

Stay-All-Day Activity (HS) – Organizer Notes



Natural Selection of the Galapagos Origami Bird

Description: An experimental design activity that can be done individually (preferred) or in pairs. Students will simulate evolution by natural selection by using coin flips and die rolls to determine mutations that arise in subsequent generations of a straw and paper loop bird. Non-competitive.

Materials: Per person or pair

paper tape die permanent marker
3 straws scissors coin meter stick/tape measure
student handout (copied back to back and stapled)

Experimental Design Section: Read over the entire activity with the participants before allowing them to start. Then they can loop back and answer the questions in the experimental design section. The independent variable is the “anatomy” of the most successful bird (overall or in a given generation) and the dependent variable is flight distance. The control trial is the ancestral bird and the experimental trials are the birds from subsequent generations. Some constants that students may consider include the force used to propel the bird, the height the bird was thrown from, the person throwing the bird, etc.

Analysis: According to Eric Brunsell, Assistant Professor of Science Education at UW-Oshkosh, a claim is something you know. Evidence is how we know what we know (a subset of the data). Reasoning explains why the evidence supports the claim. <http://www.edutopia.org/blog/science-inquiry-claim-evidence-reasoning-eric-brunsell>

There is no right or wrong answer for the claim; it depends on how students interpret the evidence from the data they collected. There is no “perfect” design for the bird. Natural selection allows the most successful bird in the given environmental conditions to reproduce. If conditions change, a successful bird may become much less successful.

The anatomical changes seen by the students should guide the answer about the bird flying 900 cm. Students might say that the bird may become extinct or it may evolve into a new species capable of sustaining flight for longer distances.

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Stay-All-Day Activity (HS) – Student Handout



Natural Selection of the Galapagos Origami Bird

Background: The Galapagos Origami Bird (*Avis papyrus*) lives in arid regions of the Galapagos Islands. It feeds on berries and drinks from natural springs. Only those birds that can successfully fly the long distance between the sparsely spaced oases will be able to live long enough to breed.

Your Task: In this activity, you will “breed” several generations of Origami Birds and observe the effect the birds’ form has on the evolutionary success of these animals.

Experimental Questions: How will random mutations affect the flight distance of *Avis papyrus* if natural selection selects for the longest flight?

Hypothesis: If the most successful bird in each generation is the only one to reproduce then the flight distance for *Avis papyrus* in subsequent generations will INCREASE/DECREASE/STAY THE SAME (circle your choice) because (provide an explanation for your hypothesis)

Independent Variable: _____

Dependent Variable: _____

Control Trial: _____

Constants: _____

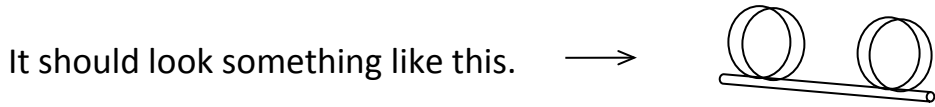
Experimental Trials: _____

Materials

paper	tape	die	permanent marker
3 straws	scissors	coin	meter stick/tape measure

Procedure

1. Make the ancestral bird (the original inhabitant) using these instructions:
 - a. Cut two strips of paper, each strip 2 cm x 20 cm.
 - b. Loop one strip of paper with a 1-cm overlap and tape.
 - c. Repeat for the other strip of paper.
 - d. Tape each strip 3 cm from each end of the straw.



2. Each bird lays three eggs in each generation. Generate three new birds as offspring using these instructions:
 - a. Number the straws 1-3. (Straw 1 is the ancestral bird made in step 1). Mark the head and tail of each straw.
 - b. The first egg has no mutations. It is a clone of the parent. Use the ancestral for this chick to save time.
 - c. The other two chicks have mutations. Determine the mutations by flipping your coin and throwing your die. Make your bird according to the information below. Record your birds' dimensions in the data table.

Coin Flip (determines <u>where</u> mutation occurs)	Die Throw (determines <u>how</u> the mutation affects the wings)
head = front wing mutation tail = back wing mutation	1 = wing position moves 1 cm toward the end of the straw 2 = wing position moves 1 cm toward the middle of the straw 3 = circumference (distance around the wing) increases 2 cm 4 = circumference (distance around the wing) decreases 2 cm 5 = width of wing increases 1 cm 6 = width of wing decreases 1 cm

3. Determine the distance each bird can fly. Release the birds with a gentle, overhand pitch. It is important to release the birds as uniformly as possible. Practice until you feel you can consistently get a good throw. Test each bird at least three times. Record the distance each bird flew in the data table on the next page. **Report your distances to the nearest cm.** Record qualitative data about the flight as well.
4. The most successful bird is the one that can fly the farthest. It survives long enough to become the parent for the next generation. All other birds die. Circle the surviving bird in your data table.
5. Repeat steps 2-4 for 3 more generations. The most successful bird becomes the parent of the next generation. The successful bird has 3 eggs: one without mutations (identical to the parent) and 2 with mutations (see step 2). Sometimes, mutations are lethal: the chick will not hatch. This will happen if a mutation causes a wing to fall off a straw, if the circumference of the wing is smaller than the circumference of the straw, or any other impossible combination. Fortunately, *Avis papyrus* is known to “double clutch” when an egg is lost. The bird lays another egg to replace the lost one. If you get a lethal mutation, disregard it and breed another chick.

Data

Anatomy of Avis papyrus – Generation 1

	front wing to head (cm)	back wing to tail (cm)	circumference front wing (cm)	circumference back wing (cm)	width front wing (cm)	width back wing (cm)
Bird 1	3	3	19	19	2	2
Bird 2						
Bird 3						

Anatomy of Avis papyrus – Generation 2

	front wing to head (cm)	back wing to tail (cm)	circumference front wing (cm)	circumference back wing (cm)	width front wing (cm)	width back wing (cm)
Bird 1						
Bird 2						
Bird 3						

Anatomy of *Avis papyrus* – Generation 3

	front wing to head (cm)	back wing to tail (cm)	circumference front wing (cm)	circumference back wing (cm)	width front wing (cm)	width back wing (cm)
Bird 1						
Bird 2						
Bird 3						

Anatomy of *Avis papyrus* – Generation 4

	front wing to head (cm)	back wing to tail (cm)	circumference front wing (cm)	circumference back wing (cm)	width front wing (cm)	width back wing (cm)
Bird 1						
Bird 2						
Bird 3						

Flight Data – Generation 1

	Flight Characteristics			Flight Distance (cm)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Average
Bird 1							
Bird 2							
Bird 3							

Flight Data – Generation 2

	Flight Characteristics			Flight Distance (cm)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Average
Bird 1							
Bird 2							
Bird 3							

Flight Data – Generation 3

	Flight Characteristics			Flight Distance (cm)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Average
Bird 1							
Bird 2							
Bird 3							

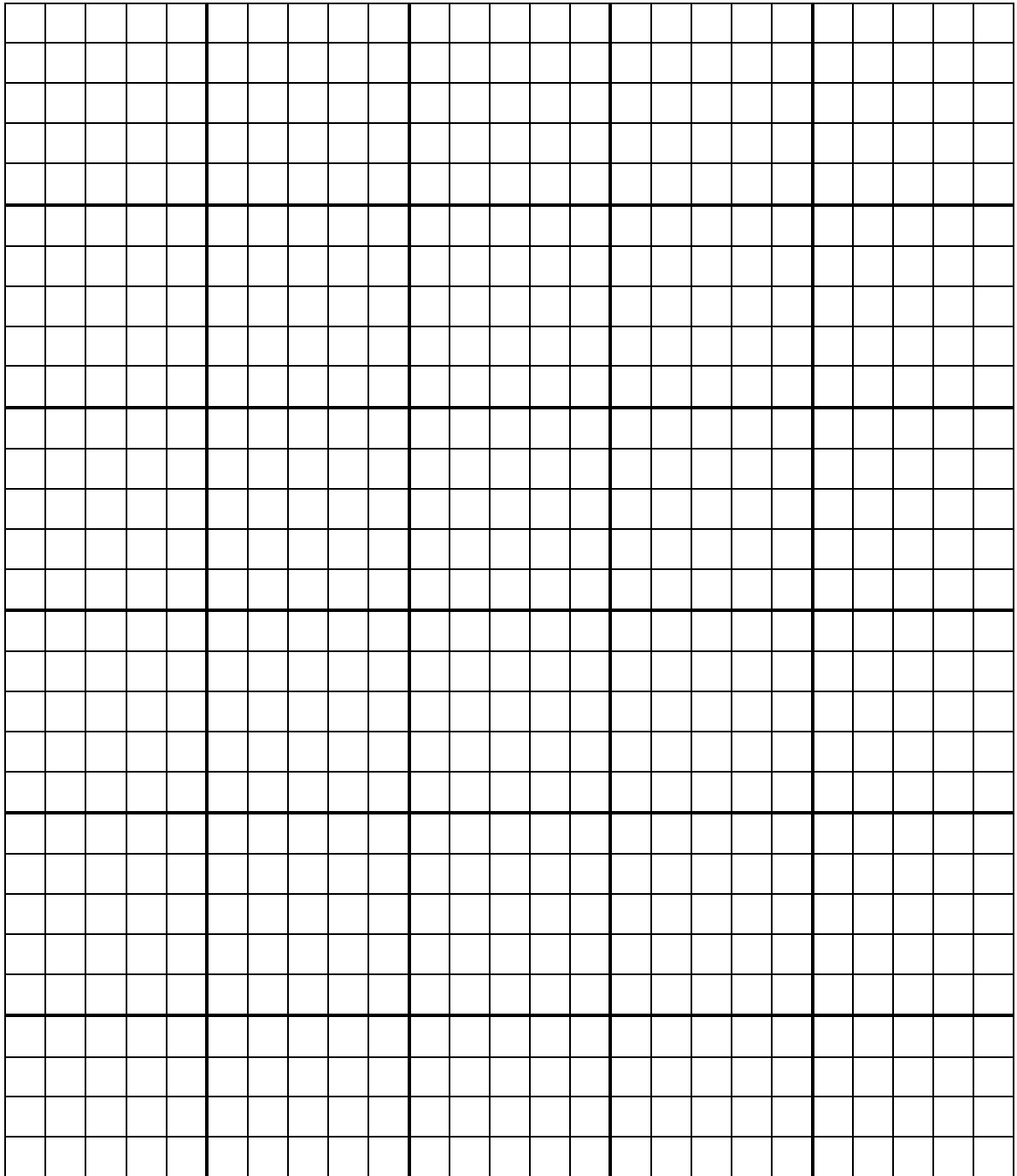
Flight Data – Generation 4

	Flight Characteristics			Flight Distance (cm)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Average
Bird 1							
Bird 2							
Bird 3							

Team name _____

Graph

Graph the average flight distance by the most successful bird vs. the generation of the bird.



Analysis

Compare the data for all of team members. Was your hypothesis supported or refuted? Make a claim about how the flight distance changed throughout the generations and whether or not natural selection was evident. Support your claim with evidence.

If you kept repeating this process for thousands of generations, would it inevitably result in “the perfect design” for *Avis papyrus*? Explain.

If the environment in which *Avis papyrus* lived were to gradually change in such a way that eventually the birds had to fly at least 900 cm in order to “survive”, what do you think would happen? Explain.

Upon completion of this event, turn in your written work and winning bird to the activity organizer.

Good work, and thanks for Staying-All-Day