

THE SCIENCE OF FRINGE

EXPLORING: CHAIN REACTIONS

A SCIENCE OLYMPIAD THEMED LESSON PLAN
SEASON 3 - EPISODE 3: **THE PLATEAU**

Overview:

Students will learn about chain reactions, where small changes result in additional changes, leading to a self-propagating chain of events.

Grade Level: 9–12

Episode Summary:

The Fringe team investigates a series of deadly accidents that they determine are being caused by complex chains of seemingly innocuous events. As they find evidence regarding who could have calculated all of the variables involved in starting the chain reactions, they themselves are setup to be the victims of one of the scenarios.

Related Science Olympiad Event:

Mission Possible - Prior to the competition, participants will design, build, test and document a "Rube Goldberg-like device" that completes a required Final Task using a sequence of consecutive tasks.

Learning Objectives:

Students will understand the following:

- A chain reaction is a sequence of reactions or events where an individual reaction product or event result triggers additional reactions or events to take place.
- Chain reactions are dependent upon variables such as initial conditions, timing, and energy transfer in order to propagate.
- The complexity of a chain reaction can range from very little (as in the case of falling dominos) to very extreme (as in the case of cascading failures in a power grid).

Episode Scenes of Relevance:

- The initial chain reaction accident
- Lincoln, Charlie and Olivia discussing the cause of the accident
- View the above scenes: <http://www.fox.com/fringe/fringe-science>
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FOX CODE



FOR SMARTPHONES

Online Resources:

- Fringe “The Plateau” full episode: <http://www.fox.com/watch/fringe>
- Science Olympiad Mission Possible event: http://soinc.org/mission_possible_c
- The Official Rube Goldberg website: <http://www.rubegoldberg.com/>
- Nuclear Chain Reaction simulation: <http://lectureonline.cl.msu.edu/~mmp/applist/chain/chain.htm>
- Cascading Failure demo: <http://vlab.infotech.monash.edu.au/simulations/networks/cascading-failure/>

Procedures:

1. Tell your students that they are going to learn about chain reactions.
2. Have your students research chain reactions in resources such as chemistry and physics textbooks and websites and discuss what they have learned.
3. Divide your class into small groups. Have each group complete the following activity:
 - a. Materials: stop watches or timers, dominos, rulers
 - b. Set up a line of dominos spaced 1 inch apart.
 - c. Use the stopwatch to time how long it takes for the complete chain of dominos to fall.
 - d. Repeat the process several times with spacing less than and greater than 1 inch.
 - e. Graph the results and see what conclusions you can draw about spacing versus speed of the reaction.
4. Discuss with the class the results of the activity. Be sure to address:
 - a. What is the relationship between the optimal domino spacing and the size of the dominos?
 - b. Did they find it easier to set up the dominos in ‘front to back of the chain’ order or the reverse?
 - c. Did the reaction proceed at the same speed throughout the domino line or change speed?

Additional Discussion Suggestions:

- Dominos toppling involve chain reactions of the same event over and over again. What other types of physical chain reactions can they think of that involve a variety of different events or objects?
- What other factors could impact the rate of the domino chain reaction? Examples include the weight of the dominos and the height to thickness ratio.
- What would happen if the dominos were set up in different environments such as a tank of water or on the moon?

Extension to Other Subjects:

History: The discovery of the nuclear chain reaction had monumental impacts on our world. Research and discuss some of these effects, such as the end of WWII, electricity production, and deep space exploration.

Biology: The polymerase chain reaction (PCR) is a fundamental tool utilized to amplify DNA strands so that they can be analyzed. What are the principles of PCR and how is it used in fields as diverse as forensics and medical research?

Social Studies: The domino effect is a term often applied to complex systemic events in areas such as the stock market and politics. Discuss specific examples where this term has been used and why it is an appropriate analogy to the situation.



National Science Standards Alignment:

E. Science and Technology – An understanding of science and technology establishes connections between the natural and designed world, linking science and technology.

H.E.1 Abilities of technological design

- b. Propose designs and choose between alternative solutions.
- c. Implement a proposed solution.
- d. Evaluate the solution and its consequences.
- e. Communicate the problem, process, and solution.