



Chapter 5: Quick Activities

The Atomic Nucleus

Domino Chain Reactions

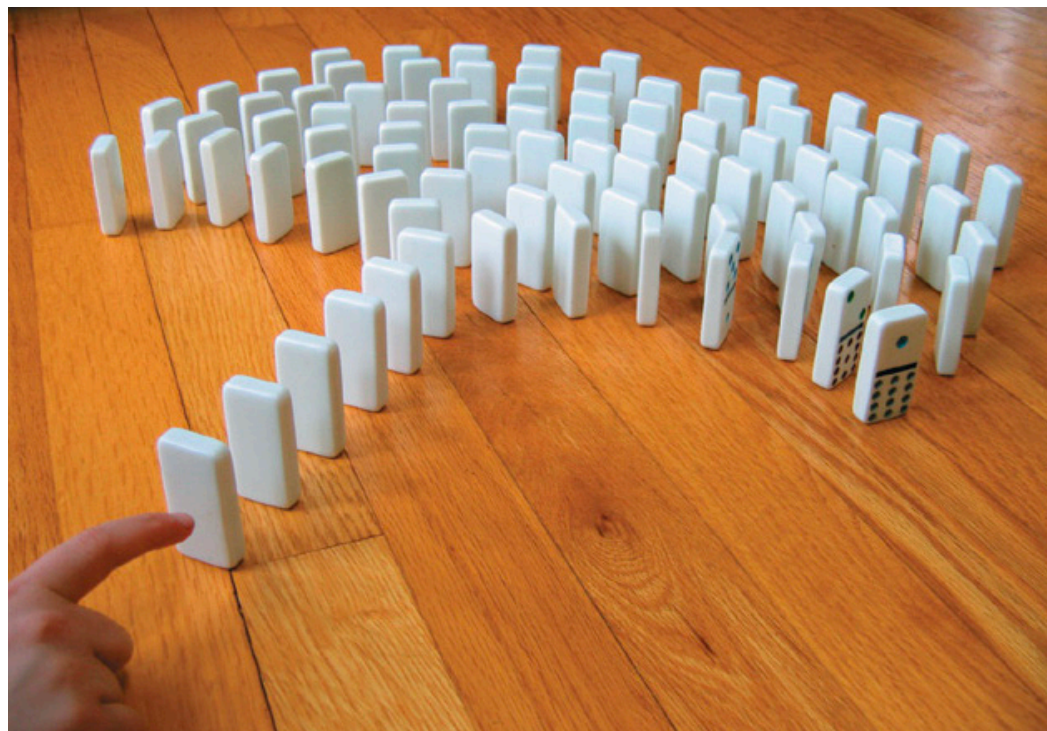
Nuclear fission reactions as described in this chapter can undergo explosive chain reactions. These are self-sustaining reactions in which the products of one event stimulate further events in an exponential manner. You can simulate such a chain reaction with a set of dominos.

PROCEDURE

1. Stand one domino upright so that when it topples it hits two other upright dominos, which also each hit two other upright dominos, and so forth.
2. Arrange as many upright dominos as you can in this fashion so that they fan out as shown in the photograph to the lower right. Your challenge will be to arrange the dominos so that every one of them falls.
3. Topple the first domino and observe the chain reaction. Focus your attention on the sound.

ANALYZE AND CONCLUDE

1. What happened to the sound of the dominos as they fell?
2. Dominos set up in this fashion create a series of rows. If the first row contains two dominos, the second row contains four, and the third row contains eight, given this progression, how many would there be in the seventh row? Is this more or less than the total number of dominos in all the first six rows?
3. What would happen if a Ping- Pong ball were tossed into a room in which the floor was covered with thousands of set-to-kill spring-action mousetraps? Such an explosive event can be seen by using the keywords "mousetrap chain reaction" in an Internet video search.



Coin Toss Radioactive Decay

Throw ten coins onto a flat surface. Remove all the coins that land tails-up. Collect the remaining head-up coins. After tossing these heads-up coins once again, remove all coins landing tails-up. Repeat this process until all the coins have been removed. Can you see how this relates to radioactive half-life? In units of "tosses," what is the average half-life of 25 coins? 50 coins? 1 million coins?

Repeat this activity, but use 10 dimes and 25 pennies. Let the dimes represent a radioactive isotope, such as carbon-14, and the pennies represent a nonradioactive isotope, such as carbon-12. Remove only the dimes when they land tails-up. Collect all the pennies and the remaining heads-up dimes. Questions: Does the number of pennies affect the

behavior of the dimes? Someone gives you two sets of coins. The first set contains 10 dimes and 25 pennies. The second set contains 2 dimes and 25 pennies. Which set of coins would have gone through a greater number of tosses? Which set provides the most "radioactivity" after a single toss? Which set is analogous to a sample of once-living and low-radioactive ancient material?

My Annual Dose

Calculate your estimated annual dose of radiation using the EPA's radiation dose calculator available at <http://epa.gov/rpdweb00/understand/calculate.html>.



Author Responses to Quick Activities

Domino Chain Reactions

1. You should find the sound quickly gets louder as more dominos fall.
2. With this progression, represented by 2^n , there should be 128 dominos in the seventh row, which is more than in all the first six rows.
3. An "explosion" of popping mousetraps would ensue as can be seen in online video demonstrations

Coin Toss Radioactive Decay

This activity relates to radioactive half-life in that it shows how radioactive decay is a statistical phenomenon. Notice that eventually you get down to the last coin, which may or may not decay upon the next throw. Also notice that some coins last for a long time while others decay right away. This is similar to radioactive atoms. Although the half-life might be 10 years, any one individual atom might last for only a few days, while others would last for

well beyond 10 years. For a coin with only two sides, you'll find that, on average, half the coins will have decayed after one toss. This is true whether you have 25 coins, 50 coins, or even a million. So, the half-life is not a function of how many atoms you have. Rather, half-life is a function of the stability of the nucleus. Atoms with stable nuclei will persist much longer than atoms with unstable nuclei.

The number of pennies in the mix should not affect the activity of the dimes. The set of coins with only 2 dimes left has gone through a greater number of tosses. The set with 10 dimes in it would be the more "radioactive" substance. Remember, according to this simulation, radiation is emitted with every time a dime lands heads up. The set with only 2 dimes is analogous to a sample of once-living low-radioactive ancient material.

My Annual Dose

No questions asked.

