PHENOMENA, DRIVING QUESTIONS AND STORYLINE

EVOLUTION

How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans?

Phenomenon	Driving Questions	Guiding Questions	Activities	PE	Storyline/Flow (How an activity leads to subsequent activities)
Some bacteria have become very resistant to antibiotics.	How do bacteria become resistant to antibiotics?	What happens when a person does not take antibiotics as prescribed?	1 [14, 15, 16, 17]	MS-LS4-4 MS-LS4-6	Some bacteria are more resistant to antibiotics than others, and because of that, can become more abundant over time.
Species look different today than they did a long time ago.	How do species change over time?	How does the environment affect an individual's probability of survival and successful reproduction?	1, 2, 3, 4, 5, 6	MS-LS4-4 MS-LS4-6 MS-LS3-1	Some traits increase an individual's chance of survival in a specific type of environment.
		How does natural selection happen?			Natural selection is the process by which some traits become relatively more common in a population over time.
		What role does genetic variation play in the process of natural selection?			Variation in traits is caused by mutations, and mutations are passed on to offspring; the frequency of the trait in the population depends on the environment.
		How do mutations affect survival?			The sickle cell mutation is harmful when a person has two copies because it affects the structure and function of red blood cells; it is beneficial when a person has one copy in an environment with malaria.
		Why does sickle cell trait frequency vary across the world?			The frequency of the sickle cell trait depends on two environmental variables—the frequency of malaria and the availability of health care.

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EVOLUTION (continued)

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Evidence of species that no longer exist can be found in fossils.	What information can we learn from fossils?	How do new species evolve?	7, 8, 9, 10, 11, 12, 13	MS-LS4-1 MS-LS4-2 MS-LS4-3	Natural selection happening over a short period of time leads to changes in trait frequency in a population; when it happens over a long period of time, populations with different traits may evolve into separate species.
		How are the diverse species living today related to each other and to the species that once lived on Earth?			Speciation is a continual process that has resulted in many life forms and billions of species, most of which have gone extinct; all species are related to one another, sharing either a recent or distant ancestor.
		What kind of evidence do fossils provide about evolution?			Fossils provide evidence for evolutionary relationships of organisms that lived in the distant and recent past.
		What other kinds of information can we get from fossils?			Fossils can also provide information about the habits, traits, and environments of extinct organisms.
		What can you learn about evolution by comparing the fossil records of fish, mammals, and reptiles?			Life forms have evolved over time, with some life forms having been relatively more abundant in the past, and other life forms becoming relatively more abundant more recently.

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		How did whales evolve?			Whales, despite sharing superficial similarities with fish, are aquatic mammals that evolved from terrestrial relatives; this evolutionary history is informed by fossil evidence and evidence from embryos.
		How can embryos provide evidence about evolutionary relationships?			Embryos can reveal evolutionary relationships that are not apparent in the adult organisms.
Humans can change the way species look or behave, including bacteria.	How are humans affecting evolution?	Is the current rate of extinction typical?	1, 14, 15, 16, 17	MS-LS4-4 MS-LS4-5	People are affecting evolution by causing a significantly higher rate of extinction than in the past.
		What is the evidence that resistance to chemical controls is evolving in other types of organisms?			People are affecting evolution by changing selection pressure on organisms that cause problems for us; the evolutionary responses of these organisms can lead to additional problems for us.
		How have humans manipulated genes in other organisms?			People have manipulated genes and, therefore, evolution of organisms for thousands of years, most recently through genetic engineering.
		How are humans affecting and affected by evolution?			There are many ways humans are affected by and affecting evolution, and understanding evolution by natural selection is important for understanding and anticipating these processes.