Notes for PowerPoint for Lesson 6
Natural Selection

Slide #	Notes	Additional Notes
1	Before learning about the evolution of cadmium-resistance, students will look at three other examples of evolution by natural selection.	
2		
3	Invisible traits are such things as resistance to cadmium (in mud worms) or chicken pox (in humans). Other examples also include what people sometimes refer to as "bad genes" --- genes that make one more susceptible to developing things like heart disease, diabetes, or breast cancer.	
4	Two short videos provide a visual model for a natural selection event that occurred in a pocket mouse population in the desert region of the southwestern U.S.	
5	This video provides a simple representation of the natural selection story in one pocket mouse population. The volcanic eruption referred to in the video happened about 1000 years ago.	
6	Students often think that the traits an organism "needs" to survive are caused by the environmental change. While the concept of existing variation is fairly easy to understand here because students are familiar with the idea of color variation (multiple alleles) from their own lives, this understanding often gets lost in unfamiliar cases. Ask students for other examples of existing variation. Ask for examples in plants (e.g. roses), food (e.g. apples), and invisible traits (smell of roses, taste of apples, susceptibility to heart disease in humans).	
7	These four conditions are needed for selection (both natural and artificial) selection to occur: **genetic variation, **the trait must be heritable **differential reproduction &/or survival due to presence of the trait (selective pressure) **time (multiple generations). Students often think that natural selection occurs in individual organisms rather than in a population or species. Natural selection occurs over many generations, not within an individual.	

8	The next five slides give another example of natural selection in a visible trait: color in beetles. There is existing variation in traits. For example, some beetles are green and some are brown.	
9	There is **differential reproduction**. Since the environment can't support unlimited population growth, not all individuals get to reproduce to their full potential. In this example, green beetles tend to get eaten by birds and survive to reproduce less often.	
10	The trait is heritable. The surviving brown beetles have brown baby beetles because this trait has a genetic basis.	
11	End result: The more advantageous trait, brown coloration, which allows the beetle to have more offspring, becomes more common in the population. If this process continues, eventually, most or all individuals in the population will be brown.	
12	Over the course of many generations, green beetles have been selected against, and brown beetles have flourished.	
13	Students may be familiar with antibiotic-resistant strains of disease organisms such as drug-resistant TB or MRSA (methicillin-resistant *Staphlococcus aereus)*. The evolution of antibiotic resistance occurs through natural selection. Imagine a population of bacteria infecting a patient in a hospital. The patient is treated with an antibiotic. The drug kills most of the bacteria but there are a few individual bacteria that happen to carry a gene that allows them to survive the onslaught of antibiotic. These survivors reproduce, passing on the gene for resistance to their offspring, and soon the patient is populated by an antibiotic resistant infection — one that not only affects the original patient but that can also be passed on to other patients in the hospital.	
14	At this point, students can review the mechanism of natural selection. Use this as an opportunity to reinforce important concepts before moving on to the evolution Foundry Cove worms. Probe students' explanations to check and correct if necessary, their understanding of concepts such as existing variation; population not individual evolution; and the difference between plasticity and inherited traits.	
15	Review the previous examples with students as necessary.	
16	The next four slides can be used to introduce the Natural Selection Process Diagram in the student handout. Depending	

	on your students, you might use the first two slides to show students how the diagram works and then let them finish alone on their own, or you may want to have the class follow along and complete their diagram as you view the four slides.	
17	This shows young Foundry Cove worms before the first introduction of cadmium into their environment. Cadmium-resistant worms make up 5% in this diagram. The students should be sure to answer the questions below the worms before/after each event. These are also on their worksheet. --20 alive; 5% resistant	
18	Many of the non-resistant adults die without reproducing. In this model, the cadmium kills more than half of the non-resistant worms. --10 alive; 10% resistant	
19	Now the population size increases to twenty, but the proportion stays the same. Two out of 20 worms (10%) of the second generation are resistant.	
20	The second row starts with the surviving adults and their young (from the end of the first row). Once again, cadmium kills more than half of the non-resistant worms. Of the ten surviving adults, two (20%) are resistant. The population size increases to twenty, but the proportion stays the same, so 4 out of 20 worms (20%) of the second generation are resistant. Again, exposure to cadmium kills many worms before they can mature and reproduce. The percentage of cadmium-resistant worms in the third generation has increased to 20%.	
21	1) Many muskrats from the area had liver lesions and high levels of cadmium in their kidneys, and there is no evidence that the population was resistant. 2) Cadmium may have killed muskrats. It's also possible that another cause unrelated to cadmium, such as disease, may have reduced their numbers. Evolution is not a solution to toxins in our environment. Resistance to contaminants has been found in very few organisms, while a whole range of detrimental effects of many toxic pollutants are well documented in many species and in many environments.	