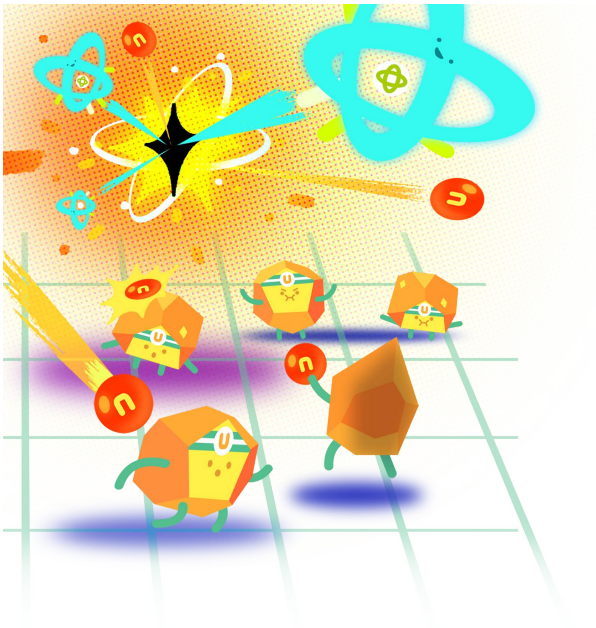
Lesson Plan: Exploring Nuclear Fission Through "Dodgeball"

Background: This activity accompanies The Spark Squad Volume 3 nuclear comic book. In this activity students will learn about and simulate nuclear fission, which is the process of splitting a large atom into two or more smaller atoms. Fission is the process by which energy is produced in a nuclear reactor. There are currently 94 operating nuclear reactors in the United States that provide more than half of our clean electricity!

Materials:

- **For whole group activity:**
  - Large open space such as a classroom or grassy area
  - Ping pong balls or recycled paper crumpled into balls (2-3 per student)
  - Chart paper for notice and wonderings
- **For small group activity:**
  - Flat, smooth surface such as a table or the floor
  - Small rectangular blocks such as dominoes or wooden building blocks (at least 10 per group plus extras)
  - Stopwatch (1 per small group)
  - Data sheets
- **For individual activity:**
  - Spark Squad Volume 3 Comic Book
  - Writing materials (e.g., paper, pencils)



Key Vocabulary: Before reading The Spark Squad Volume 3 nuclear comic book, review key vocabulary with students.

- **Nucleus:** the central part of an atom, containing protons and neutrons.
- **Neutron:** a subatomic particle found in the nucleus of an atom.
- **Fission:** the process of splitting a heavy atomic nucleus into smaller nuclei, releasing energy.
- **Nuclear Reactor:** a device that controls the release of energy from nuclear fission.
- **Uranium:** a radioactive element that is the primary fuel used in nuclear reactors.
- **Chain reaction:** a self-sustaining process where the splitting of one nucleus leads to the splitting of other nuclei, releasing more neutrons to maintain the process.
- **Joules:** a unit for measuring work and energy.

Direct Instruction: Depending on grade level, teachers or students will start by reading The Spark Squad Volume 3 Nuclear comic book. In this volume, the Spark Squad is determined to qualify for the regional Power Fair by collecting enough joules (power measures). The Spark Squad introduces a new character, Dakota, who will help the team learn about nuclear power and find success in qualifying for the power fair!

Whole Group Activity: Bring all students together in a large group to simulate nuclear fission through a game of "dodge ball." Explain to students that they will represent atoms, and the ping pong balls, or crumpled paper balls will represent neutrons.

Step 1: Have students stand in a large group, clustered together.

Step 2: Provide each student with 2 or 3 ping pong balls or crumpled paper balls.

Step 3: Educator or group leader will begin the chain reaction by tossing a neutron (ping pong ball or paper ball) into the group.

Step 4: When a uranium atom (student) is hit by a neutron, they fission (split) by tossing their neutrons randomly into the group causing other uranium atoms to split.

Step 5: Once a uranium atom splits and tosses their neutrons, they sit on the ground.

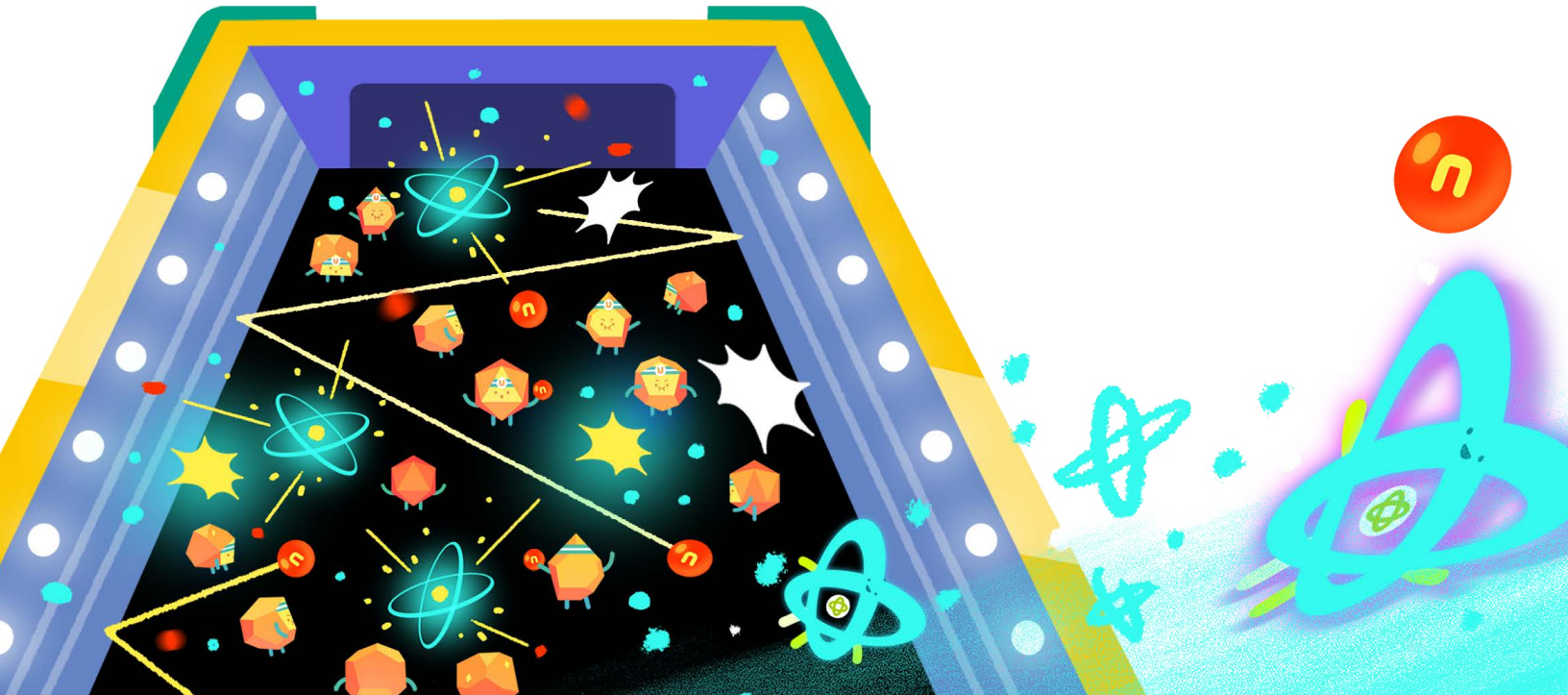
Step 6: The reaction is over when there are no more neutrons being tossed.

Step 7: After a few minutes of play, gather the students to conclude the activity. Ask them what they noticed about the activity:

- Was everyone sitting?
- If not, did it make a difference where the uranium atoms were standing?

Explain that uranium atoms need to be close together to reach critical mass to create a chain reaction.

Note: This activity can be performed multiple times to demonstrate different variables to students and have them suggest changes that help sustain the reaction.



Small Group Activity: Next, divide the students into small groups of two or three to model a chain reaction. If needed, start by showing students a brief video of a demonstrated chain reaction using dominoes – there are many examples available on YouTube!

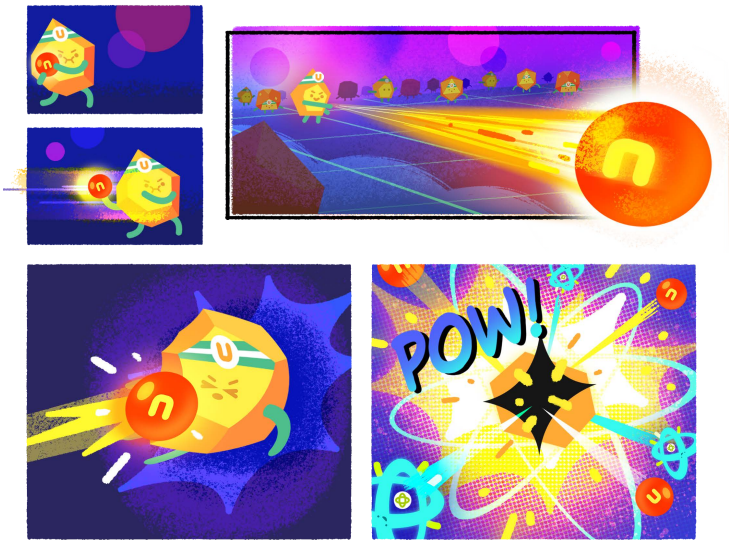
Step 1: Provide each group with at least 10 dominoes, small wooden blocks, or any light, rectangular item of uniform weight, as well as a data sheet for tracking their observations and a stopwatch for timing the chain reaction. Explain to students that the blocks will represent the nuclei in a fission reaction.

Step 2: Have students set up the blocks in a chain reaction pattern. Each block will represent a nucleus.

Step 3: Have one student begin the chain reaction by tapping the first nucleus (block) so that it will hit (split) the next nucleus, causing a chain reaction.

Step 4: Encourage students to set up their blocks in different patterns (e.g., straight line, zigzag, etc.) and document their observations on the data sheets provided. Suggest that students observe and document the following:

- How quickly the chain reaction ends.
- If different patterns result in longer chain reactions.
- If the number of blocks affect the length of the chain reaction.



Step 5: Conclude the activity by having the students come back together to share and discuss their observations. Educator can create a T-chart on large chart paper for notice and wondering. Ask students to share their discoveries from their data collection sheets. Educator may have to give an example to get the conversation started.

Independent Activity (Optional): Have students revisit The Spark Squad Volume 3 comic book. After reviewing the premise of the comic book, have students conduct a small research project about the pros and cons of nuclear energy. Students can review the following resources:

- 5 Fast Facts About Nuclear Energy | Department of Energy
- Advantages and Challenges of Nuclear Energy | Department of Energy

After students have completed their research introduce the following writing prompt:

"Imagine you are part of the Spark Squad team. You all have just qualified for regionals by collecting enough nuclear joules (power measures). In preparation for regionals, you've been asked to share your thoughts on nuclear energy. Write a brief paragraph about the pros and cons of using nuclear energy to generate electricity."

Closure Activity: Bring all students back together to discuss the whole group, small group, and individual activities. Ask the students to share their paragraphs with the class and encourage them to discuss the different perspectives presented about nuclear energy. Suggest asking a few questions to summarize the large and small group activities:

- What are some of the key factors that affect the speed and pattern of a nuclear fission chain reaction?