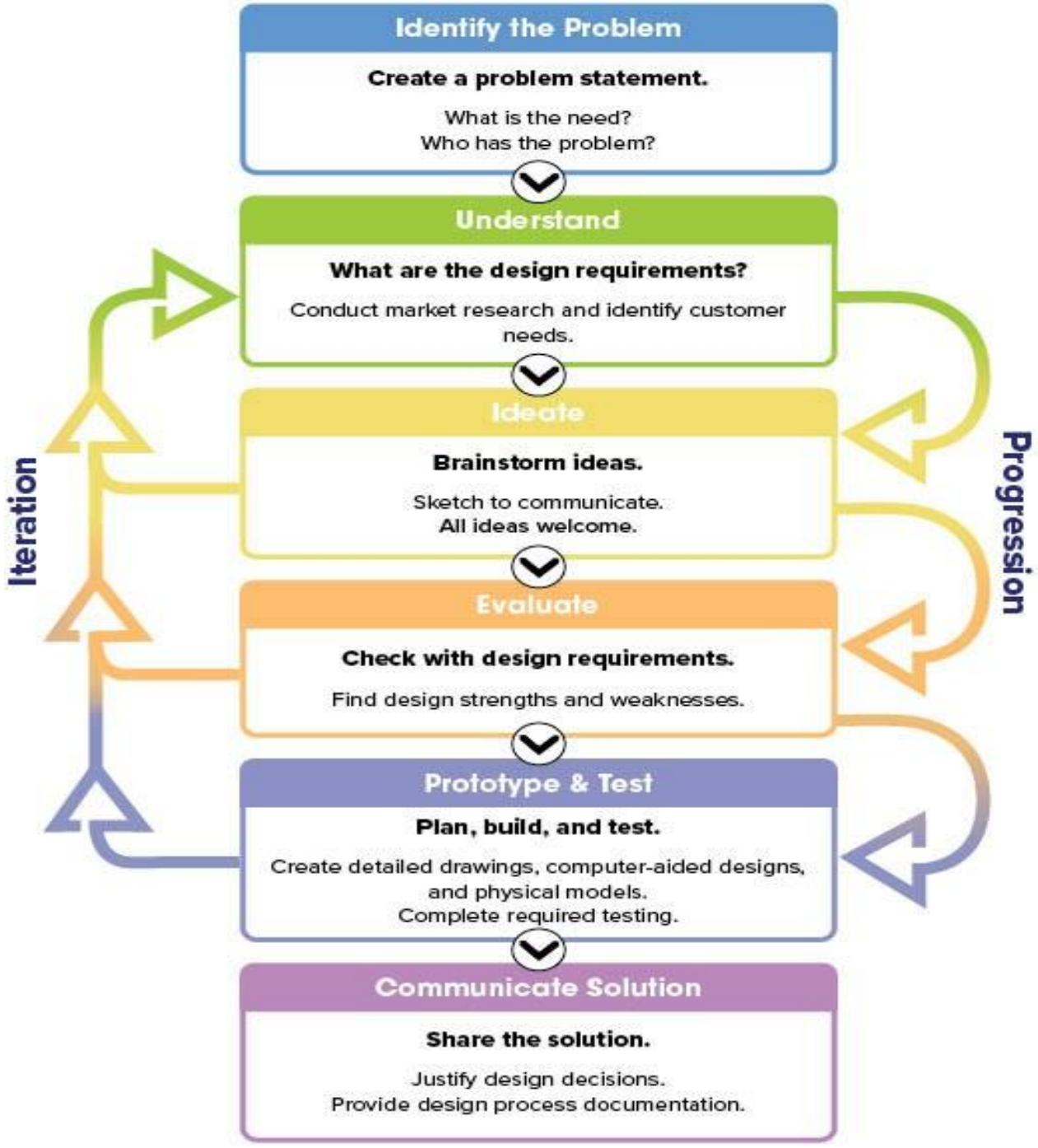
# DIGITAL PORTFOLIO

# WEEK 4

Name:

Date

# Engineering Design Process



# 1.4.1. SFM Analysis Digital Gallery Notes

**Name:** _____ **Date:** _____

Choose 2 posters from the digital gallery. For each poster, answer the questions below for the thermoregulation system in nature on the poster. After completing your own SFM analysis, find a classmate who chose the same examples and compare your SFM analysis. Then, write down what you learned from your classmate.

**Thermoregulation in Nature Example 1:**

What is the system?

What is the primary function of the system?

What are some structures that help the system achieve its primary function? Put a sketch if needed.

What is the mechanism for how the system achieves its primary function? How does the system achieve its primary function?

Notes from your classmate:

**Thermoregulation in Nature Example 2:**

What is the system?

What is the primary function of the system?

What are some structures that help the system achieve its primary function? Put a sketch if needed.

What is the mechanism for how the system achieves its primary function? How does the system achieve its primary function?

Notes from your classmate:

# 1.4.4. Thermal Regulation Experiment Part 2: Analyze Data

**Name: _____Date: _____**

| **Look at your graph and document the values. Use the Data Visualization information to fill in data for other materials.** | | | |
|---|---|---|---|
| **Material** | **Start Temperature (°C)** | **Final Constant Temperature (°C)** | **Time Duration from start to constant** |
| **Control** | | | |
| Cotton | | | |
| Bubble Wrap | | | |
| Aluminum Foil | | | |
| Paper | | | |

| **Observations** |
|---|
| **Which material causes <u>the least change</u> in temperature? _____** <br><br> **Which material causes <u>the most change</u> in temperature? _____** <br><br> **What does this mean in terms of "thermal insulation."?** |

**Based on your test results, rank materials from the best thermal insulating to the least.**

1._____

2._____

3._____

4._____

5._____

6._____

# 1.4.5. Evaluate Data & BID Analogy

**Name: _____ Date: _____**

**Part 1: Evaluate Data**

Use the information gathered during Parts 1 and 2 of the Thermal Regulation Experiment, your new knowledge of heat transfer and conduction, and the **1.4.5. Thermal Regulation Experiment Part 3: Additional Data** to answer the questions below.

**1. Think about Structure and Function. What does the jar do? (function)**

| **Structure: Components** | **Role of each Component** |
|---|---|
| | |
| | |
| | |
| | |

**2. Which material was the best at insulating? Which material was the worst?**

**3. Which material from the experiment yesterday is the best at conducting? Which material was the worst? What does this tell you about the thermal conductivity of the material?**

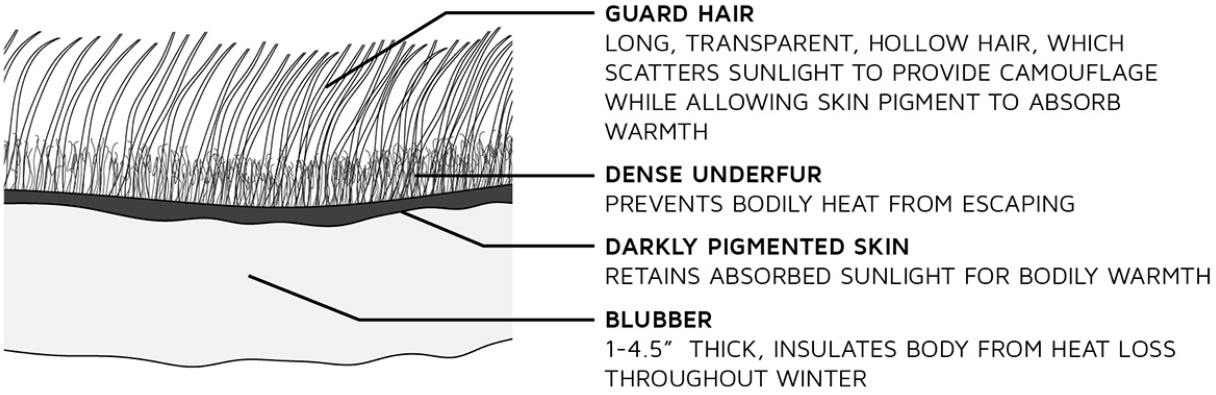
Choose one of the graphs from **1.4.5. Thermal Regulation Experiment Part 3: Additional Data**. The graphs show data derived by wrapping the ice jar with layers of bubble wrap, cotton, and aluminum foil. You will analyze them to determine how changing the number of wrapping layers affects heat transfer.

**4. Write down the graph number _____ and the material _____.**
**How does adding more layers of the same material affect how long the ice stays cold? Justify your answer by discussing the trends on the graph.**

**5. How is the data you have collected in the thermal regulation experiment and in the additional data provided relevant to your design?**

**Part 2: BID Analogy**

Remember the polar bear? We talked about polar bear fur when we learned about SFM in thermal regulation systems. Below is our polar bear fur diagram and our SFM table for polar bear fur.




| **Structure** | | **Function** |
|---|---|---|
| *Component name* | *Structure of component* | *What does each component do?* |
| Guard hair | Long, transparent, hollow hair | Scatters sunlight yet allows skin pigment to absorb warmth |
| Underfur | Shorter, denser hair | Prevents bodily heat from escaping |
| Skin | Darkly pigmented | Retains absorbed sunlight |

| | | |
|---|---|---|
| Blubber | 1-4.5” thick layer of fat | Insulates body from heat loss |

**1. Polar bears use two types of heat transfer to keep warm in the cold Arctic. What do you think those two types of heat transfer are? Why? Justify your answer.**

> ***Hint:*** *Think about the polar bear’s blubber and fur. Think about the polar bear’s pigmented skin and how that is similar to a hot car in the sun****.***

**2. Looking at the diagram of polar bear fur above, how many insulating layers do you think the polar bear has? List these layers and give an explanation.**

**3. Compare the layers a polar bear uses to stay warm to how adding layers to the outside of the jar helped keep the ice in the jar colder for longer. How does adding insulated layers change heat transfer both in the polar bear and in the thermal regulation jar experiment?**

**4. Think about what you have learned about heat transfer. What other organisms in nature use heat transfer principles to regulate body temperature?**

**5. How can the different types of heat transfer and BID examples be applied to the solution you are designing for your client?**

**EDPL Research Notes:** *Add any notes you think are relevant to your design challenge problem.*