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#  Lesson Plan 1 – Introduction to Newton’s 3 laws

 **9:30 to 9:45**

 Introduction – Students will introduce each other.

 **9:45 to 10:15**

Students will take a pre-test to determine prior knowledge and/or misconceptions of concepts surrounding

Newton’s 3 Laws of motion

Graphics of ideas surrounding path of objects’ motion and the force behind the motion, as well as, objects’ paths of trajectory are depicted. Ideas surrounding gravity of falling objects and flying objects, as well as, orbiting objects and objects on other celestial bodies are another component. Concepts surrounding inertia and momentum are also explored. Students are asked to draw or write short answers in response to the graphic prompts. See attached document: 10 pages.

**10:15 to 10:35** Take the students outside for experiential learning activity.

They will be observing the path of motion of thrown objects of various sizes, shapes and weights.

The objects’ paths demonstrate Newton’s 1st law and object in motion will stay in motion in a straight line unless acted on by an unbalanced force. The object of course only goes so far until the force of gravity starts to act upon it, resulting in a distinctive curved flight path. It also show’s Newton’s 2nd law F=MA: force equals mass time acceleration. The heavier objects go higher and farther, as do the objects that are thrown faster

**10:35 to 10:50** Snack and bathroom break.

**10:50 to 11:40** Students will rotate to 6 indoor stations to observe the motion activities designed to highlight ideas surrounding Newton’s 3 Laws.

1. Balloons – Newton’s 3rd Law for every action there is an equal and opposite reaction. Students will blow up balloons and let them go the air will rush out one end of the balloon which will propel it in the other direction.

2. Marbles – Newton’s 3rd Law for every action there is an equal and opposite reaction. Marble will be grouped into sixes at various places on the chalk rail. Students will gently roll 1, 2, and then 3 marbles into the group the resulting motion will be equal and opposite.

3. Clothes pins – Students will set clothes pin on top of an index card balanced on top of a cup. They will then flick the card out from under the clothes pin and observe its motion. This demonstrates inertia and also gravity. Newton’s 1st law – an object at rest. The object wants to keep doing what it is already doing.

4. Pennies- Students will attempt to catch a penny that is balanced on their elbow by swinging their hand out and down. This also demonstrates inertia and gravity.

5. Alien sling shots- Newton’s 2nd law. The more you stretch the alien the harder the farther it can go and the harder it can hit.

6. Rolling balls of different masses- Newton’s 2nd Law The more massive object – the bowling ball hits the cabinet across the room with more force. If 2 tennis balls are rolled towards the cabinet, one very quickly and one very slowly, the fast one hits with more force.

**11:40-12:00**

Have a class discussion about what they have experienced in relation to the following questions.

1. What is Newton’s How does Newton's 1st law relate to what we have been observing?
2. How does Newton’s 2nd law relate to what we have been observing?
3. How does Newton's 3rd law relate to what we have been observing?
4. What is gravity? What effect does it have on objects?
5. What affects the momentum of an object?
6. How is inertia affected by mass?

**Lesson 2 Bernoulli’s Principle and the Principles of Flight**

**9:30- 10:15**

Review of previous concepts through a series of power point images to foster discussion of ideas surrounding Newton’s 3 laws including the effects of gravity and inertia. We will display images and have students tell how these real life situations illustrate these concepts. We will use discussion to expose and address misconceptions.

**10:15-10:35**

Broke students into 3 groups and had each group collaboratively make a poster of each of Newton’s laws.

**10:35- 10:50** Snack

**10:50- 11:15**

Bernoulli’s Principle

We will lead students through a series of experiences which will expose any misconceptions and help them understand the ideas surrounding Bernoulli’s principle. Show them a stiff paper curved into a bridge shape. Ask them to predict what will happen when you blow under the arch. Then blow under the air and they will see that it moves down. Let students perform the motion as well so they can experience the effects. Talk through the movement of air above and underneath the arch. Air moves more quickly underneath because you are blowing there, than on top where there is no disturbance. Ask students which area had more pressure, leading them to the determination that there is more pressure on top since the paper moved down. Then having them follow this to the logical conclusion that slow air exerts more pressure. We will take them through the process again by blowing across the top of a strip of paper. We will have them predict and walk through all the previous steps. This will lead us into a discussion of Bernoulli’s principle and how it affects the lift of airplanes.

**11:15-11:30**

We put up and image of a plane and had the students come up with what forces are working on the plane. We were trying to draw out the ideas of drag thrust lift and gravity.

**11:30-12:00**

Fold and fly paper airplanes

End paper airplanes

**Lesson 3 Flight**

**9:30- 9:50**

Review Newton’s 3 Laws

Have students fold a paper in three sections lengthwise and illustrate each law. We will talk through and work as a group on this.

**9:50 -10:10**

Graphics showing forces on the ground: Have students label and explain on worksheet.

Graphics showing forces in the air: Have students label and explain on worksheet.

**10:10 - 10:40**

Revisit Bernoulli show hairdryer trapping ping pong balls in the fast moving stream because the slow moving air all around exerts a higher pressure

Review the principles of drag, lift, thrust, and gravity

We will also discuss aerodynamics and show images of various shaped crafts.

Show several short video clips demonstrating aerodynamics

**10:40– 10:55** Snack

**10:55 – 11:50**

Students will all fold the same simple plane.

All students stand in a line and watch as all fly their planes.

They will than modify their plane by placing 3 paperclips at locations of their own choosing.

Again all students will stand in a line and fly their planes while everyone watches. Each will exhibit their paperclip placement before their flights. We will discuss the effects of placing mass on different parts of the plane.

Students will then modify their plane one more time with paperclips taking into consideration their observations of their classmates’ planes. They will have access to unlimited amounts of clips at this point. We will discuss what happened and the effects of too much mass.

A final modification to their planes will be the addition of horizontal stabilizers which will be created by making two ½ inch cuts (about 1 ½ inches apart0 in the back edge of each wing.

A great resource to use for this lesson was The Paper Airplane Book by Seymour Simon.

Students will once again test their planes.

**11:50- 12:00**

Debrief and discuss rocket build next time. Pass out large and/ or colourful paper and clips for any students who wish to continue their exploration of paper airplane flight over the next week.

**Lesson 4 Rocket build**

9:30-9:45

Revisit Newton’s 3rd law and aerodynamics

9:45- 10:00

Make plan

10:00-10:45

Students will build rockets in groups. They will follow as a group making fins and nose cones. They will secure a small piece of modeling clay inside the nose cone. Even though students were given templates to help them with the process, there was lots of room for deviation in size, shape, and color both of poster boards creating these parts and duct taping holding it in place. Students will build rockets out of 2 liter soda bottles as a base. This rocket will be shot off using a launching platform that I purchased off the web. The rockets will be filled with water and placed on launching platform. The platform will then be attached to a bicycle pump and filled with ~60 -70 lbs of air pressure. When the rockets are released from the platform, they will shoot ~ 30 feet into the sky shooting air and water out of the back end. This is a very fun and dramatic visual example of Newton’s 3rd law. Lots of information about water rockets can be obtained from this website: <http://www.water-rockets.com/>. There are an array of sites selling launchers form ~$24 to over $60. There are also plans for people who want to make their own. I bought the one I use for ~$30.

10:45-11:00 Snack

11:00- 11:40

Finish Rocket build. We will allow students to embellish their rockets with paint and other found decorations.

11:40-12:00

Discuss air resistance and shock absorbency in preparation for lunar lender build next time.

**Lesson 5 Lunar Landers, Presentation and Rocket Launch**

**9:30- 9:45**

Revisit gravity with ball demonstration (I will swing a ball above my head on a string and make the analogy that the string represents gravity) and discussion of gravity with a globe. Talk about counter acting gravity and increasing air resistance.

Show video clip pathfinder artist simulation of landing on Mars.

**9:45-10:15**

Build Landers with choice of various materials. Lander must house a 3 oz cup holding 2 marshmallows- to simulate astronauts. Their task is to design a lender which maximizes air resistance and minimizes the force of impact in order to retain astronauts in their capsule upon landing. They may not cover the top of the cup. The lender will be dropped from the second floor. Lesson was adapted from a NASA AIMS lesson plan <http://teachers.egfi-k12.org/lesson-build-lunar-lander/> We changed the lesson by allowing students to select their own materials from an assortment of Styrofoam trays, sponges, marshmallows, straws, foam rubber, packing materials, etc.

**10:15-10:30**

Test landers. Students will drop landers off the 2nd floor balcony to see if their designs accomplished the goal of retaining the astronauts in the capsules.

**10:30 – 10:45** Snack and bathroom break.

**10:45- 11:15**

Plan out and practice presentation for parents. Students will discuss their learning during this unit to accompany a power point presentation of images of student work.

**11:15- 12:00**

Parent attended student presentation of learning and rocket launch.