Leap Year Any Time

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Time: 45-120 minutes+

Content Connections:

- Science
- Astronomy
- Social Studies (celebrations, history)

Overview: Students explore the concept that mass bends space, creating orbital rotations. The interesting part comes in the implication on days and seasons.

Materials:

- Pencils, crayons, colored pencils, markers
- paper, construction paper
- calculators,
- Hula hoop
- Cloth big enough to cover hula hoop
- (optional) 8-10 binder clips to hold cloth to hula hoop
- 3-5 marbles (analogs for planets)
    - (option for Hard and Extreme- each marble has the X, Y, and Z axis drawn in three distinct colors of sharpie (red, black, green)
    - 
- <1lb item to lightly depress the cloth (simulating the sun bending space time)
- Device able to capture and playback 3-5 seconds of video
    - (option for Hard and Extreme - SlowMo feature on the recording).

Directions

Part One: Simulating Orbits

- Stretch a piece of fabric over a hula hoop. You can have students hold the cloth to the hoop, or attach the cloth to the hoop with binder clips.
- Explain that this is a representation of space.
- Roll a marble across the surface, allowing for observations
    - Note that the ball keeps rolling in a direction
- Place an item in the middle <1lb that will push down the cloth in the middle--a subtle depression
- Briefly explain to the students that this is like the sun, an object with such a large mass that it literally bends space! Ask for predictions on what will happen when you spin a marble around the sun.
- Do your best to spin a marble into orbit around the sun; allow the students to try. We'll never have a perfect orbit because gravity is acting in a downward direction in our classroom, but the idea is that the Earth is the marble spinning around the sun.
- (optional - connects to Medium, Hard, and Extreme options) Record the spinning of one marble with a phone (one student rolls an orbit while you record.. multiple students can record if technology is available).
    - (optional) connects to Extreme option. Do another recording, but this time use 3-5 mables at the same time to try and simulate the rotation of multiple planets.
- Ask how long it took for the marble to make its way around. Maybe 1-2 seconds depending on the speed. Explain that this is the orbit.

Part Two: Leap Year concept and voting

- Ask how long it takes for the Earth to go around the sun (answer = 365.25 days). Be sure to answer with either .25 or ¼ depending on the students readiness to these concepts.
- Instead of telling students about leap year and the extra day, start by asking: "**What would you do with an extra quarter of day each year?" Have the students put to a vote. For example, would you rather...**
    - **Have a six-hour party each year?** (be sure the students understand that .25 or ¼ of 24 hours is 6 hours). What is the benefit, what are the problems? *For example, we could pause the clock for six hours, but when it started back up, it would be 6 hours behind the sun (night time would be at noon for an entire year unless we did some clock adjusting).*
    - **Wait 4 years (6+6+6+6=24 hours) and add an extra day into the calendar?** *It's what we currently do, but nobody really celebrates leap day, and people who are born on leap day only get a birthday every four years.*
    - Another option? (psst, some ancient calendars saved the time up and had entire leap months! ...link in the extension options below).

Part Three: Application Options

- Based on the level of readiness (and access to recording software mentioned above) choose the activity(ies) that best fit your group.

EASY	MEDIUM	HARD	EXTREME
Depending on how you voted, create either a 6-hour party each year or a 1-day party each four years. Use paper to create the invitation. How could the whole Earth celebrate? What would you call the celebration? How would you explain to other kids why the world is celebrating?	Use the recorded video to see how long it took to make an orbit around the sun (round to the nearest second). If a second is equal to a month, how many months are in your calendar? (ex. the marble took 4 seconds, so you get four months on your new planet). Create a new calendar. What would you name your months? Why? Lets say you have a few extra hours in your rotation (just like the Earth)... What would you do with this extra time? (reflect back on the earlier discussion). What would you call this time? If you decide on a celebration, how could the whole planet celebrate?	Use the recorded video of one marble going in orbit. Determine how many seconds it took to make it around the sun. Do NOT round. If each second is equal to a month, how many months (and extra days) does your calendar have? *For example, 3.1 seconds would be 3.1 months.* Let's get more tricky, watch the slow motion video and count how many times the marble rotated on its axis! *For example, it may have made the orbit is 3.1 seconds, but it spun 75 times.* Now you know the number of rotations on its axis (days) and how long the orbit is (years). Make a calendar. How do you make your calendar work? How many days does	Do the same thing as the hard column except do this for every marble in the solar system! (i.e.--you rolled 4 marbles in orbit at the same time; that's four planets in the solar system). You may want to work with a team...unless you're super hardcore focused. Once you're done with all the calendars, be sure to name your planets. Present your solar system.

		a calendar have? How do you make it fit into a year? Does it come out evenly? If not, you will have to make a decision for what to do with the extra time each orbit...is it a leap day, year, month? Present your calendar and solution for any extra days.	

EXTENSION

- Research some factoids about leap day/year: https://www.history.com/news/why-do-we-have-leap-year
- Research the history of the first leap year and how it was added to the calendar: https://www.nationalgeographic.com/news/2016/02/160226-leap-year-science-time-world-cultures-february/