Name _____ *Example (Egg Osmosis)* _____

Period _____ Date _____ Seat No. _____

IB EXPERIMENT DESIGN TEMPLATE STYLE B

State the problem

What percent sucrose solution is isotonic relative to the inside of a chicken egg?

List any research, past knowledge or observations about the problem that will help you formulate a hypothesis

Substances diffuse across membranes according to their own concentration gradient independent of other solutes.

Water moves via osmosis from a hypotonic to a hypertonic environment.

Solutes moves via diffusion from a hypertonic to a hypotonic environment.

There is no net movement of solute particles and water molecules in an isotonic environment.

Draw Inferences

Formulate a hypothesis

(must be testable and falsifiable)

A de-shelled chicken egg placed in an isotonic sucrose solution will not gain or lose mass.

Make a predictive If, and, then statement

and *(testing statement that briefly describes the experiment)*

If the hypothesis is correct, and *sets of de-shelled chicken eggs are placed in sucrose solutions of varying concentrations and their masses recorded at regular time intervals,*

then *the solution in which a set displayed no significant changes in mass is isotonic relative to an egg's interior*

then *(predictive statement with test type and probability, e.g. t—test: p<0.05)*

Design an Experiment

Select Relevant Variables

Manipulated variable (independent or cause)

Concentration of sucrose in solution.

Responding variable (dependent or effect)

Average change in egg mass.

Important variables to be controlled in both set-ups. (constants, controlled variables)

Examples: light, temperature, vibration, etc.

- *All eggs will be de-shelled using the same procedure and time intervals.*
- *All solutions are to be made with distilled water.*
- *All egg groups will be subjected to the same temperatures and soaking times.*
- *Massing of all eggs will be done at specific time intervals.*

Select Materials

Safety

Safety goggles & aprons

List equipment / Draw apparatus

Per group:

Eggs (x8)
Sucrose
Distilled water
Balance scale (IP = 0.1g)
100 mL Plastic massing beaker
600 mL Beaker (x2)
Vinegar (5%)
Spatula
Hot plate/stirrer
Timer

Name _____

IB EXPERIMENT DESIGN TEMPLATE STYLE B

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Design an Experiment (cont.)

Design a method for collecting sufficient data

Independent (manipulated) variable:

What is being measured? Sucrose solution (m/v%)

Number of levels 8 *Level Interval* 6% (m/v%)

Measuring Instrument(s) 600 mL Beaker / Balance scale

Precision of Measurement 50 mL / 0.1 g

Tolerance interval (TI) ± 25 mL / 0.05 g

Number of Experimental Trials 8 (eggs)

Dependent (responding) Variable:

What is being measured? Mass & Time (10 min intervals)

Measuring Instrument Balance scale / Timer

Precision of Measurement 0.1 g / 1 min

Tolerance interval (TI) ± 0.05 g / 0.5 min

Discuss methods for controlling or minimizing the influence of relevant unwanted variables

Example: To minimize cross contamination, beakers are to be thoroughly cleaned between trials.

- *Eggs are to be completely de-shelled to ensure the entire membrane surface is available for diffusion of substances.*
- *Eggs will be placed in containers that allow them to float freely thus avoiding some eggs from being totally submerged while others are not.*
- *In case the vinegar caused dehydration or waterlog a midpoint sucrose soaking solution of 21% will be used as a baseline.*

List any variables that are outside the control of the experimenter

- *The effect vinegar has on the integrity and permeability of the egg membrane is unknown.*

What is the control (what you are comparing the results to)

- *The control is the group of eggs that remain in the 21% baseline sucrose solution.*

Check a method for analyzing & processing data

Means-based numerical
(1.2 cm; 3 sec; 42.3 mL)

- ☐ *Average Difference Paired Test*
- ☐ *One-populations means t-test*
- ☐ *Two-populations means t-test*
- ☐ *Regression analysis*
- ☐ *Other* _____

Proportions-based categorical
(yes, no; male,female)

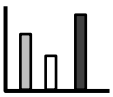
- ☐ *One-populations proportions t-test*
- ☐ *Two-populations proportions t-test*
- ☐ *Chi-square test*
- ☐ *Other* _____

Qualitative Tools
(Drawings, descriptions)

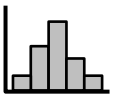
- ☐ *Scale bar (e.g., 100µm)*
- ☐ *Magnification index (e.g., 100X)*

Circle a method for displaying processed data

Graph Types



Bar graph (categorical)
Example: Artemia density and filtered light (colors).



Histogram (continuous data)
Example: Artemia density and wavelength.

Box & Whisker plot (range & quartiles)
Example: Egg-laying variation among Artemia.

Means plot with standard or CI error bars
Example: Comparing Artemia sizes in two ponds.

Correlation scatterplot
Example: Artemia density as a function of temperature.

Line, Semilog, or Log-log graph
Example: Artemia tolerance to heavy-metal pollutants.

Pie Graph
Example: Percent of Artemia in a region.

Name _____

IB EXPERIMENT DESIGN TEMPLATE STYLE B

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In the space below (for quantitative data only),

- design a data table for displaying relevant raw data.
- enter proxy data into the data table.
- run the proxy data through your chosen quantitative analysis tool.
- display the processed proxy data in a graph.

Teacher Notes:

10 bowls of 8 eggs.

Bowl	A	B	C	D	Control (baseline)	E	F	G	H	Extra
Number of Eggs	8	8	8	8	8	8	8	8	8	6 -8
Sucrose Conc. %	0	6	12	18	21	24	30	36	42	21

Make 9 liters of 42% Sucrose solution as follows:

In a 4 Liter beaker, add 3 L of water and place on a hot/stir plate. Add 1260 g of sugar. Repeat two more times to make a total of 9 liters. Pour all 3 batches into a bucket and thoroughly mix. Pour the sucrose solution into 3 one-gallon jugs. These jugs will represent the stock solution. Students will dilute from the 42% sucrose solution to obtain what they need.

After de-shelling the eggs, each group is to make 1 liter of 21% baseline solution to soak their eggs in for one day (see table below). Each group will also prepare 1 liter of their assigned sucrose concentration according to the table below for use the next day:

Mix the following volumes…		**…to make 1000 mL of % solution**
of 42% solution and…	**water…**	
1000 mL	0 mL	42%
858 mL	142 mL	36%
714 mL	286 mL	30%
572 mL	428 mL	24%
500 mL	500 mL	21%
429 mL	571 mL	18%
286 mL	714 mL	12%
143 mL	857 mL	6%
0 mL	1000 mL	0%