Sonic Speed: A Physics Adventure!

Materials Needed:

- Notebook or paper
- Pen or pencil
- Calculator (a phone calculator is fine!)
- Optional: Internet access for quick research (e.g., to look up Sonic level details or speeds of real-world objects)
- Optional: A device to watch a short Sonic gameplay clip if desired

Lesson Content:

Part 1: Gotta Go Fast! Introduction (5-10 minutes)

Hey there, future physicist and game designer! You're a fan of Sonic the Hedgehog, right? What's the first thing that comes to mind when you think of Sonic? Chances are, it's his incredible **SPEED**! Today, we're going to dive into what makes Sonic so fast from a science perspective. It's going to be way past cool!

Quick Question: What's your favorite Sonic game or moment that showcases his speed?

Part 2: What is Speed, Anyway? (15-20 minutes)

In science, **speed** is a way to measure how fast something is moving. It's calculated by dividing the **distance** an object travels by the **time** it takes to travel that distance.

The formula is: **Speed = Distance / Time**

For example, if Sonic runs through Green Hill Zone, which is 1000 meters long, in 50 seconds, his average speed would be:

Speed = 1000 meters / 50 seconds = 20 meters per second (m/s).

Units of Speed: We can measure speed in different units, like meters per second (m/s), kilometers per hour (km/h), or miles per hour (mph).

Activity 1: Calculate Sonic's Speed!

Let's imagine a scenario:

- 1. Sonic needs to race across a new zone called 'Pixel Parkway'. The zone is 2 kilometers (which is 2000 meters) long.
- 2. He zips through it in just 40 seconds (without collecting any rings, he's on a mission!).

Your Task:

- Calculate Sonic's average speed in meters per second (m/s). Show your work!
- Convert that speed to kilometers per hour (km/h). (Hint: There are 3600 seconds in an hour and 1000 meters in a kilometer. So, to convert m/s to km/h, multiply by 3.6).

Think about it: How does this compare to real-world speeds, like a cheetah (around 112 km/h) or a race car?

Part 3: Beyond Speed - Acceleration! (10-15 minutes)

Sonic doesn't just move fast; he can also get up to speed incredibly quickly! Think about his Spin Dash. He goes from 0 to super-fast in a blink. This change in speed (or velocity) over time is called **acceleration**.

Acceleration happens when something:

- Speeds up (positive acceleration)
- Slows down (negative acceleration, also called deceleration)
- Changes direction (even if the speed stays the same!)

When Sonic uses his Boost, he's massively accelerating! When he hits a spring, he experiences a sudden acceleration upwards.

Discussion Quickie: Can you think of other moments in Sonic games where he accelerates or decelerates quickly?

Part 4: Creative Game Design - Sonic's New Move! (20 minutes)

Now it's your turn to be a game designer! Using what you've learned about speed and acceleration, design a brand-new special move or ability for Sonic.

Your Task:

- 1. Name your move: Make it sound cool and Sonic-y!
- 2. Describe what the move does: How does Sonic perform it? What does it look like?
- 3. **Explain the physics:** How do speed and/or acceleration play a key role in this move? For example, does it involve a rapid burst of speed? A change in direction at high velocity? Overcoming air resistance in a unique way?
- 4. **Sketch it out (optional):** If you like drawing, feel free to sketch Sonic performing your new move.

Be creative! Think about how this move would be fun to use in a game.

Part 5: Wrap-up and Why This Matters (5-10 minutes)

Great job today! We've seen that even in the fantastical world of Sonic, basic physics principles like speed and acceleration are at play. Game developers, even when they exaggerate physics for fun, often start with these real-world concepts to make character movements feel intuitive and exciting.

Final Thoughts:

- What was the most interesting thing you learned about speed or acceleration today?
- How does understanding these concepts change how you think about playing games or designing them?

Bonus Challenge (Optional): Think about Sonic's jumps. What forces are acting on him when he's in the air? (Hint: Gravity is one!). This dips into projectile motion, another cool physics topic for another day!