

Name _____ Block _____ Date _____

Evolution: Mutation and Selection Gizmo Part 1: Natural Selection

Purpose

What question are we trying to answer by exploring this simulation?

Gizmo Warm-Up (Overview)

- Click *play* to see the simulation in slow motion. Describe what happens over and over again.
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- Speed up the Gizmo by moving the *sim. speed* slider to the right. What happens to the bug population over time?
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I. Selective Pressure

- Why don't all bugs reproduce to make offspring for the next generation?
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Anything that can cause individuals to die or prevent them from reproducing is called a **selective pressure**.

II. Variation

- Press *pause* when a bug appears that has a circle on it. Click on this bug, as well as others without circles. How is the circled bug's genotype different than the other bugs'?
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- What caused this change to occur? (Hint: What is the ultimate cause of any change in a gene?)
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- Click on another circled bug (you may need to click *play* and *pause* until another circle appears). Do all mutations match the environment, or are they random?
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Variations are always present in a **population**. These variations are caused by **random mutations – not the environment**.

III. Competition and Survival of the Fittest

- Increase the *sim. speed* by 1 notch and press *play*. Wait at least 10 generations before pressing *pause*. Click on 2 bugs – one that matches the background color better, and one that does not match the background color as well. What type of bug has a higher "fitness?"
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Fitness refers to an individual's ability to survive and produce offspring. Higher fitness means greater reproductive potential.

- Infer why this bug's fitness is higher.
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IV. Heredity

- Reduce the *sim. speed* to its lowest level. Click *reset*, then click *play*. Click *pause* when a bug experiences a mutation and survives the bird attack. Describe the mutation below.
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- Click *play* and *pause* to see the bug's offspring. What do you notice about the genotypes of some of the offspring?
-

Organisms pass on their genes – and their variations onto **offspring**, so the **next generation** looks and acts like them.

V. Adaptation

- Increase the *sim. speed* 2 notches and click *play*. After about 50 generations, click *pause*. Describe how the average color of the beetle has changed.
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- Describe how the average fitness has changed. _____
 - Click *play* again, and *pause* after about 100 generations. Describe how the average color and fitness of the beetle has changed now.
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Over **many generations**, variations that increase individual fitness are passed on more than variations that do not. These variations spread and become more common, resulting in an **adaptation** within the **population**.

VI. Environmental Change

- Do not reset the Gizmo. Move the sliders under *Background color* to change the color of the leaves significantly. What happens to the average fitness of the bugs?
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- Click *play*. Over time, what happens to the color and average fitness of the bugs?
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- In reality, predict another likely outcome of a sudden, dramatic environmental change for a population, especially one that lacks genetic diversity.
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An **environmental change** can result in a **different selective pressure**, which can result in a new change in the population if variation is present and the population can survive enough generations for adaptation to occur. If variation is not present, or the environmental change is too sudden or challenging, **extinction** may occur (inability to adapt).

Summary

In your own words, explain how a group of organisms can change over time.

Evolution: Mutation and Selection Gizmo Part 2: Rates of Evolution

Purpose

What question are we trying to answer by exploring this simulation in part 2?

I. Mutation Rate

- With the *mutation rate* at 0.1, click *play* and click *pause* when the average fitness rises above 90%. How many generations did it take for the average fitness to reach about 90%?
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- Reset the Gizmo, and change the *mutation rate* to 10.0. Click *play* and *pause* when the average fitness reaches 90% again. How many generations did it take for the average fitness to reach about 90%?
-

- Summarize how the amount of variation (controlled by mutation rate) affects the rate of evolution.
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II. Rate of Reproduction

- Set the *mutation rate* back to 1.0. To simulate a higher reproduction rate, increase the *sim. speed* slider to halfway. Click *play*. How long does it take for the population to reach 100% average fitness?
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- Summarize how reproduction rate affects the rate of evolution in a population.
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III. Selective Pressure

- Reset the Gizmo. Change the background color to white by moving all the color sliders all the way to the right (255). What is the average fitness of the bug population?
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When all individuals have an **equal fitness** and no variation is advantageous, there is **no selective pressure**.

- Click *play*, then click *pause* after 100 generations. What happened to the population overall?
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- Summarize how lack of a selective pressure affects the rate of evolution in a population.
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Summarize

Describe three factors that can increase the rate of evolution in a population.
