

# EVOLUTION



## Grades 7–12

### Biological Evolution

#### Objectives:

- Identify the 5 major components for evolution to occur
- Understand that mutations occur randomly
- Understand that natural selection can be environmentally dependent

**Vocabulary:** Variation, Inheritance, Selection, Time, Adaptation, Mutation, Biological evolution

#### Materials:

- Mutation worksheet with instructions and natural selection demo attached

#### Lesson:

##### *What is biological evolution?*

- The process of change over time in the heritable characteristics, or traits, of a population of organisms.
- This change sometimes results in the origin of new, distinct populations of species.
- All living things share common ancestors. Note: *individuals* of a species do not evolve; populations of species evolve.
- Studying evolution helps us to understand the history and diversity of life on the planet.
- Evolution is an ongoing process — it does not stop. Species alive today are not an endpoint, but a step in a continuum that has been ongoing for 3.5 billion years!

*Variation, Inheritance, Selection, Time and Adaptation* are all the driving mechanisms of evolution.

- Natural selection is driven by the environment and natural events (and is not random).
- Species differ from one another due to the adaptations they have acquired through evolution. Mutation is a random and constant event that introduces variation into a population.

#### Activities:

- Mutation Game- Just how random IS mutation?
  - Use this activity to demonstrate just how random mutations are (pages 4-5 of this document).
  - Mutation will be represented by rolling dice - each roll of the dice is, of course, random.
  - Imagine there is a population of fish swimming around in a pond. The fish are breeding and producing offspring.
    - Rolling the dice represents random mutations present in the offspring of the population of fish. (Technically, it is a mutation that occurred during the formation of the reproductive cells of the parents.)

# EVOLUTION



## Grades 3–6

- The mutations may or may not help the fish survive. Will YOUR fish survive? Remember, evolution takes many generations.
- Ask the following questions:
  - What cumulative mutations are present in your third generation of fish?
  - Did all your fish survive?
  - Were some of your mutations counterproductive?
  - For this activity, it is not relevant whether they survived, but rather what are their chances of getting a new mutation. Some mutations are helpful, some are harmful, and some don't affect anything at all! Remember, the important mutations for evolution are the ones that occur in the genes located in the reproduction or germ cells — the ones involved in inheritance. Play the game again and compare the differences with your students.
- Natural Selection Demo - Survival of the Fittest?
  - Use this activity to demonstrate natural selection (pages 6-7 of this document).
  - Ask the following questions:
    - What happened during the game?
    - In this environment with this food, which mutation was selected for mutation?
    - Which ones reproduced better than the others?
    - Did the organism choose to have that mutation?
      - No - it was born that way. Organisms that successfully reproduce under these environmental conditions are considered “fit.” Their offspring may also have that mutation and may also be successful— i.e. reproduce as long as the environmental conditions favor that mutation.  
(The organism with the most helpful mutation was able to gather and eat the most food, and thus be healthy enough to survive and successfully have offspring.) Keep in mind, though, that the organism just has to be fit enough, not perfect, to reproduce in order to be successful.

### Tools:

- Videos:
  - Natural Selection: <https://www.youtube.com/watch?v=q-xqbPqIEWQ>
  - Transitional Fossil: [https://drexelomy.sharepoint.com/:v:/g/personal/jah536\\_drexel\\_edu/EfpG5ptj531FkfYeD VqkFiEB3ZPMtlpRpvzJS0JIUfuxaQ?e=82Gjvg](https://drexelomy.sharepoint.com/:v:/g/personal/jah536_drexel_edu/EfpG5ptj531FkfYeD VqkFiEB3ZPMtlpRpvzJS0JIUfuxaQ?e=82Gjvg)

# EVOLUTION



## Grades 3–6

### PA Academic Standards:

PA 3.1 A, B, C PA 3.3 A

PA 4.1 A, D NGSS; LS3, LS4, S1-3,7

# EVOLUTION



## Grades 7–12

### Evolution Game

Biological evolution is the process of change over time in the heritable characteristics, or traits, of a population of organisms. This change sometimes results in the origin of new, distinct populations of species. Studying evolution helps us to understand the history and diversity of life on the planet. Try your hand at the evolution game.

Know before you begin:

- This activity can be done inside or outside
- All supplies are easy to find, substitute or modify
- Adult supervision is recommended
- Please choose a safe space for this activity

Materials:

- Extinction game printout
- Six-sided dice

Instructions:

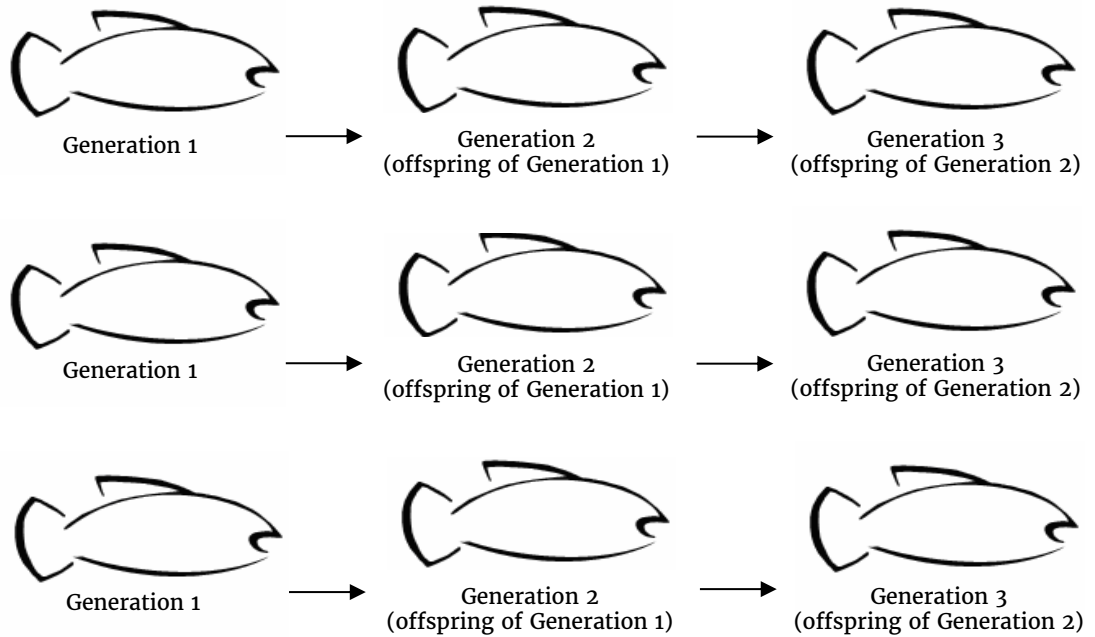
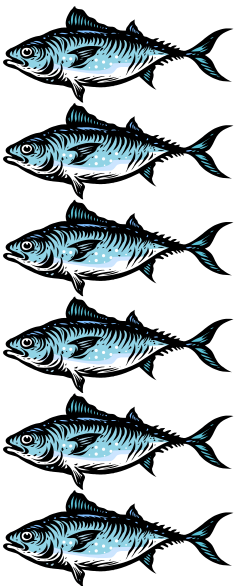
- Gather your supplies.
- Roll the die three times. These first three rolls of the die represent mutations inherited by the first generation of offspring. These mutations occurred in the parent population's reproductive cells.
  - Record the mutation that matches the number on your die in the first box marked Generation 1.
- Roll the die as many times as you have fish:
  - If one of your fish rolls a 6, do not continue to roll for that line of fish.
- These second three rolls (may be less) of the die represent mutations that occurred in the reproductive cells in Generation 1 and inherited by their offspring. Record in Generation 2.
- Answer these questions:
  - What mutations have occurred in your breeding population of fish?
  - Did all of your generations survive?
  - What total mutations are present in Generation 3?

# EVOLUTION



## Grades 3–6

Parent Population  
of fish



### Die # = Mutation

- 1= lungs
- 2 = extra fins
- 3 = more efficient gills
- 4-5 = no-mutation—  
fish stays the same
- 6 = fish dies—  
population extinct.

### Your population of fish is breeding!

The first three rolls of the die represent mutations inherited by the first generation of offspring. These mutations occurred in the parent population's reproductive cells. Record the mutation that matches the number on your die in the first box marked Generation 1.

The second three rolls of the die represent mutations that occurred in the reproductive cells in Generation 1 and inherited by their offspring. Record in Generation 2.

What mutations have occurred in your breeding population of fish?  
Did all of your generations survive? What total mutations are present in Generation 3?

# EVOLUTION



## Grades 7–12

### Natural Selection Game

Natural selection happens when a variation within a population allows certain individuals successfully reproduce under specific environmental conditions while other individuals without the variation do not survive. Try your hand at this natural selection game to see if your variation makes you more “fit.”

Know before you begin:

- This activity can be done inside or outside
- All supplies are easy to find, substitute or leave out entirely
- Adult supervision is recommended
- Please choose a safe space to play

Materials:

- Bucket or other container
- Plate or another flat container
- Set of tongs
- Spatula
- Set of chopsticks
- Marbles or small rocks

Instructions:

- Set up your bucket - this will represent your stomach.
- Choose your “mutations/ adaptations” - either tongs, a spatula, or set of chopsticks - this will represent your mouth.
- Set up your marbles on the plate - these represent your food.
- Goal: Use your adaptation to move the “food” to the bucket.
  - How long does it take to move 10 marbles with your adaptation?
  - Try again with a different adaptation. How long does it take to move 10 marbles now?
  - Try again with the last adaptation. How long does it take now?
- Which adaptation was easiest? Quickest? Most challenging?

# EVOLUTION



## Grades 3–6

- If all three adaptations are members of one population of organisms—they are **all the same species** and their mouths are **natural variation (mutations)** in that population.
  - Which individual would survive to reproduce?
  - What happens if you switch foods from marbles to bread or noodles?