

# Natural Selection in Action!

## Manus Simulation Activity Guide



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## ***How the Piloses Evolved Skinny Noses (Manus) Classroom Activity Instructions***

**Objective:** Students will discover how adaptation by natural selection affects a population of manus when environmental changes occur. Guided by the activity, students will:

- Adopt one of the manus
- Work together as a class to count the number of manus in each generation
- Graph the number of longer-eared and shorter-eared manus in each generation
- Find out what happens to longer-eared and shorter-eared manus

**Duration:** Approximately 30-45 minutes, depending on class size (not including reading the book)

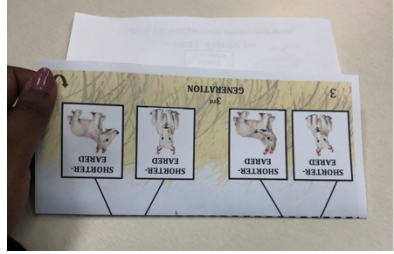

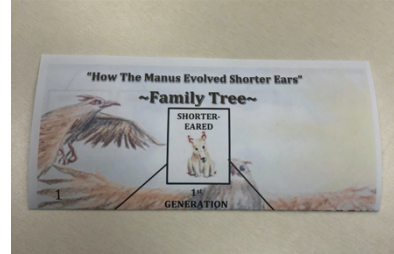
### **Materials:**

- *Family Tree Worksheets*- each student will receive one of two types: longer-eared or shorter-eared. On the last page of these instructions there is a key that shows the number of longer- and shorter-eared *Family Tree Worksheets* you will need based on class size. The *Family Tree Worksheets* will need to be folded along the dotted lines.(see below for simple folding instructions)
- *Graphing worksheets*-one for each student
- Coloring utensils
  - Optional: two different colors; one to graph the shorter-eared manus and one to graph the longer-eared manus

### **Set-up Instructions:**

1. Students should go to a place where they have a solid surface to write and color. Preferably, students will sit at tables or desks.
2. Pass out one *Graphing Worksheet* to each student.
3. Shuffle the *Family Tree Worksheets* and pass out one to each student or have the students pick the sheet themselves. You can tell the students that everyone will not have the exact same sheet. The key for the number of worksheets you need to print is on the last page of this instruction guide.
4. Look at the pictures below. Tell each student to fold their *Family Tree Worksheet* on the dotted lines. Students can fold the sheets with instructions from you, but you may fold them for students if needed.
  - a. Flip the *Family Tree Worksheet* with the blank side facing up.
  - b. Fold the paper into thirds on the dotted lines.
    - Folding Step 1: Fold the bottom section (3rd generation) toward the middle.
    - Folding Step 2: Fold in top section (1st generation) to the middle.

- End Result: At the end of folding, the only part facing up should be the top section labeled “1st Generation”.

Folding Step 1:	Folding Step 2:	End Result!
		

5. As the activity progresses, students will unfold the *Family Tree Worksheet* and each student will graph the total number of longer-eared and shorter-eared manus in each generation.

#### Activity Instructions:

1. Begin the activity by explaining to students that they are going to be looking at manus
  - a. Introduce the environment, and highlight the length of the grass on the left hand side of the sheet. Say to the students **“Today we are going to look at manus. Manus live in grassy areas. The areas where the manus lived had tall grass where they could hide from gorps - the animals that eat them.”**
  - b. Introduce the variability in moth population. Say **“Some of the manus have longer-ears, and some have shorter-ears. The manus are one large population, and each one has different sized ears. So, each of your individual manus - whether its ears are longer or shorter - is from the same population.”**
  - c. Have students individually look at their *Family Tree Worksheet* to see whether their manu has *longer ears* or *shorter ears*
2. Now, the class will count how many shorter- and longer-eared manus are in the population for the 1st generation. You can keep track of the class numbers for each generation by writing or tallying them on the board.
  - a. Have the students with longer-eared manus raise their hand and add up the number of longer-eared manus for the entire class.
  - b. Have the students with shorter-eared manus raise their hand and add up the number of shorter-eared manus for the entire class.
  - c. Point out that there are more tallies on the board for longer-eared manus in the 1st generation than shorter-eared manus.
3. Color in the squares in the graph corresponding to the number of shorter- and longer-eared manus

- a. Optional: To help students see the shift in the population of longer-eared and shorter-eared manus, use two different colors for graphing. For example, use red for the shorter-eared manus and blue for the longer-eared manus.
4. Explain the environmental change to the students
  - a. Say **“But all of a sudden, the weather changed and became very hot and sunny all of the time. And now the grass doesn’t grow very high.”**
  - b. **“This means that the manus with shorter ears can still hide in the grass, but the manus with longer ears have a hard time hiding in the grass, so it is easier for gorps to find them.”**
5. Take a minute to discuss with your students what they think will happen with the next generation of manus now that the grass is shorter:
  - a. **Which manus are likely to get eaten by the gorps?**
  - b. **Which manus are less likely to get eaten by the gorps?**
  - c. **Which manus do you think will live long enough to have many children?**
  - d. **Which manus might get eaten before they have any children?**
6. Walk students through what happens to the first generation of manus.
  - a. Tell your students: **“Some of the longer-eared manus aren’t able to stay hidden from the gorps and are eaten when they are quite young—before they have a chance to have any children. However, some of the longer-eared manus are lucky enough to not get spotted quickly. They live long enough to have one child. Counting off will tell us which manus with longer ears were lucky enough to live long enough to have one child and which manus with longer ears died before having any children.”**
  - b. Assign the students who have longer-eared manus to either an “A” or a “B”, alternating. Tell your students: **“The reason for this is that some of the longer-eared manus aren't able to hide from the gorps and will get eaten. However, some of the longer-eared manus are lucky enough to not get eaten and are able to live and have a child. Counting off will tell us which manus with longer ears were able to have one child and which manus with longer ears died before having any children.”**
  - c. The longer-eared manus assigned to students with an “A” then die and will not have any children.
    - i. Tell your students: **“These manus got eaten by the gorps when they were young. They died before they could have any children.”**
    - ii. Students whose longer-eared manus died should cross out the manus on the sheet (because they’re dead!) and recycle the *Family Tree Worksheet*.
  - d. The longer-eared manus assigned to students with a “B” will live and have one child.
    - i. Tell your students: **“These manus were lucky. They were not spotted by the gorps and did not get eaten. They lived long enough to have one baby.”**
    - ii. Students with longer-eared manus that lived should fold out their worksheet to show the 2nd generation children and cross out the manu from the 1st generation (because it has now died of old age).

- e. The shorter-eared manus will live and have two children.
  - i. Tell your students: **“The shorter-eared manus did not get eaten, so they lived the longest. They lived so long that they were able to have two babies.”**
  - ii. Students with shorter-eared manus should fold out their worksheet to show the 2nd generation and cross out the manus from the 1st generation (because it has now died of old age).
7. Now that the first generation has died walk through what happens to the second generation. The class will count how many shorter- and longer-eared manus are in the population for the 2nd generation. Keep track of the class numbers for each generation by writing or tallying them on the board.
  - a. Have the students with longer-eared manus raise their hand and add up the number of longer-eared manus for the entire class.
  - b. Have the students with shorter-eared manus **raise their fingers** to show how many they have and add up the number of short-eared manus for the entire class.
8. Color in the squares in the graph corresponding to the number of longer-eared and shorter-eared manus.
  - a. Optional: To help students see the shift in the population of longer-eared and shorter-eared manus, use two different colors for graphing. For example, use red for the shorter-eared manus and blue for the longer-eared manus.
9. After this, as in the 1st generation, assign the students who have longer-eared manus with either an “A” or a “B”, alternating.
  - a. The longer-eared manus assigned to students with an “A” then die and will not have any children
    - i. Tell your students: **“These manus got eaten by the gorps when they were young. They died before they could have any babies and so they did not have any children.”**
    - ii. Students whose manus died should cross out the manu on the sheet (because it’s dead!) and recycle their *Family Tree Worksheet*.
  - b. The longer-eared manus assigned to students with a “B” will live and have one child.
    - i. Tell your students: **“These manus were lucky enough to avoid getting eaten by the gorps so they were able to live long enough to have one baby.”**
    - ii. Students with longer-eared manus that lived should fold out their worksheet to show the 3rd generation and cross out the peppered moth from the 2nd generation (because they have now died of old age).
  - c. The shorter-eared manus will live and have two children
    - i. Students with shorter-eared manus should fold out their worksheet to show the 3rd generation and cross out the manus from the 2nd generation (because it has now died of old age).
10. Now that the second generation has died, walk through what happens to the third generation. The class will count how many shorter- and longer-eared manus are in

the population for the 3rd generation. You can keep track of the class numbers for each generation by writing or tallying them on the board.

- a. Have the students with longer-eared manus raise their hand and add up the number of longer-eared manus for the entire class.
  - b. Have the students with shorter-eared manus raise their fingers to show how many they have and add up the number of shorter-eared manus for the entire class.
11. Color in the squares in the graph corresponding to the number of longer-eared and shorter-eared manus.
- a. Optional: To help students see the shift in the population of longer-eared and shorter-eared manus, use two different colors for graphing. For example, use red for the shorter-eared manus and blue for the longer-eared manus.
12. As a class, have a discussion about what the graphs in each generation look like. Here are some examples:
- a. **In the first generation, are there more shorter-eared or longer-eared manus?**
  - b. **In the second generation, are there more shorter-eared or longer-eared manus?**
  - c. **In the third generation, are there more shorter-eared or longer-eared manus?**
  - d. **Did the number of manus with shorter ears increase or decrease over time? Why?**
  - e. **Did the number of manus with longer ears increase or decrease over time? Why?**
13. As a class, have a discussion about what caused the shift in the population. Here are some examples:
- a. **Why are there more shorter-eared manus in the population nowadays, even though there used to be more longer-eared manus in the population before the weather changed?**
  - b. **What do you think would have happened to the population of manus if the weather did not change? Would the population have changed?**
  - c. **How did the manus evolve shorter ears?**

Summary of Class Activity for Teachers:

- Have students unfold their *Family Tree Worksheets* to understand how each generation of manus either lives on or dies out.
- Have students color in the total number of longer-eared and shorter-eared manus in each generation, to show how the population is changing overtime.
- Have a larger discussion with the students so they understand how the manus evolved shorter ears!

<b>Classroom Size</b>	<b>Number of Lighter-Winged <i>Family Tree Worksheets</i> to Print</b>	<b>Number of Darker-Winged <i>Family Tree Worksheets</i> to Print</b>
10	7	3
11	8	3
12	8	4
13	9	4
14	10	4
15	10	5
16	11	5
17	12	5
18	12	6
19	13	6
20	14	6
21	14	7
22	15	7
23	16	7
24	16	8
25	17	8
26	18	8
27	18	9
28	19	9
29	20	9
30	20	10
31	21	10
32	22	10
33	22	11
34	23	11
35	24	11