Using Dice to Explore Radioactive Decay: Answer Key

Part II: Analyzing Our Graphs

1. Melanie thinks that when radioactive isotopes “decay” it means the atom disappears into nothing releasing radioactivity. Melanie’s idea is not completely correct. Explain using specific data we collected today to support your response.

Answers will vary but should focus on the idea that during radioactive decay the element turns into another element. Students should use their stacked column graph or the class data to support their claim.

2. Scientists often measure the rate of decay of radioactive elements in terms of “half-life” or the amount of time required for half of a radioactive sample to decay. Using your line graph, determine the half-life for each element in today’s simulation. NOTE: Your unit will be “rounds”.

   a. Half-life of element #1: Specific answers will vary (should be read off graph) but should be near 4 rounds
   b. Half-life of element #2: Specific answers will vary (should be read off graph) but should be near 2 rounds

3. After one half-life, ½ of the sample has decayed so ½ is still radioactive. After a second half-life, ½ of the remaining material (½ of the original) has decayed leaving ¼ of the original (½ of ½) still radioactive. At the end of three half-lives, what fraction of a radioactive isotope would you expect to still be “radioactive” (1/2, 1/4, 1/8, etc.)? 1/8

4. 
   a. Based on the class data half-life you calculated above, how many rounds would it take until 1/8 of the original element #1 sample was still radioactive? HINT: how many half-lives must have occurred? Answers will vary but should be 3 times the half-life value of element #1
   b. Based on the class data half-life you calculated above, how many rounds would it take until 1/8 of the original element #2 sample was still radioactive? HINT: how many half-lives must have occurred? Answers will vary but should be 3 times the half-life value of element #2

5. Consider the following statement:
   The longer the half-life, the faster the rate of radioactive decay.
   a. Is this statement true or false? False
   b. Explain using specific data we collected today to support your choice. Answers will vary but should focus on the fact that the half-life of element #1 was longer but it decayed at a slower rate (more radioactive material was present for more “rounds”). Students should cite specific data to support their claim.
6. Consider the following statement:
   The rate of radioactive decay is always the same, constant value for all radioactive isotopes not matter what element they are.
   a. Is this statement true or false? **False**
   b. Explain using specific data we collected today to support your choice.
      Answers will vary but should focus on the fact that the half-life of element #1 and #2 were different as illustrated by the steepness of the radioactive decay curves or the fact that different amounts of radioactive materials were present for each element after each round. Students should cite specific data to support their claim.

**Conclusion:**
Based on what you learned today, answer the following questions:

1. What happens to radioactive atoms when they decay? (Be specific but be careful not to overgeneralize)

   Answers will vary but should focus on the idea that the radioactive element emits particle and/or high-energy radiation as it decays. Depending on the nature of the decay, the daughter nuclide may or may not be a different element and may or may not be radioactive itself.

2. How do scientists describe the rate of radioactive decay? Is it linear?

   It is not linear relationship but rather an exponential one. It is not critical that students use the term exponential but rather that they understand the relationship is not linear. They can also discuss how the rate of decay is described using half-life (the amount of time it takes half the sample to decay). They should demonstrate that they understand that after 1 half-life you have ½ of the original sample, after 2 half-lives you have ¼ of the original etc.