Bay Area Scientists in Schools Lesson Plan

Lesson Name **Which falls faster?**

Developed by **Seth Zenz** **For Grade** **2nd**
Standards Connections 2-PS: Motion can be described (observe position change over time); Motion can be changed with force (push, pull, size of change is related to strength or amount of force); Objected fall to the earth unless held up.

Vocabulary Definitions:

Force – something that makes objects move
Gravity – The force which makes things fall
Air resistance – The force of the air pushing back against something moving
Fast, slow, heavy, light, big, small
Density – how heavy is an object *for its size*?

Materials

Volunteer Brings:

7 baggies, one for each group containing 2 objects and a sheet to record predictions/observations.
Pairs of objects should illustrate a clear idea.
Examples:
Wood & Metal Ruler – same size and weight, different material → material doesn't matter
Board & Paper – same size, very very different weight → same air resist. has disruptive effect on very light objects with large surface area like paper or leaf
Baseball / Nerf ball – same size, different weight → air resist. minimal, fall at same rate
Red Ring / Pink ring – same size, different weight → air resist. minimal, fall at same rate
Red ping-pong ball, white golf ball – same size, diff. weight → air resist. minimal, same rate
Soft cube, soft disk (w/ hole) – same weight, different size → different air resistance has effect on larger surface area. *(Can also illustrate differences in air resistance if disk turned sideways.)*
Styrofoam cup / Plastic cup – same size, different weight → air resist. minimal, fall at same rate

Classroom Needs: Can kids stand on chairs? Board space for writing. Hard floor to drop objects on.

Set-Up Requirements: Set up baggies with objects and data table in each one.

Introduce and Engage

Making personal connections, engaging curiosity, *building connections to kids' experiences*

Personal Introduction: *What do you do for work, hobbies, play? Why are you interested in this topic?*

I'm Seth, I study physics, and in my spare time I like to play games and take walks through San Francisco. My job is to study the basic *forces* of the universe. [Write the word force on the board, and then define:] A force is when something pushes on something else, and makes it move. The way I study forces is at a particle accelerator in Switzerland, but there are forces we can study together that are closer to home…

Building Connections to Kids' Experiences: *Can you think of an experience most kids would have related to your topic? Is there something to show that will grab their attention? Or can you can pose a mystery with a question about something they see everyday?*

For example, raise your hand if you've been on a roller coaster. [Ask individuals with their hands up: What did you feel right at the top? Did you feel the wind pushing?] These are all forces acting on your body.

When you drop something, what happens? It hits the ground—why? why doesn't it go up? [If someone mentions gravity write it down underneath the word force.] Things fall towards the Earth – the ground - because of a force we call "gravity". Today we're going to do some experiments with gravity to find out more about it.

Learning Experiences

What kids will see, do, hear,touch, taste or make.

Any combination of demonstrations, hands-on activities, and pictures that helps kids explore new ideas. Describe specific experiences in the order you plan, including instructions you need to give students.

Demonstration:

We're going to use a chart like this to record the data from our experiments. [Draw data chart on the board.] I'd like you to pass around these two balls and look at them. [pass balls with same size and noticeably different weight.] Can somebody describe the difference between the two balls? [list all differences on board] If not mentioned – Does one feel heavier than the other? The weight you feel is actually the pull of gravity on the object.

If we dropped these two balls at the same time, do you think one will fall faster? Which one? [mark prediction on the chart] OK, let's see. I'd like a volunteer to be our "dropper". Your job as dropper is to stand on this chair when I say "start" and to carefully drop both things at the same

time from the same height. [To the group:] I'd like all of you to be the "observers" this time. Use your eyes and your ears to figure out if one object hits the ground before the other. Your ears will be the most accurate – listen for one thump or a thump-thump sound. You'll have to be quiet – no talking. I will be our "recorder" to write down what we find out. Everybody ready? Start!

What happened? Did they hit at the same time or different? [If lot's of disagreement suggest another trial.] They hit at the same time. [Record results on data sheet] Were you surprised? So how can we describe what we observed? [Help students get to: Two objects of the same size and different weight fall at the same speed] This is our hypothesis – an idea to test.

Individual Experiments:
You're going to do your own experiment to explore our hypothesis. You'll do your experiment three times to be sure what you're seeing and so that each of you get a turn being the dropper, the observer, and the recorder. For trial 1, I'll give you your job and then you will trade jobs and, trial 2 and 3, when I say "trade jobs". [Split students into groups of three by counting off Group 1: recorder, dropper, observer,]

When I say so, each group will come and get a bag of objects and your data table and choose a place where you can do your experiment without hitting anything. Look at your objects and decide together which one you think might fall faster, and why you think so. Recorder – your job is to fill in the first three rows on our sheet [point to rows on chart on the board] after your group decides what to say. You have 5 minutes and then I will clap like this as a signal to be quiet so we can start our experiment. When everyone is quiet, I'll say "Start". Drop your objects and record the results from trial 1. I will say "trade jobs" so you can each have another job and then clap for quiet to start trial 2. and do the same again for trial 3. Any questions?

Group 1 please get up and choose an area to work. Group 2, etc. [Each group gets two objects and a sheet]
[Clap] Start Trial 1. Trade Jobs for Trial 2. [Clap] Start Trial 2. Trade Jobs. [Clap] Start Trial 3. [Clap] Ok let's all come back up here and see what you found out.

Sharing Experiences & Building Ideas

How kids will share experiences and build links to ideas and vocabulary.

***Sharing and Interpretation**: Ideas for questions to invite sharing and guide interpretation of experiences.*

Students present their results—which fell faster?
Draw pictures with forces—big and small arrows, and interpret as a group why one might have fallen faster than the other. For example: our hypothesis says that the same surface area on the bottom should fall at the same speed, but it looks like in this experiment the objects were the same size on the bottom surface but they still fell at different speeds. Some other force must be

at work here. What do you think it could be? Explain air resistance. Connect object shape to amount of air resistance, and point out that lighter objects are affected more by air resistance than heavier ones. A really thin, light object like a leaf or paper can actually be pushed enough by the air to sort of float down taking a wiggly path down rather than a straight path.

Closing Statements: *connect experiences to larger world, big ideas, vocabulary.*

So what forces affected the way things fell in our experiments today? [gravity, air resistance]
Do heavier objects fall faster than lighter ones? [no – write on board – Two objects of the same size and different weight will still fall at the same speed, unless another force interferes.

This makes gravity a really weird force. Think about it. If a river was pushing a light rock and a heavy rock of the same size – which one would move further, faster? The light rock because there is less mass – less stuff - to move. If the wind is pushing two sail boats with equal size sails across the lake, which boat will go faster the heavier boat or the lighter boat? The light boat because there is less mass – less stuff - to move.
But gravity makes everything fall at the same speed – regardless of weight! It actually pulls harder on objects with more mass and less hard on objects with less mass so they will move at the same speed. Physicists are still trying to figure out why!

Follow-Up Activities

Ask Teacher and kids to write a letter about what they learned. Include drawings!
Things to observe in the future
- Pay attention to how things fall
- Think about forces when on roller coaster, on a bus, etc.

Reading Connections:
- Newton and Me by Lynne Mayer http://www.amazon.com/Newton-Me-Lynne-Mayer/dp/1607180677
- Give It a Push! Give It a Pull!: A Look at Forces by Jennifer Boothroyd http://www.amazon.com/Give-Push-Pull-Lightning-Exploring/dp/0761360565
- Isaac Newton and Physics for Kids: His Life and Ideas with 21 Activities by Kerrie Logan Hollihan http://www.amazon.com/Isaac-Newton-Physics-Kids-Activities/dp/1556527780/ref=pd_sim_b_1

Gravity In Action

Contributed by: COSI Columbus

http://tryscience.org/experiments/experiments_gravity_athome.html

Objective

Explore the effects of gravity on a slowly falling object.

What You Need

- 3 small plastic bags (not zip-lock kind) or 12 inch pieces of plastic cut from a trash bag or grocery bag.
- Some string
- 3 small stones of different sizes.
- Masking tape

To Do and Observe

Make 3 small parachutes; each one weighted with a different size stone.

1. Cut 12 lengths of string, each 20 inches long.
2. Use a paper clip to punch four holes, equally spaced around the opening of each bag.
3. Tie a separate string into each small hole, and let the strings dangle down below the bags. 4. Use a piece of masking tape to secure the string ends to a stone.
5. Do this with each bag. Test your parachutes!
6. Next, arrange your parachutes in order; small, medium and largest stone. Take them outside. 7. Loosely wrap the string and baggy around each stone.
8. Throw each parachute up into the air and observe the time it takes for each one to reach the ground.
9. Time several tries for each parachute if you wish to get an idea about which parachute falls to the ground fastest and slowest.

What's Going On

Gravity is the universal force of attraction in space. It pulls objects with mass together, keeps planets in orbital motion, and holds you and me firmly grounded on Earth.

Gravity pulls down equally on all your falling parachutes. But each one must push against the resisting force of air molecules in the atmosphere as it travels earthward. Depending upon its size, each of your stones has a different surface area and weight! Those stones with larger surface areas

and lighter weights fall at a different rate than heavier stones with smaller surface areas. Stones of equal weight, yet different surface areas will fall to earth at different rates.

Now, imagine doing the same experiment using both large and small plastic bags.

Parent/Teacher Tips

Try to make sure that the stones are securely fastened to the parachutes with masking tape. Also, the tape itself has weight and will create a resistance to falling. Equal amounts of tape are encouraged for each parachute.