Introduction to Biology’s 4 Big Ideas Group\_\_\_\_\_\_\_\_

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| --- | --- |
| Name: | Date: |
| Course: Biology Period 1 2 3 4 5 6 7 | Teacher: McQuade |

**Day 1: Big Idea- Systems**

A system is a collection of organized things that creates a whole composed of relationships among members. Cells operate both as systems and subsystems. In other words, cells are collections of organized things that interact, and so can be considered a system on their own. In multicellular organisms, though, many different types of cells interact to form tissues and organs, and so cells are also components of larger systems. The structure and function of subcellular components, and their interactions, provide essential cellular processes.

**Learning Objectives**

* Students will create a model of a cell and identify the functions of the various organelles
* Students will construct explanations as to how interactions of subcellular structures provide essential functions
* Students will predict the effects of a change in a component of a biological system on the functionality of an organism

**Part 1: Watch the Animation:** Watch the following video on YouTube. As you watch complete the chart below by making a list of terms that you see but don’t know. Consider the following when deciding what to put in your list.

<https://www.youtube.com/watch?v=8IlzKri08kk>

Respond to 2 of the following metacognitive prompts. Write at least 2 sentences for each prompt.

|  |  |  |
| --- | --- | --- |
| I felt confused when…  I was distracted by…  I started to think about…  I got stuck when…  I stopped because… | A connection I made was…  I figured out that…  I finally understood…  An image in my head was..  A prediction I made was… | I first thought that… but then realized that…  A word/ some words I did not know…  I remember that earlier in the text…  I lost track of everything except…  The time went by quickly because… |

While I was watching… \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

While I was watching… \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What was the most interesting fact you learned from this animation?
2. Write down 2 questions you could ask about this animation.
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_?
   2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_?
3. Write down 3 terms from this animation. Explain what each one means.
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Draw a picture or graphic that shows an important idea from this movie. Label your drawing with words or descriptions.

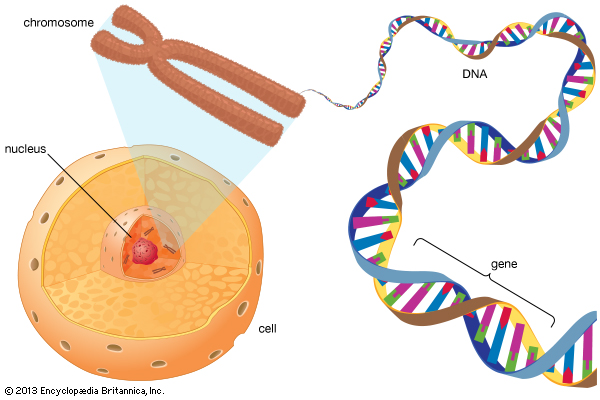
Each group will receive a model of a CELL in a plastic bag. Use this to complete the following.

**Part 2: With your Text Book**

1. Use your dictionary to look up the following words: DNA (deoxyribonucleic Acid), Gene, and Chromosome. Construct an explanation for how these 3 things are related or interact.

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1. Identify the following structures using the words provided.



Label the diagram with the following words:

Cell

Nucleus

Chromosome

DNA

Gene

1. Use metacognitive strategies to read pages 198-199. In the chart below identify whether each of the following cell parts is used for storage, clean-up, or support. Next, give a summary of how each part performs its job.

|  |  |  |
| --- | --- | --- |
| Cell Part | Circle one | Summarize how this part does this job? |
| Vacuoles & Vessicles | Clean-up , storage, support |  |
| Lysosomes | Clean-up , storage, support |  |
| The Cytoskeleton | Clean-up , storage, support |  |

1. Use metacognitive strategies to read pages 197 &200-202. In the chart below describe the structure (what they look like or are made out of) and function of each of the following organelles in building proteins for cells.

|  |  |  |
| --- | --- | --- |
| Organelle | Structure (what does it look like) | Function (what does it do) |
| Ribosome |  |  |
| Endoplasmic Reticulum |  |  |
| Golgi Apparatus |  |  |
| Nucleus |  |  |
| Mitochondria |  |  |

1. Read page 202.What important ideas and information did you get from the text about organelles that capture and release energy?
2. List a question you have about how organelles capture or release energy.
3. Predict what would happen if the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ did not function properly in the cell or was missing altogether (make a claim). Provide evidence to support your answer, and explain your reasoning.

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1. In the model you received, what does the plastic egg represent? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What do the strips of paper inside the egg represent? What is their role in maintaining homeostasis?

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1. What does the plastic baggy represent? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. See pages 193-194 in your text. Construct an explanation based on evidence cited from your text about whether the model of the cell you are working with is a prokaryotic cell or eukaryotic cell. Make sure to include the page numbers where I can find your cited evidence.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Based on all of this information, construct an explanation based on evidence and reasoning on how a cell represents a system (see p1 background information for a definition of a system).

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**Day 2: Big Idea- Information**

Yesterday we learned that cells act as systems with many interacting parts. Living systems store, retrieve, transmit and respond to information essential to life processes. The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring

**Learning Objectives:**

* The student is able to use representations and models illustrating how genetic information is transcribed and translated into proteins which gives organisms their traits.
* The student can predict how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced.
* The student is able to construct scientific explanations that use the structures and mechanisms of DNA and RNA to support the claim that DNA is the primary source of heritable information.

**Background Information**: Each group has a bag that represents one cell of a finch (a type of bird). The entire class, then represents a population of finches. In your group you will use the information stored in the genetic code of your finch to determine what traits it has.

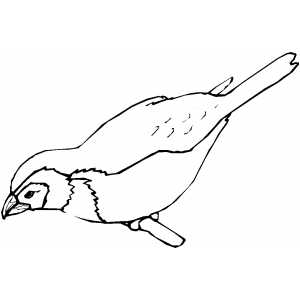
1. What is DNA made out of? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What are proteins made out of? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Write all of the DNA sequences your group is working with in the chart below

|  |  |
| --- | --- |
| Sequence 1 |  |
| Sequence 2 |  |
| Sequence 3 |  |
| Sequence 4 |  |

1. Every person in your group should choose 1 chromosome to work with
2. Copy the DNA sequence in the space provided below
3. Transcribe your DNA sequence into mRNA in the space provided below
4. Translate your mRNA sequence using the codon chart and beads.
5. Sketch what your protein looks like in the space below

|  |  |
| --- | --- |
| DNA Sequence |  |
| mRNA Sequence |  |
| Amino Acid Sequence |  |
| Draw your protein |  |
| Trait |  |

1. Does your protein look exactly the same as anyone else’s in your group? YES / NO
2. How many different kinds of amino acids exist?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. How many amino acids were in your protein?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. How many different kinds of amino acids were in your protein? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. 6. Based on your results as a group, cut out the correct beak for your finch and glue it on. Then color the finch below based on your groups results.



1. Does your group’s bird share any traits with any other groups birds? If so, which trait(s) with which groups(s)?
2. Does your group’s bird look exactly like anybody else’s bird? Yes / No
3. If all of these birds represent a population of the same species, why aren’t they all identical?

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1. Why do you think different organisms of the same species have some of the same proteins?

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1. Why do you think different organisms of the same species have different proteins?

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1. There are some proteins that are found in every living organism, even different species. Why do you think that is?

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1. What is the connection between the DNA sequence found in the nucleus of your cell and the physical trait seen in your finch?

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1. Given what you know about DNA 🡪 RNA 🡪 Protein, predict what you think the outcome would be of a change in the DNA Sequence to the sequence of RNA, and to the protein that is made.

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14. In the space provided draw your DNA Sequence and the corresponding mRNA and protein sequence. Then, simulate a mutation by making 1 change to the DNA sequence (In other words, change an A, T, C, or G do a different letter). Draw the corresponding mRNA and protein for this new DNA. Please use a highlighter in both the original and mutated sequences to show me where you made the change.

|  |  |  |
| --- | --- | --- |
|  | Original sequences | Mutated Sequences |
| DNA |  |  |
| RNA |  |  |
| Protein |  |  |

15. Based on the information in question 14, was your prediction in #13 correct? Explain why or why not. Cite evidence to support your answer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

16. Based on your answers to # 13-15, would your finch still look the same with a change in its DNA sequence? Explain why or why not. Cite evidence from precious responses to support your answer.

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**Day 3: Big Idea- Energy**

Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis**.** All living systems require constant input of free energy, and organisms must exchange matter with the environment to grow, reproduce and maintain organization. All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy

**Learning Objectives:**

* Students will construct explanations of the mechanisms and structural features of organisms that allow organisms to capture, store or use free energy
* Students will be able to illustrate in a diagram how interactions among living systems with their environment result in the movement of matter and energy

**Background Information**

Yesterday as a class we created a population of finches, each with its own unique sets of traits. One trait that we saw varied amongst our finches was their beak size and shape. Today, we will explore how these different beak shapes lead to the birds participating in different food chains to move matter and energy through the ecosystem.

When animals consume other living things like plants or other animals, they don’t just get energy but also matter. Draw a food chain for each of the following 4 types of foods available to the finch, using arrows to depict the movement of matter and energy. It should include the sun, at least one producer, and at least 2 consumers. You will make 4 food chains, one for each of the following food sources:

Watch the following animation and draw a food chain for each of the following birds. You can use the one illustrated in the animation. <https://www.youtube.com/watch?v=_6ZkewO96OQ>

* 1. Large insects
  2. Small insects
  3. Large seeds and nuts
  4. Nectar

1. Define homeostasis.
2. How does the finch use the **energy** it receives from its food to help maintain homeostasis? (Hint: think about activities a bird must do that require energy)
3. How does the finch use the **matter** it receives from its food to maintain homeostasis? (Hint: think about parts of a bird)

**Day 4: Big Idea- Evolution**

The process of evolution drives the diversity and unity of life. Evolution is the change in the genetic makeup of a population over time. Natural selection is a major mechanism of evolution, and it acts on phenotypic variations in populations. Organisms are linked by lines of descent from common ancestry, and so share many conserved processes and features.

**Learning Objectives:**

* Evaluate evidence provided by data to qualitatively and quantitatively investigate the role of natural selection in evolution
* The student will explain the connection between genetic variations in organisms and phenotypic variations in populations

**Background Information**

Charles Darwin observed in his journal that finches living on different Galapagos Islands had different beaks. He also observed that the environment on each of four islands was quite different from the environment on the other three islands; in particular, the type of food available to the finches was different on each island.

Use your chrome books and go to Google Maps. Type in “Galapagos Islands” and use the avatar to take a virtual tour.

Darwin developed a hypothesis that the finches had all been the same at one time, (probably blown over from the coast of South America), with some variations in their beaks which made some beak types better adapted to the food on each island and so the birds with those beaks survived and reproduced and the others did not on that particular island with its particular type of food.

Each group represents the birds with one of the variations of beak found in finch populations. You will use the appropriate tool based on the chart below to represent your bird’s beak, and a graduated cylinder to represent their stomach.

Different islands are represented by four different plates containing one type of food. Each group has one tool, 4 paper plates with the food available on that island, a graduated cylinder and a stopwatch. One member of the team uses the tool to pick up as much food as possible within 10 seconds and places it into the cup (stomach). The food cannot be touched. The plate and the cup are held steady by another group member. Use a stopwatch to time the feeding (ten seconds), and record how much food was eaten in the chart below, using the graduated cylinder to measure it. Replace the food back onto the plate and repeat with each group member performing 1 trial per island.

|  |  |  |
| --- | --- | --- |
| Beak Shapes |  | Tool |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | clothespin |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | Spoon |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | Tweezers |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | Pipette |

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| --- | --- | --- | --- | --- | --- |
| Island/ Food Source | Trail 1 (mL) | Trial 2 (mL) | Trial 3 (mL) | Trial 4 (mL) | Average (mL) |
| Island 1: Large seeds and nuts |  |  |  |  |  |
| Island 2: Large Insects |  |  |  |  |  |
| Island 3: Small Insects |  |  |  |  |  |
| Island 4: Nectar |  |  |  |  |  |

1. Based on your results, do you think your bird would have survived on all four islands? Why or why not? Cite evidence from your trials to support your answer.

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1. On which island would your bird be the most successful? Explain.

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1. Describe the trait/ structural feature of your bird that makes them successful ate eating this type of food.

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1. On which island would your bird be the least successful? Explain.

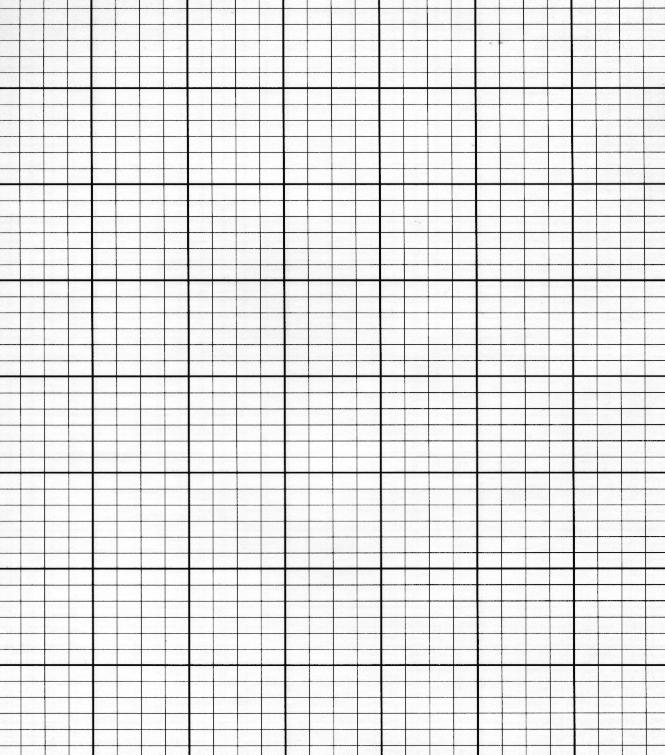
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1. What kind of structure do you think would be best at consuming this food source? Explain.

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| --- | --- | --- | --- | --- |
| Beak Shape | Island 1: Large seeds & Nuts | Island 2: Large Insects | Island 3: Small Insects | Island 4: Nectar |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average |
| http://d1vn86fw4xmcz1.cloudfront.net/content/royptb/370/1666/20140287/F2.large.jpg?width=800&height=600&carousel=1 | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average | Group 1  Group 2  Average |

Use the class data from yesterday’s lab to construct a bar graph showing the **average** amount of food eaten for each type of beak on each island. Make sure to label your X and Y axes correctly, give your graph a title, and make a key.



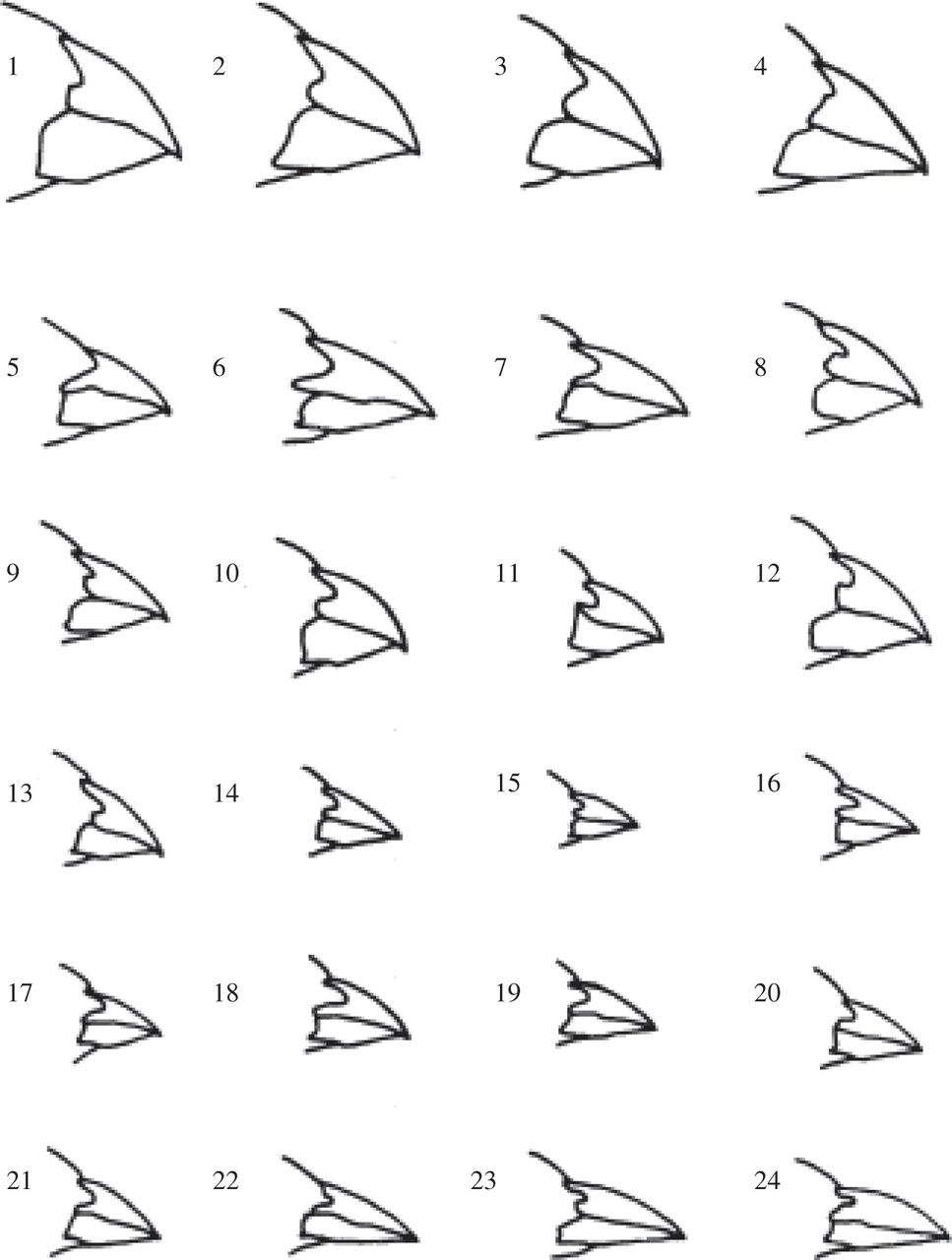
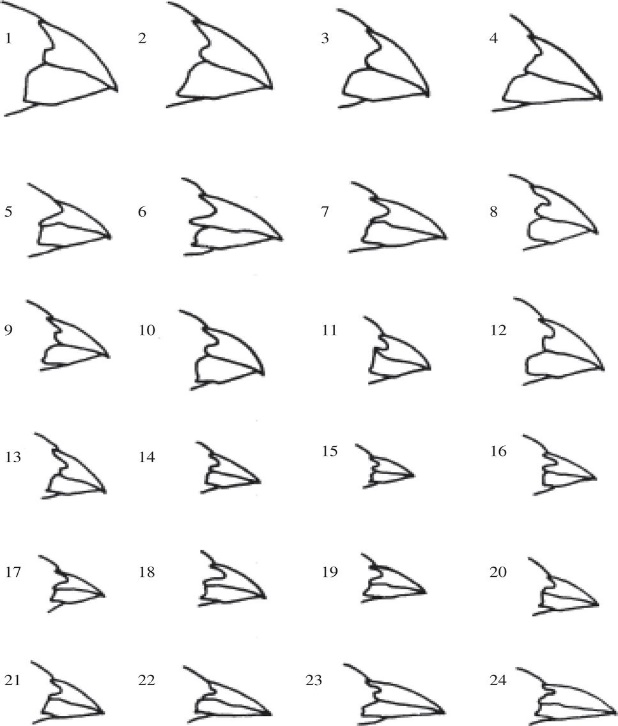
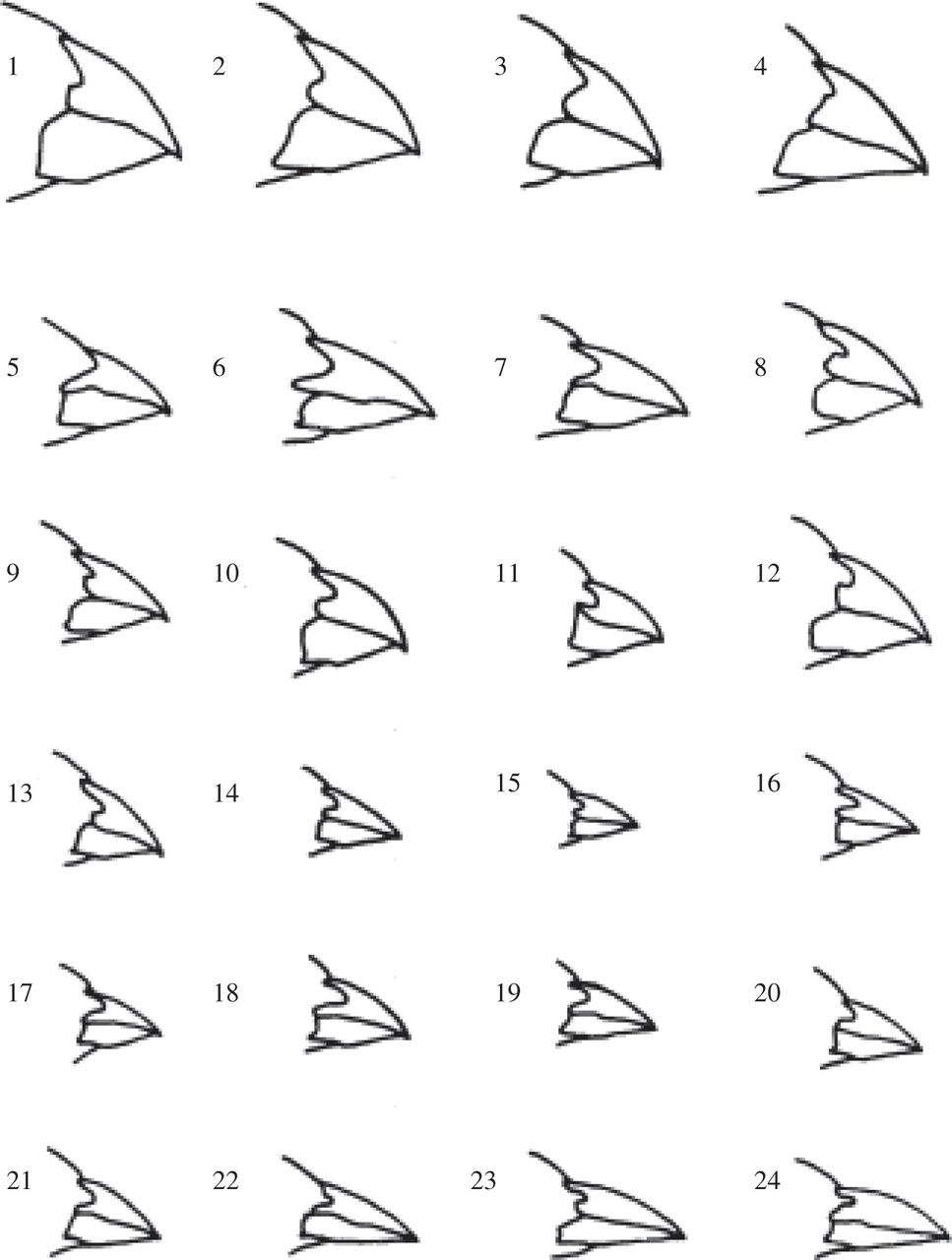
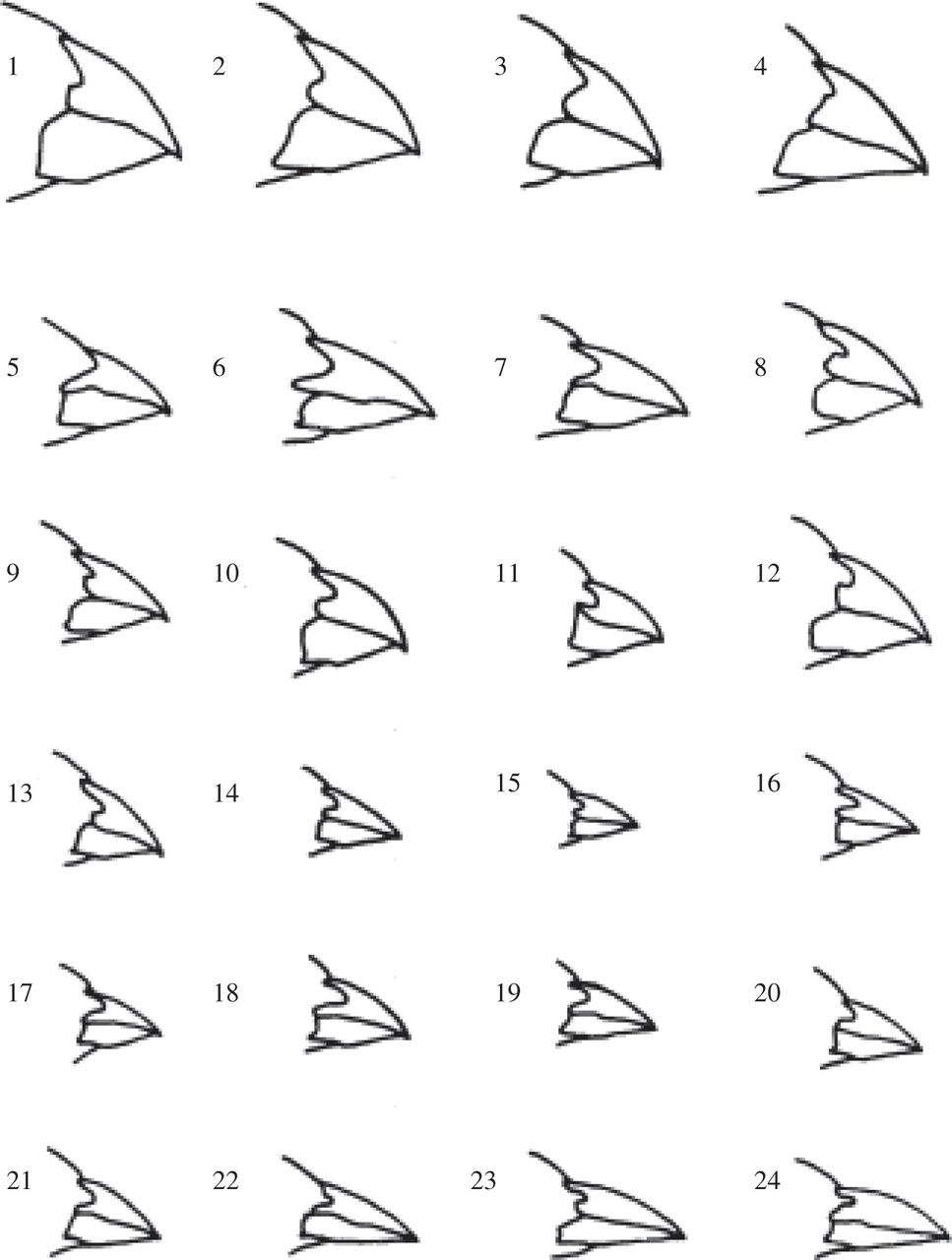
*Rules of Heredity for this activity*

*The bird with the smallest amount of food consumed is declared “starved to death without reproducing”.*

*The bird with the most food consumed is declared “thriving” and is rewarded with two children with the same beak.*

*The remaining two birds survive and have one child each with the same beak.*

1. If all 4 types of bird were caught in a storm and equally distributed on each island, based on your results and the rules of heredity listed above, identify the island (food source) each beak it would be most successful in. Use each island and bird beak only once.

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1. Define adaptation.

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1. What was the adaptation we were looking at in this activity?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What is the definition of natural selection?

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1. What is the definition of evolution?

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1. Birds’ beaks are the tools they have to gather food. What determined what type of beak each bird had?

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1. How was natural selection important/ evident in this activity?

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1. What exactly did the “selecting” in this activity?

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1. What does natural selection act on, genotypes (DNA) or phenotypes (physical traits)?

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1. How does natural selection affect the genotypes of populations over many generations?

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1. The best adapted (fittest) to the available food have the best chance of surviving (not starving to death) and of having descendants. Why are variations in these beak forms important for evolution?

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1. What role do you think natural selection plays in the evolution of man and other organisms?

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1. Based on what you have learned about natural selection and evolution, do you think that natural selection will ever create a “perfect” organism? Give evidence to support your answer. Some things you might consider are the different types of environments that exist, and the traits that work well in them.

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