Objective

By the end of this lesson, Emily will understand the basic principles of physics involved in building a marble roller coaster. She will design and create her own roller coaster using simple materials, learning about concepts such as gravity, momentum, and friction along the way.

Materials and Prep

- Marbles (1-3 different sizes)
- Cardboard (for building the roller coaster structure)
- Scissors (for cutting cardboard)
- Tape or glue (for assembling the coaster)
- Ruler (for measuring track lengths)
- Pencil (for marking measurements)

Before the lesson, ensure that Emily has a safe space to work and access to the necessary materials. It might be helpful to watch a few online videos about roller coasters to inspire her designs!

Activities

- **Research and Inspiration**

  Start by exploring different types of roller coasters. Look at videos or images of famous roller coasters and discuss what makes them exciting. This will help Emily get ideas for her own design.

- **Design the Coaster**

  Using paper and a pencil, Emily will sketch her roller coaster design. She should think about how high the hills will be, where the curves will go, and how to make the ride thrilling!

- **Build the Roller Coaster**

  Using the cardboard, scissors, and tape/glue, Emily will create her roller coaster based on her design. Encourage her to test her marble at different points to see how it moves and adjust the track as necessary.

- **Test and Iterate**

  Once the roller coaster is built, Emily will test it with the marbles. If the marble doesn’t roll smoothly or falls off, she can make changes to improve the design. This is a great way to learn about problem-solving!

Talking Points

- "Did you know that roller coasters use the force of gravity to keep the marble moving? When the marble goes down a hill, gravity pulls it down!"
- "Momentum is really important in roller coasters. When the marble speeds up, it can carry itself over the next hill. Can you think of a time when you felt momentum, like going down a slide?"
- "Friction is what slows the marble down. If the track is smooth, the marble will go faster. What materials do you think will create the least friction?"
- "Every roller coaster has a starting point, or a 'lift hill.' Why do you think we need that? It gives the marble the energy it needs to go!"

- "How do you think different track shapes affect the speed of the marble? Let's experiment and find out!"
- "Roller coasters are designed to be safe, but they also need to be thrilling! What features do you think make a roller coaster exciting?"
- "When you build your coaster, think about the height of the hills. What happens when you make them taller or shorter?"
- "Testing your design is super important! If something doesn’t work, what can you change to fix it?"
- "What do you think would happen if we added loops to our roller coaster? Let's try it!"
- "Remember, engineering is all about creativity and problem-solving. There’s no one right way to build your coaster!"
- "After testing, we can reflect on what worked well and what didn’t. How can we learn from our mistakes?"
- "Finally, let's celebrate our hard work! What was your favorite part of building the roller coaster?"