

## Notes for PowerPoint for Lesson 4 Survivors at Foundry Cove!

Slide #	Notes	Additional Notes
1	Different species respond to toxins in their environment in different ways, and the worms in Foundry Cove have a special story to tell.	
2	<p>Even though Foundry Cove was highly contaminated in the 1980s, <i>L. hoffmeisteri</i> was the most common macrobenthic organism in <u>both</u> Foundry and South coves. Scientists were surprised by this discovery and wanted to find out if <i>L. hoffmeisteri</i> are generally so tolerant of cadmium, or if there was something special going on with the population of Foundry Cove worms.</p> <p>Scientists had already learned that some plant species have evolved resistance to metals, but they did not know much about the evolution of metal resistance in animals. At the time (1980s), a genetic basis for resistance in animals had been found only in a population of isopods living in a metal-polluted river in England.</p>	
3	Samples of gut contents of <i>L. hoffmeisteri</i> had elevated levels of both cadmium and nickel. Scientists concluded that at least some of the cadmium in Foundry Cove was bioavailable and could be absorbed by body tissues.	
4	<p>The overall density of macrobenthic organisms, including <i>L. hoffmeisteri</i> worms, in Foundry Cove was just about the same as that in South Cove, a very similar environment about a mile to the south. However, the taxonomic richness (diversity) was lower at Foundry Cove.</p> <p>According to the current EPA guidelines, the actionable level of cadmium is 1 ppm. Depending on the location and other factors, the EPA can require cleanup of cadmium over 1 ppm.</p>	
5	Discuss these questions and then have students complete the first two pages of their worksheets.	
6	To collect sediment samples in Foundry Cove, a device similar to this Ekman grab was used, though the researchers used	

	canoes rather than a big ship like this.	
7	<p>Ask students to explain the results shown here.</p> <p>Sediments and worms were collected from both Foundry Cove and the control area (South Cove). Most worms from both sites survived 28 days in the cleaner sediment from the control site. When kept in cadmium-contaminated sediments from FC, almost all worms from the control area died, while 90% of the worms from FC survived.</p> <p>This is a common type of experimental design, called a ‘reciprocal transplant’ experiment. In this type of experimental design, the researcher attempts to determine if the population of interest maintains a certain trait even when grown under different environmental conditions—in particular, the environment of a separate target population, such as a control population. The control population is also transplanted to the experimental population’s site. This design can help us learn whether there’s something in particular about the experimental population that determines the expression of the trait or whether ‘site’ determines the trait’s expression.</p>	
8	<p>Scientists conducted research to find out which type of resistance was allowing the mud worms to survive in FC. Malaria provides an example in people:</p> <p><u>Plasticity (aka phenotypic plasticity) / acclimation:</u> Modifying one’s behavior in response to the environment is an easy-to-see example of plasticity. For example, travelers often take anti-malaria medications in high-malaria areas. This provides some protection to the individual traveler, reducing his or her chance of getting malaria, but the protective effects cease when medication is stopped. The protection from malaria is temporary, not genetic, and cannot be passed to offspring.</p> <p><u>Heritable trait:</u> People who carry <i>one</i> sickle cell gene are resistant to malaria, though not completely protected from the disease. Compared to non-carriers, they have about 1/10 the risk of dying from malaria. In a group of people living in an area with high rates of malaria it benefits the population as a</p>	

	<p>whole to have people who are resistant to the disease and therefore more likely to reach reproductive age in good health.</p> <p>** Note that for people NOT living in malaria-prone areas, having this sickle cell gene is NOT adaptive. Therefore, be careful using the word ‘adaptation.’ Adaptations describe inherited traits that are performing useful functions. There are lots of instances of inherited traits that are either no longer performing a useful function or perhaps never were.</p> <p>.</p>	
9	<p>Discuss students’ ideas for experiments that could determine which type of resistance is found in the FC worms.</p>	
10	<p>The Foundry Cove worms and the South Cove worms were field collected. The Foundry Cove offspring are second generation offspring of field collected parents. This graph shows the percentage of worms of each of the three types that survived 28-day exposure to sediments with the indicated levels of cadmium.</p> <p>In sediments with 0 mg/g cadmium, survival rates for all types are similar. At 20 mg Cd/g, survival of FC worms and their offspring is similar, while just a few SC worms survive. At 30 mg Cd/g, survival of FC offspring drops more than that of FC worms, but survival is still much higher than SC worms. At 45 mg Cd/g and above, no SC worms survive the 28 days, while even at 90 mg Cd/g, a small percentage of the FC worms and the FC offspring still survive.</p> <p>This experiment showed that cadmium resistance in the population of worms in FC was indeed inherited, since the second generation offspring also display the trait. Though the resistance was less pronounced in the offspring than in the adults, it is clearly inherited. Additional lab experiments showed that in about 4 generations, a population of non-resistant <i>L. hoffmeisteri</i> evolved resistance.</p>	