Name: _____ Date: _____

Sea Turtle Assessment

Sea Turtle Population in Danger?

In 2018, there were a lot of news stories with headlines like: *The sea turtle population in Australia is mostly females* and *Most of the new sea turtles born are female*

The Problem: In 2018, scientists in Australia conducted a study to understand the proportion of male to female sea turtles near the Great Barrier Reef. They expected to find slightly more females because of the rising temperatures on this warm beach. They were surprised to find that, of a population of 200,000 sea turtles, 99.1% of the youngest ones were female, 99.8% of the teenage turtles were female, and 86.8% of the whole population was female. Sea turtles' sex is determined by the temperature of the egg while it is developing in the sand. This table shows the temperature at which sea turtles hatch into males or females.

Temperature	Sea Turtles That Hatch
28°C (82°F) or below	Mostly males
Between 28°C (82°F) and 31°C (88°F)	Half male and half female
31°C (88°F) or above	Mostly females

With more and more female sea turtles, the populations of sea turtles around the world are in danger because both male and female sea turtles are needed to survive and reproduce.

A Solution? Sea turtle conservation efforts are trying many different approaches to protect the sea turtle population. One idea is to move the eggs to an environment in which they can be kept at a controlled temperature. However, the eggs still need to be moved safely. In order to move sea turtle eggs safely, consider the following:

Criteria

- Sea turtle eggs must not rotate or change orientation from how they were first laid in in the ground.
- In a natural environment, sea turtle eggs are heated from above as the sun warms the sand on top of the eggs.
- Sea turtle eggs need humidity to grow, ideally between 80% to 90% relative humidity.
- A temperature of 28°C (82°F) or slightly lower is needed to help produce more male turtles.
- It takes about 10 minutes to move the eggs, so a heater must maintain the desired temperature for 10 minutes.

Constraints

- There is no access to a power source during transportation.

Your Task: Evaluate and select the best possible design for a sea turtle egg incubator (a device that keeps objects warm) that can move the sea turtle eggs to a more permanent location.

Part 1. Evaluate an Existing Incubator: Incubator A

This is an existing egg incubator available for purchase online.
Will it work to move the sea turtle eggs? Review the advertised characteristics of this incubator below:

- Adjustable incubation temperature
- Heating element is above the eggs
- Eggs are rotated on rotating disks
- Humidity can be set for up to 85% relative humidity
- Power supply from a cord to an outlet
- Holds up to 7 eggs
- Costs $200

1a. First, use the criteria and constraints from page 1 to complete the "optimal solution" row in the **testing matrix** to show the ideal incubator characteristics.

Complete the testing matrix on the separate page found on Design Testing Matrix for Sea Turtle Assessment in the row for 1a.

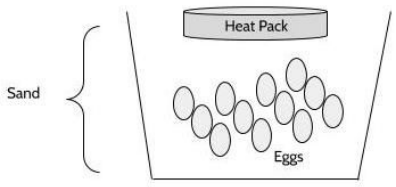
1b. Incubator A was tested against the criteria and constraints and the results of those tests are shown in the Design Testing Matrix.

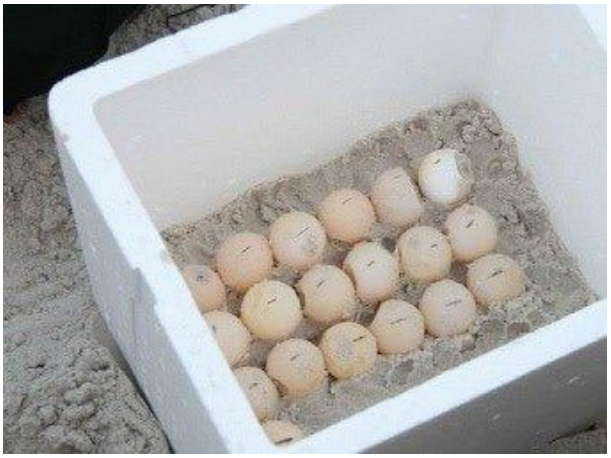
Use the testing matrix to write an argument that states whether or not Incubator A will be sufficient for relocating the sea turtle eggs. Consider the criteria and constraints in the Design Testing Matrix and the advertised performance of Incubator A in your argument.

Part 2: Alternative Design: Incubator B

In a Google search, we found a homemade turtle egg incubator. Below is a picture and a side-view diagram of the incubator.

This incubator claims that it has the following characteristics that will work to incubate turtle eggs:





- Chemical heat packs placed in the top of the incubator, when started, keep the eggs warm for 20 minutes
    - Calcium chloride is on one side, and water is on the other. To start, squeeze the pouch to combine the two substances. The reaction produces calcium hydroxide and hydrochloric acid.
    - Here is the chemical equation: $CaCl_2 + 2H_2O > Ca(OH)_2 + 2HCl$
- When the heat pack is in place, the incubator keeps the eggs at about 35°C
- Eggs sit still in sand
- No guaranteed humidity control
- Holds up to 20 eggs
- Costs $50

How is energy produced in the alternative design using a hot pack if it is not plugged in? Respond to the prompts below.

2a. Is this an ***endothermic*** or ***exothermic*** reaction and why?

_____

_____

_____

_____

2b. Draw a model to explain, "How does the hot pack heat up the turtle eggs?" Use an LOL energy model to show the energy transfer for the reaction occuring in the hot pack to the turtle eggs.

Draw your model on the separate page LOL Models for Sea Turtle Assessment in the space provided for question 2b.

Part 3. Remember, our goal is to select an incubator that will support the relocation of eggs while keeping them at a temperature that will result in more males hatching.

3a. Using the information provided about Incubator B, complete the **testing matrix row** based on how you think it will perform in tests against the criteria and constraints.

Complete on the separate page Design Testing Matrix for Sea Turtle Assessment in the row for 3a.

3b. Which incubator design would work best in order to meet our target design goal?
(Circle one.)

- Incubator **A**
- Incubator **B**
- Combined design features of **A and B**

3c. For the criteria of temperature, how would you optimize the design using the chemical reaction in **Incubator B** in order to ensure the hatching of **male** sea turtles? You may choose to increase, decrease, or keep the same amount of reactants in your redesign. It is not necessary to include the exact amounts of reactants used. In your response, include an updated LOL energy model compared to the original LOL model you made for question 2b to explain why your redesign will work.

Draw your model on the separate page LOL Models for Sea Turtle Assessment in the space provided for question 3c.

3d. Besides temperature, which additional characteristics from each design would you use in your optimal design? To do this, go through each criteria and constraint and state your reasons for which design (Incubator A or B) you would choose for that characteristic.

Criteria and Constraint	Which design characteristic (Incubator A's or B's) would you choose and why?
Egg rotation	
Power source	
Humidity	
Length of time temperature is held	
Location of heat source	