New York State Required Labs – Review

- Diffusion Through A Membrane
- Making Connections
- Beaks of Finches
- Relationships and Biodiversity
Diffusion Through a Membrane
Diffusion Through A Membrane

**indicator** – chemically indicates if a substance is present by changing color

- **iodine** = starch indicator solution
- **Benedict’s solution** = glucose indicator solution – must be heated
**Diffusion Through A Membrane**

**diffusion** – movement of molecules from a region of high concentration to a region of low concentration – no energy needed (passive transport)

![Diagram of diffusion through a semipermeable membrane](image)

随着时间

半透膜
we used a dialysis tube to simulate a semi-permeable cell membrane
the dialysis tube was filled with glucose solution and starch solution, sealed and rinsed with water
it was placed in a beaker with water and iodine and allowed to sit
Diffusion Through A Membrane

results of starch test – inside and outside of cell
Diffusion Through a Membrane

results of glucose test – outside of cell
Diffusion Through a Membrane
**Diffusion Through A Membrane**

![Image of glucose molecule]

**glucose molecule**

![Image of part of a starch molecule]

**part of a starch molecule**
Diffusion Through a Membrane

**osmosis** – diffusion of water across a semi-permeable cell membrane from region of high concentration to a region of low concentration – no energy needed (passive transport)
Diffusion Through a Membrane
Diffusion Through a Membrane

cell membrane

cell wall

red onion cells in tap water

cytoplasm
Diffusion Through a Membrane

bathing the cells in 10% NaCl = salt water, by “wicking” it through

NaCl
Diffusion Through a Membrane

- cytoplasm
- cell membrane
- cell wall

red onion cells in salt water
Diffusion Through A Membrane

bathing the cells in distilled water, by “wicking” it through
Diffusion Through a Membrane

*red onion cells in distilled water – returned to normal*
Diffusion Through A Membrane

Which is in distilled water and which is in salt water?
Diffusion Through A Membrane

Applications –

- salt on roads to melt snow
- intravenous saline solutions
- salty foods make you thirsty
- salt on slugs to kill them
- salty foods do not spoil as easily
- gargling with salt water
- digestion of starch to glucose
Making Connections
Making Connections –
Part A: Looking for Patterns  A1. What Is Your Pulse Rate?

**pulse** – results from expansion of arteries each time your heart beats to send a surge of blood through your body

- measured pulse three times and found average pulse rate
- tallied class average pulse rates
Making Connections –
Part A: Looking for Patterns    A1. What Is Your Pulse Rate?

Complete a Data Table
Use the average pulse rate for each student in the class to complete the data table below.

<table>
<thead>
<tr>
<th>Pulse rate per minute (range of averages)</th>
<th>&lt; 51</th>
<th>51-60</th>
<th>61-70</th>
<th>71-80</th>
<th>81-90</th>
<th>&gt; 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students in this range</td>
<td>1</td>
<td>10</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Prepare a Histogram
Use the information in the data table to prepare a histogram of the class results. Use the grid below.
- Provide a title for the histogram.
- Label the vertical axis and mark an appropriate scale on the vertical axis.
- When you have determined the height of each column, shade in the vertical bars.

Histogram Title: Average Pulse Rates

```
<table>
<thead>
<tr>
<th>Number of Students in This Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 51</td>
</tr>
<tr>
<td>51-60</td>
</tr>
<tr>
<td>61-70</td>
</tr>
<tr>
<td>71-80</td>
</tr>
<tr>
<td>81-90</td>
</tr>
<tr>
<td>&gt; 90</td>
</tr>
</tbody>
</table>
```

Bell-Shaped Curve
Making Connections –
Part A: Looking for Patterns     A1. What Is Your Pulse Rate?

• after exercise, pulse increased
• heart beats faster - increasing circulation - to carry more oxygen and nutrients to the cells of the body
• breathe faster to obtain more $O_2$ and release $CO_2$
• respiratory and circulatory systems working together to maintain homeostasis
Making Connections — Part A: Looking for Patterns

A2. How Does Fatigue Affect Muscle Performance?

• squeezed clothespin for one minute – counted
• squeezed again for one minute using same hand
• the second time number of squeezes was lower due to **muscle fatigue**
Making Connections — Part B: Investigating Claims

claims are accepted if there is evidence to support them

<table>
<thead>
<tr>
<th>Student A</th>
<th>Student B</th>
</tr>
</thead>
<tbody>
<tr>
<td>claims more clothespin</td>
<td>claims more clothespin</td>
</tr>
<tr>
<td>squeezes in 1 minute if</td>
<td>squeezes in 1 minute if</td>
</tr>
<tr>
<td>exercises 1st – faster</td>
<td>rests 1st – exercise uses</td>
</tr>
<tr>
<td>pulse rate, blood</td>
<td>energy - resting person</td>
</tr>
<tr>
<td>getting to muscles faster</td>
<td>will have more energy</td>
</tr>
</tbody>
</table>

conduct a controlled experiment to determine which claim is correct
Experimental Design

**Question:** Can you squeeze a clothespin more times in one minute if you exercise or rest beforehand?

**Hypothesis:** (tentative statement about the expected relationship between the variables) You can squeeze a clothespin more times in one minute if you rest first.

**Title:** The Effect of Exercise and Rest on Clothespin Squeezing Rate
Experimental Design

**Dependent variable:** (what you measure) number of times the clothespin can be squeezed in one minute

**Independent variable:** (the one we vary to see how it affects the dependent variable) amount of exercise

**Variables that must be controlled (kept constant):**
- type of clothespin
- fingers used
- time of exercise/rest
- time of squeezing
- same hand for each trial

*use maximum sample size and number of trials in experiment*
Making Connections – Part B: Investigating Claims

Experimental Design

• half of class rests and half of class exercises – then all count number of clothespin squeezes in one minute

OR

• whole class rests and counts number of clothespin squeezes in one minute – then whole class exercises and counts number of clothespin squeezes
Making Connections – Part B: Investigating Claims

Final Report

• Title
• Hypothesis
• Materials and Methods – materials used and what you did
• Data Collected – includes data tables and graphs
• Discussion and Conclusions – does data support or refute hypothesis and explanation
• Suggestions for Improvement – sources of error, variables that must be controlled and that influenced outcome
• Suggestions for further research – new research questions
Peer Review

Defending findings and conclusions to peers:

- presentation
- address final report
- answer questions
- visual aids

Results and conclusions accepted if they can be repeated by other scientists
Beaks of Finches
Beaks of Finches

Charles Darwin
Beaks of Finches

Darwin’s finches show great **variation** in beak **adaptations** – shapes and sizes - due to isolation of bird populations on islands with different kinds and amounts of food.
Beaks of Finches

- different tools represent different beaks
- seeds (small and large) represent food
- tray represents the island
- cup represents finch stomach
Beaks of Finches

Round One: No Competition, Original Island
- feeding with no competition - one person at a time
- feeding on small seeds
- as many as possible in given time
- repeated twice with each person = 4 trials total
- average of 13 or greater survived
- average of less than 13 moved to new island

Round One: Feeding with No Competition

| Partner #1 | Trial #1 | | | Seeds Collected |
|------------|---------| | | |
|        |  | | | |
| Partner #2 | Trial #3 | | | |
|        |  | | | |
|        | Trial #4 | | | |
|        | Average | | | |
Beaks of Finches

**competition** – interaction between two or more individuals to obtain a resource that is in limited supply

Round Two: Competition

- on original island with small seeds (if survived round 1)
- on new island with large seeds (if did not survive round 1)
- competition – feeding with another team from same dish

<table>
<thead>
<tr>
<th>Partner #1</th>
<th>Trial #1</th>
<th>Trial #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner #2</td>
<td>Trial #3</td>
<td>Trial #4</td>
</tr>
</tbody>
</table>

Seeds Collected

- Original island (small seeds)
- New island (large seeds)
Beaks of Finches

Round Three: Increased Competition
- competing with all other species left on your island
- all successful at feeding on small seeds at one dish
- all successful at feeding on large seeds at another dish

<table>
<thead>
<tr>
<th>Round Three: Feeding with Increased Competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original island (small seeds)</td>
</tr>
<tr>
<td>Seeds Collected</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Partner #1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Partner #2</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Beaks of Finches

This activity simulates concepts involved in natural selection:

variation – different beak types and seed sizes
competition – more than one bird feeding at a time
struggle for survival – each bird trying to get enough to survive
adaptation – particular characteristics of each beak
environment – the birds, food and island
selecting agent – the size of seed available
Beaks of Finches

Overall:
• some birds had beaks that allowed them to survive on small seeds
  - if a bird survives it can reproduce
  - it may then pass its traits on to its offspring
• other birds could not survive on small seeds, but could survive on large seeds
• still other birds could not survive on either size seed
• over time **adaptive radiation** occurred - new species evolved from a common ancestor – each new species occupies a different habitat or ecological niche (in this case with different food)
Different finches have beaks with different characteristics that allow them to compete successfully on different types of food – each species has its own niche, which limits competition.

In order for a species to survive, the appropriate type of food must be available.
Relationships and Biodiversity
• *Botana curus* – hypothetical plant
• used to make Curol – for treating cancer
• *Botana curus* – endangered, grows slowly
• related species: X, Y and Z
• will determine which is most closely related to *Botana Curus* using structural and molecular evidence
• will decide which species (X, Y or Z) is most likely to produce Curol
Relationships and Biodiversity

Structural Evidence – Test 1: Structural Characteristics of Plants
Relationships and Biodiversity

Structural Evidence – Test 2: Structural Characteristics of Seeds
Relationships and Biodiversity

Structural Evidence – Test 3: Microscopic Internal Structure of Stems

examined cross section of stem under microscope to determine arrangement of vascular bundles

Figure 1
Relationships and Biodiversity

Structural Evidence – Test 3: Microscopic Internal Structure of Stems

*Botana curus* scattered bundles

Species X circular bundles

Species Y circular bundles

Species Z scattered bundles
Hypothesis after examining structural evidence is that *Botana curus* is most closely related to species Z.
Relationships and Biodiversity
Molecular Evidence – Test 4:
Paper Chromatography to Separate Plant Pigments

**pigments** – absorb sunlight in plants, give plants color, ex: chlorophyll
- pigments extracted from each species
- placed on chromatography paper
- chromatography paper placed in water
Relationships and Biodiversity

**Molecular Evidence – Test 4:**
**Paper Chromatography to Separate Plant Pigments**

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**Images:**
1. Bottles labeled with plant species.
2. Paper strip for chromatography.
3. Beaker with test samples.
Relationships and Biodiversity

Molecular Evidence – Test 4:
Paper Chromatography to Separate Plant Pigments
Relationships and Biodiversity

Molecular Evidence – Test 5: Indicator Test for Enzyme M
Molecular Evidence – Test 5: Indicator Test for Enzyme M

*Botana curus*
enzyme M present

Species X
enzyme M absent

Species Y
enzyme M present

Species Z
enzyme M present
Molecular Evidence – Test 6: Using Simulated Gel Electrophoresis To Compare DNA
Relationships and Biodiversity

Molecular Evidence – Test 6: Using Simulated Gel Electrophoresis To Compare DNA
Relationships and Biodiversity

Molecular Evidence – Test 6: Using Simulated Gel Electrophoresis To Compare DNA
Relationships and Biodiversity

Molecular Evidence – Test 6: Using Simulated Gel Electrophoresis To Compare DNA
<table>
<thead>
<tr>
<th></th>
<th>Botana curus</th>
<th>CAC</th>
<th>GTG</th>
<th>GAC</th>
<th>TGA</th>
<th>GGA</th>
<th>CTC</th>
<th>CTC</th>
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<tbody>
<tr>
<td>mRNA</td>
<td>GUG</td>
<td>CAC</td>
<td>CUG</td>
<td>ACU</td>
<td>CCU</td>
<td>GAG</td>
<td>GAG</td>
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<tr>
<td>Protein</td>
<td>VAL</td>
<td>HIS</td>
<td>LEU</td>
<td>THR</td>
<td>PRO</td>
<td>GLU</td>
<td>GLU</td>
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<tr>
<td></td>
<td>Species X</td>
<td>CAC</td>
<td>GTG</td>
<td>GAC</td>
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<td>CAC</td>
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<td>LEU</td>
<td>SER</td>
<td>PRO</td>
<td>VAL</td>
<td>GLU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Species Y</td>
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<td>GAC</td>
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<td>GGA</td>
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<td>VAL</td>
<td>GLU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Species Z</td>
<td>CAC</td>
<td>GTA</td>
<td>GAC</td>
<td>TGA</td>
<td>GGA</td>
<td>CTT</td>
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<td>VAL</td>
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<td>GLU</td>
<td>GLU</td>
<td></td>
</tr>
</tbody>
</table>
Molecular Evidence – Test 7: Translating the DNA Code to Make a Protein
Sample Completed Table 1: Comparison of *Botana curus* with Species X, Y, and Z

<table>
<thead>
<tr>
<th>Species</th>
<th>Structural Evidence</th>
<th>Molecular Evidence</th>
<th>Gel Electrophoresis DNA Banding Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Botana curus</strong></td>
<td>Answers will vary.</td>
<td>Blue Yellow Pink</td>
<td>Present</td>
</tr>
<tr>
<td><strong>Species X</strong></td>
<td>Answers will vary.</td>
<td>Blue Yellow Pink</td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Species Y</strong></td>
<td>Answers will vary.</td>
<td>Blue Yellow (see below*)</td>
<td>Present</td>
</tr>
<tr>
<td><strong>Species Z</strong></td>
<td>Answers will vary.</td>
<td>Blue Yellow Pink</td>
<td>Present</td>
</tr>
</tbody>
</table>
Relationships and Biodiversity

• Which species – X, Y or Z - is most similar to *Botana curus* and is most likely to produce Curol?

• Which kind of evidence – structural or molecular – is most helpful to make decisions about relationships between species?

• Which evolutionary tree diagram best shows the relationships between species used in this lab?
biodiversity – a measure of the number and types of organisms in a location

• helps maintain ecosystem stability
• useful to humans for food, medicine, clothing, shelter, oxygen, soil fertility, future genetic variation, enjoyment
• we have no right to destroy
Relationships and Biodiversity

**extinction** – no more of a given species left on earth

causes of extinction and loss of biodiversity:
  • destruction of natural habitats
  • pollution
  • overharvesting
  • invasive species
  • removal of predators
Relationships and Biodiversity

Human activities are reducing biodiversity and are causing the extinction of real organisms that have real uses, like the hypothetical *Botana curus*. Many people feel that it is important to preserve biodiversity. Some do not feel that it is worth the cost and effort.
New York State Required Labs

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- Relationships and Biodiversity