Nature vs. Nurture: How Genes and the Environment Shape Vocal Learning in Songbirds

Name: _____   Date: _____

Using songbirds as a model to understand the contributions of genetics and environment in vocal learning

Key concepts

- Traits are determined by genetics and environment.
- Genetics refers to the genes (pieces of DNA) that a living thing has and how they are activated.
- Environment refers to the surroundings and experiences that a living thing has during its life.
- Neuroplasticity (*neuro* means brain and *plasticity* means modable or changeable) is the idea that brains change as a living thing learns.

Part 1: Background Information

1. What are the three types of finches we will be using in our experiment? Describe each of their songs in your own words.

Type of Finch	Description of Song

2. Why do male finches sing?

3. Why are finches a good model organism for learning about how humans learn language?

4. What brain features do all vocal learners share?

5. How are genetics important in forming this brain feature?

6. What role does neuroplasticity play in vocal learning?

Part 2: Experimental Design

Your task is to design an experiment that will provide evidence to help determine if a finch's song is determined by its **genes**, its **environment**, or **both**.

You will use two finches (experimental and control) that are twin brothers for this experiment - you can choose which species. Your control finch should be tutored by the same species that it normally would. For your experimental finch, you can change up the tutor.

You have the following available to you:

Baby Finches	Tutors
2 Zebra Finch Brothers	Zebra Finch (will only teach Zebra Finch)
2 Bengalese Finch Brothers	Bengalese Finch (will teach ANY finch)
2 Long-Tailed Finch Brothers	Long-Tailed Finch (will only teach Long-Tailed Finch)
	No Tutor

Fill in the blanks below to show your experimental design and your hypothesis/predictions.

CONTROL TREATMENT   **EXPERIMENTAL TREATMENT**

Baby Finch Species:

_____

Control Tutor Species:

_____

Prediction: What do you think the baby's song will be like?

Experimental Tutor Species:

_____

Prediction: What do you think the baby's song will be like?

Hypothesis: What is your reasoning for your predictions?

Part 3: Experimental Results

Use the following website to carry out your experiment: https://sites.google.com/view/finch-experiment/

SONGS

Listen to the audio clips of your control and experimental baby finches. Compare and contrast them to the clips of each adult species.

   1. What do you learn from the song of your control baby finch?

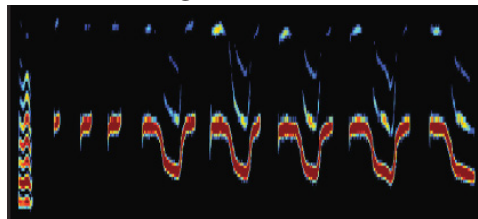   2. What do you learn from the song of your experimental baby finch?

SPECTROGRAMS

Sketch the spectrograms below for each baby finch and compare/contrast them to spectrograms for tutor and own species.

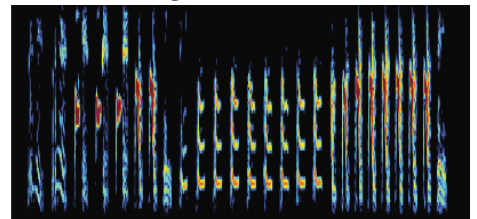| Control Baby Finch	Experimental Baby Finch
Sketch:	Sketch:
Comparison/Conclusion:	Comparison/Conclusion:
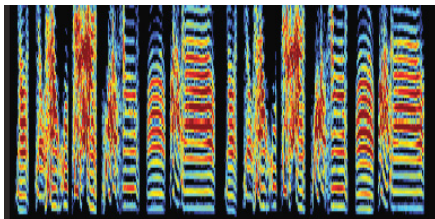
Zebra Finch   Long-Tailed Finch   Bengalese Finch

NEURON ACTIVITY

Describe the activity of the neurons (*normal* or *high*) in the deep and secondary parts of the listening area of the brain for each situation.

1. Control finch listening to the same species.

2. Control finch listening to other species.

3. Experimental finch listening to the same species.

4. Experimental finch listening to other species.

What conclusion can you make from the neuron activity that you observed?

Part 4: Assessment

As you can see from the background information and data, a combination of genes and environment shapes a lot of behaviors. In what ways do genes and the environment affect song learning in finches?

CLAIM: Song learning in finches is influenced by a combination of genes and environment.

Choose evidence from the background information in the slide deck and/or from your experimental results to support this claim. You should have at least one piece of evidence for genetics and at least one piece of evidence for environment.

EVIDENCE #1

REASONING

EVIDENCE #2

REASONING

EVIDENCE #3

REASONING