

Biomimicry Worksheet

Part A. Biomimicry and Insulation

Data Table 1. Uninsulated Hand (Control)

Name	Time (s)

Data Table 2. Insulated Hand (Experimental)

Name	Mass (g) of Vegetable Shortening	Time (s)
	50 g	
	75 g	
	100 g	

Data Table 3. Class Data for Uninsulated Hand (Control)

Group	Time (s) for Each Group Member		
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Data Table 4. Class Data for Insulated Hand (Experimental)

Group	Time (s) 50 g of Insulation	Time (s) 75 g of Insulation	Time (s) 100 g of Insulation
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Data Table 5. Average Time for Hand Submerged

	Total Time (s)	Total Number of Students	Average Time (s)
Uninsulated Hand (Control)			
50 g Insulation (Experimental)			
75 g Insulation (Experimental)			
100 g Insulation (Experimental)			

Post-Lab Questions

Part A. Biomimicry and Insulation

1. In this activity, the effect of using vegetable shortening (fat) as an insulating material for the body was investigated. This mimics the natural features of which organism or group of organisms?
2. Based on the class data, what conclusions can be drawn regarding the amount of insulation and the ability to withstand cold temperatures?
3. Give two examples of other designs in nature that help insulate and describe how each works.
4. Insulation is a challenge that humans are faced with daily. Give examples of how we mimic nature to insulate ourselves.
5. In the 1940's, a new technique was utilized to ship frozen foods, specifically meat, to other countries. The foods were protected from thawing by lining the ships' holds with containers of frozen lard (animal fat). Meat packers discovered that instead of using common insulating material, such as cork, lard economized space and efficiently protected the meat. List advantages and disadvantages for using lard as an insulation material.

Part B. Biomimicry Design Challenge

Design and engineer a product that solves a human challenge using nature as the primary resource. As a biomimic, use nature's blueprint or recipe to synthesize a product that could be utilized by humans.

1. **Brainstorming Biomimicry Examples.** The chart below is to inspire and guide you as you immerse yourself into the world of biomimicry! Fill in the section for Brainstorm Human Applications with your group and then discuss actual applications with your instructor.

Problem (human challenge)	Organism	Organism's Solution	Brainstorm Human Application(s)	Human Application(s)
Repel bacteria and microorganisms	Galapagos shark	Dermal denticles		Reduce buildup that causes fuel efficiency issues on ships. Prevent secondary infections in healthcare.
Collect water from fog	Stenocara beetle	Bumps on wing covers, waxy shell		
Movement of water without other solutes (such as salt)	Red blood cells	Membrane with hour glass-shaped pores		
Nanoparticle dangers (alter cell structures, possibly killing cells)	Bacteria (sulfur-reducing)	Release a protein that causes nanoparticles to fall out of solution		
Water movement without pumps	Trees	Capillary action and transpiration		
Reduce drag	Humpback whale	Scalloped edges on flippers		
Interior temperature control	Termite den	Chimney and tunnels		
Repel dust and dirt	Lotus flower	Microscopic nail-like protuberances		

2. Research and Guiding Questions for Biomimicry Design Challenge.

- a. Research biomimicry on the Internet. Create a list of man-made products based on natural solutions.
- b. What human challenge do you plan to address with a solution based on biomimicry?
- c. What organism in nature will the solution design mimic? Describe how the mimicking of this organism solves the human challenge. (The way the organism uses the design does not necessarily have to be how humans will use it).
- d. What materials are needed to create the new product?
- e. Describe the solution design. Explain in words and a labeled sketch.
- f. Explain how the design will be tested and what data will be collected to determine whether it solved the human challenge.

Post-Lab Questions

Part B. Biomimicry Design Challenge

1. What human challenge was addressed with the final design solution? (This may differ from brainstorming.)
2. What organism in nature was mimicked for the solution?
3. How did the mimicking of this organism solve the human challenge? (The way the organism uses the design does not necessarily have to be how humans use it.)
4. What data was collected to verify whether or not the design solution worked?
5. How effective was your design at solving the human challenge? Base your reasoning on the collected data.
6. What modifications were made to improve the design?
7. With unlimited resources, what modifications might improve the design?