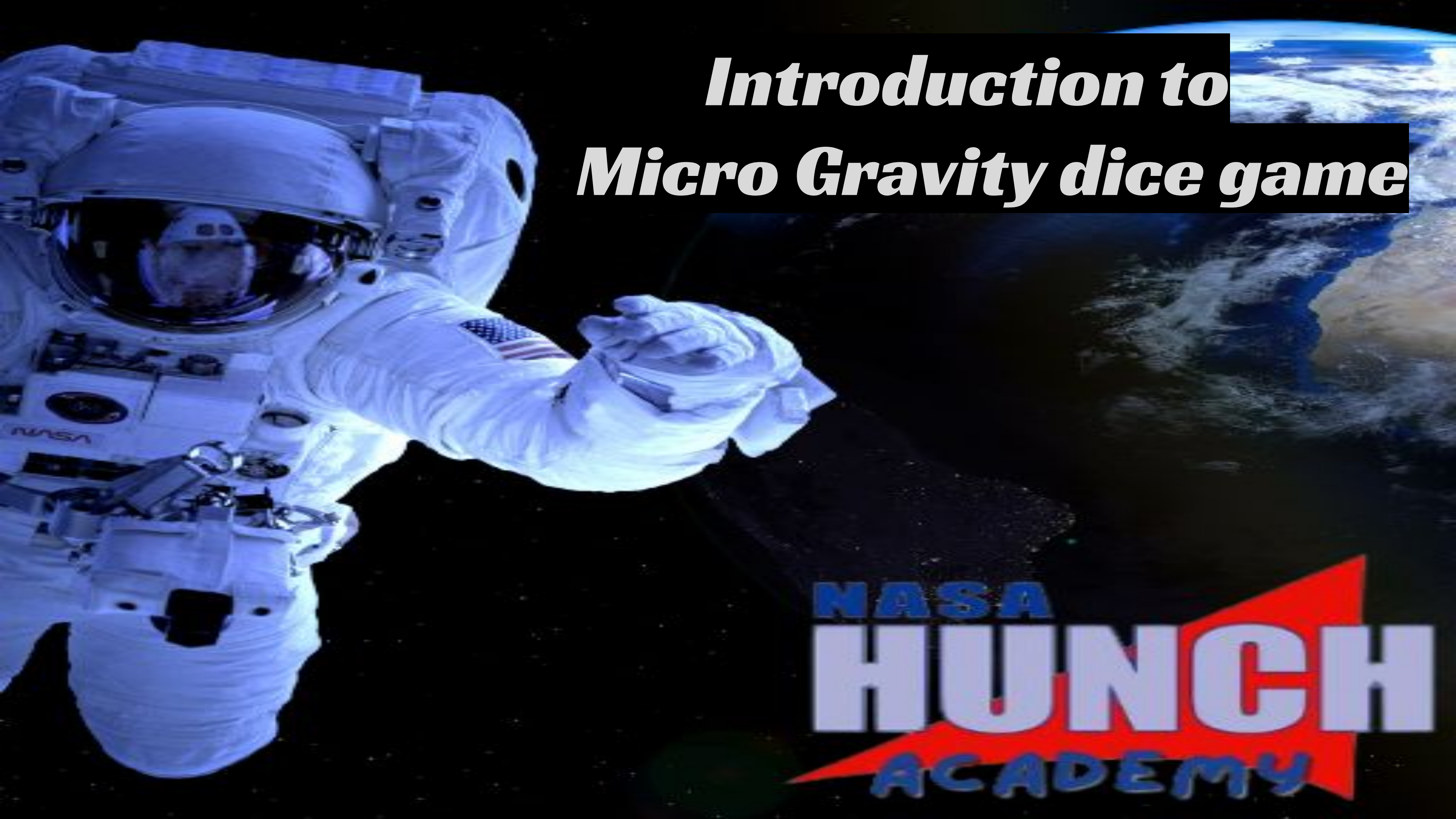
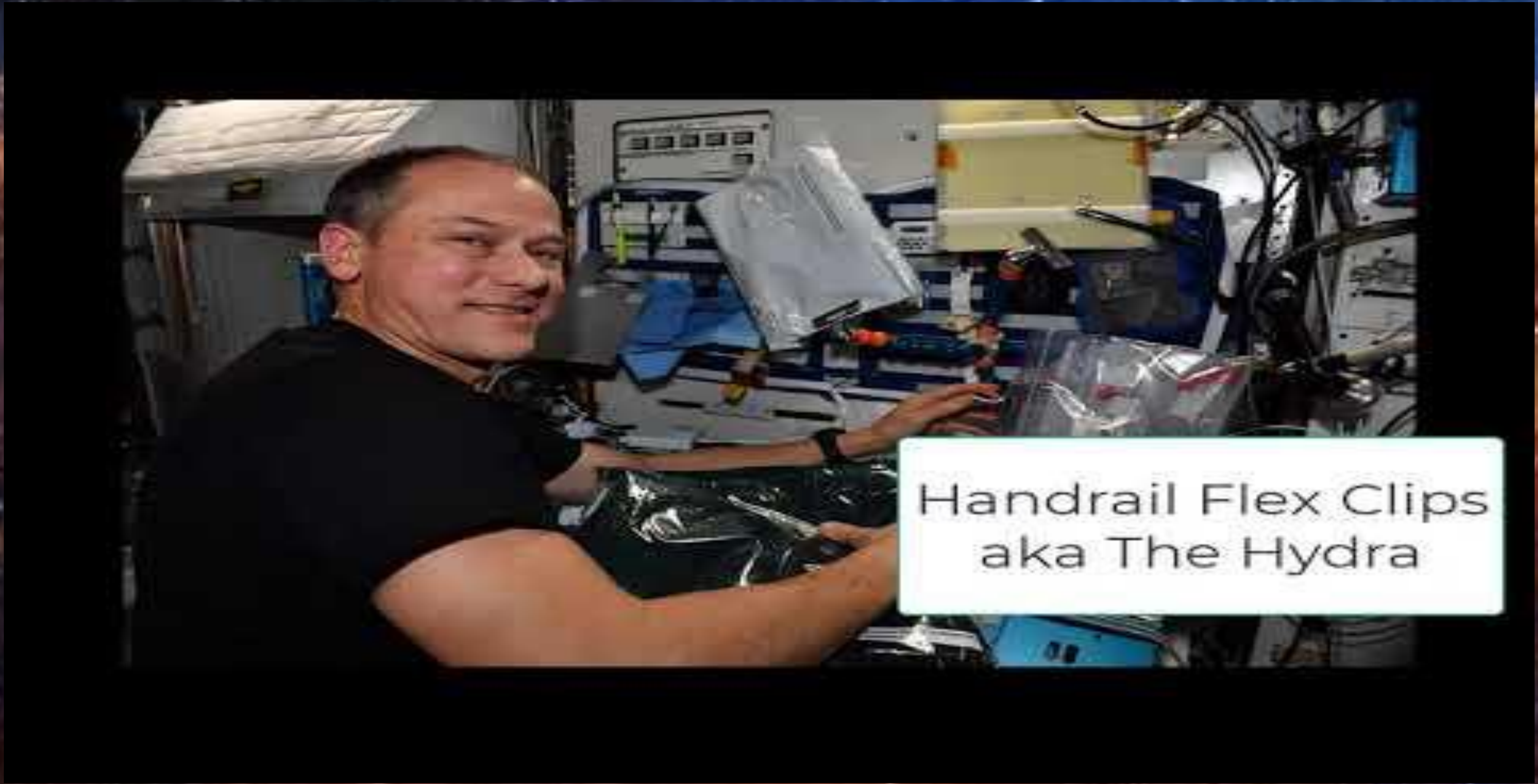
Introduction to Micro Gravity dice game



Introduction to NASA HUNCH video.



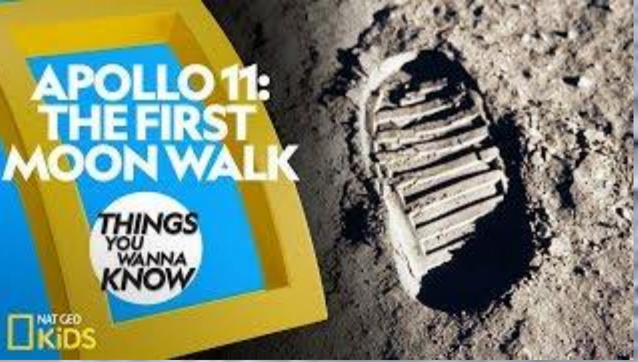
Mission Statement: Empowering Elementary School Students in STEM through NASA HUNCH Academy

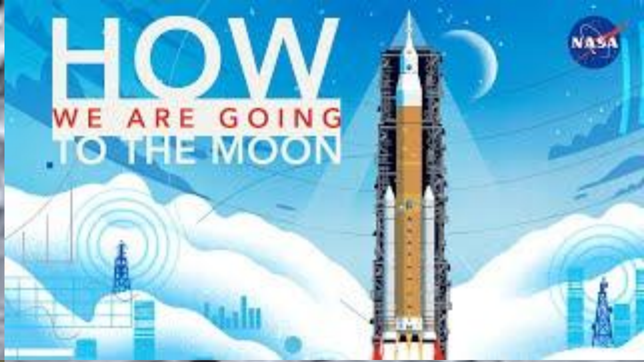
At NASA HUNCH Academy, our mission is to ignite a passion for STEM (Science, Technology, Engineering, and Mathematics) among elementary school students by providing an immersive and innovative educational experience inspired by NASA HUNCH. We strive to cultivate curiosity, critical thinking, and creativity, laying the foundation for future leaders in space exploration and technology.

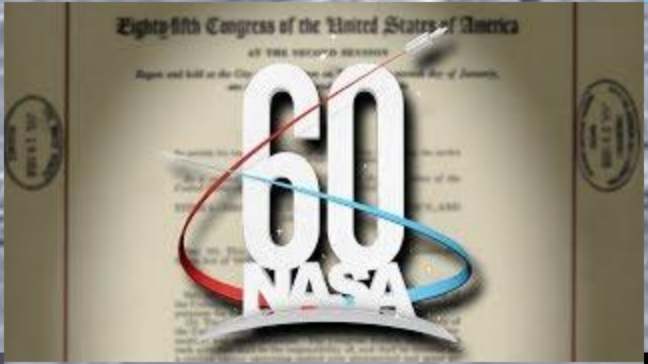
Vision Statement: Fostering a Generation of Young Explorers and Innovators

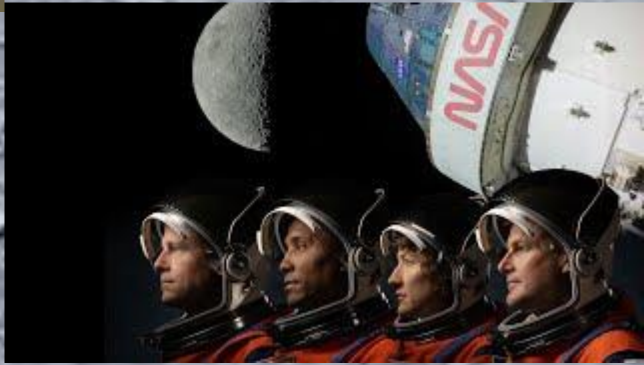
Our vision at NASA HUNCH Academy is to create a dynamic learning environment where elementary school students can thrive in STEM fields. We envision a future where every child is equipped with the knowledge, skills, and inspiration needed to contribute to space exploration and technological advancements. Through hands-on experiences, collaboration, and mentorship, we aim to nurture a community of young explorers and innovators who will boldly shape the future of science and technology.

NASA and Moon landing videos

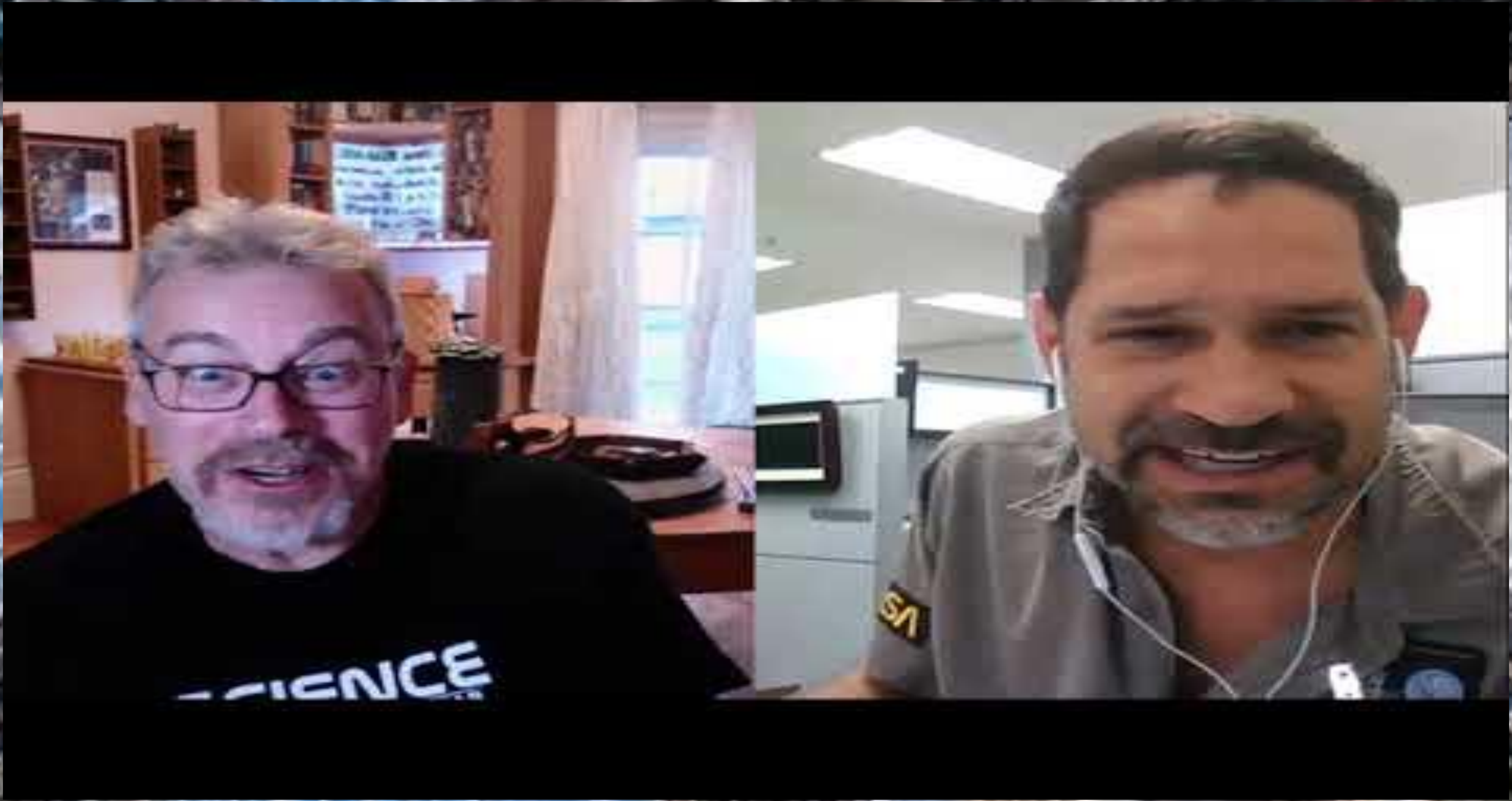








Introduction to NASA HUNCH Micro Gravity Dice Game video



Objective

Read over the NASA HUNCH PowerPoint, visit the websites, and watch the videos for information.
https://www.hunchdesign.com/uploads/2/2/0/9/22093000/micro-g_dice_rolling.pdf
Our objective is to help NASA develop and design a prototype of a dice game that will work in zero gravity. This project is important for the astronaut's mental health. We need them to be able to relax and have fun while they are on long missions to space. What better way to do this than with a game they can play in zero gravity? They would like a dice game that they can play easily and react similarly to how it does on Earth. It must be lightweight because it costs $1.2 million per pound of material that goes into space. How can we make a dice game that will work in space? We will use magnets to help our dice stick to the game board in zero gravity. In these investigation stations, we will be weighing and measuring, testing how dice react, and testing different types of magnets. We will discuss how to design a dice that will have either a magnet or a steel ball inside it and whether the magnet needs to be on the game board or in the dice. After we finished all the stations and used that data to help us with our blueprints or drawings of our design. We used a CAD program called Tinkercad.com to help the students design their game board and dice. I 3D printed some of their designs. Tinkercad is a free and easy-to-use CAD program that works well with elementary-aged students. 3D printing is a huge upcoming industry. The younger these students are introduced to it the better. If you don't want to use a CAD program you can still have your students draw their designs on paper. Have fun and think like a Scientist and an Engineer.

Discussion Questions

What is gravity and how does it affect us here on Earth?
What is a magnetic field?
How do North and South poles differ on a magnet?
What is attracted to a magnet and why?
How strong are magnets?
Does the strength of a magnet depend on the size of the magnet?
Is one Pole stronger than the other?
What is the difference between 2D and 3D shapes?
What size is a dice?
How many numbers do you see on a dice?
What shape is a dice and why does it's shape matter while rolling it?
Does a dice land on the same number every time?
What is the probability of it landing on the number 1?
Does the way you roll a dice change the number it will land on?

Websites that will help

What is Gravity

https://spaceplace.nasa.gov/what-is-gravity/en/

https://www.coolkidfacts.com/gravity/

https://www.generationgenius.com/videolessons/gravity-pulls-things-down-video-for-kids/

Solar System: Gravity and Inertia: StudyJams! Science | Scholastic.com

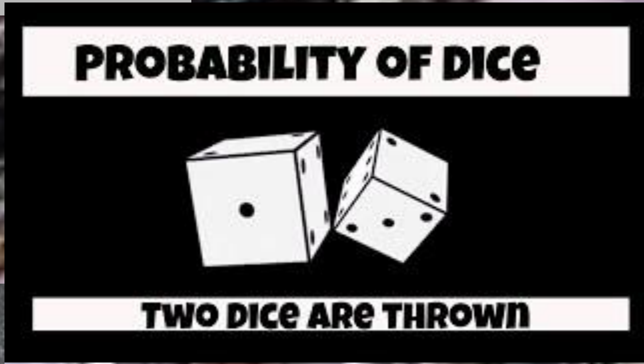
Dice Probability

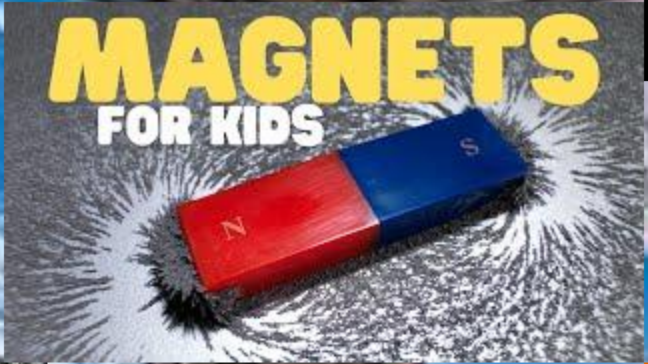
https://www.education.com/activity/article/probability-dice-game/

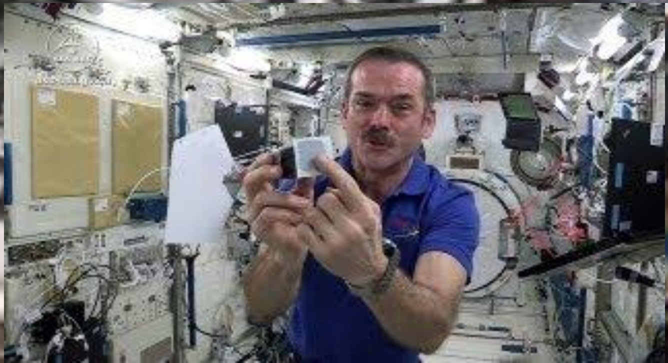
Scientific method/ data collecting

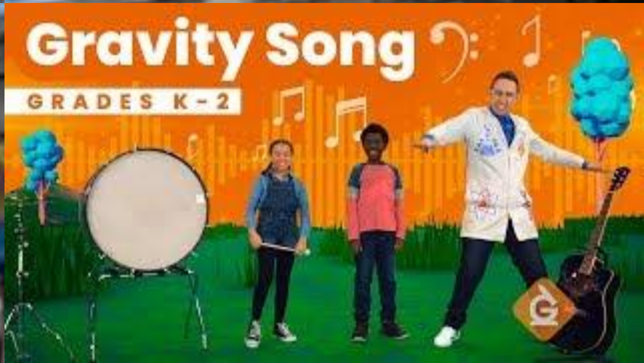
StudyJams! Science Activities | Scholastic.com

Videos about gravity and dice









Elementary Common Core Math Standards

[Grade 5 » Geometry | Common Core State Standards Initiative (thecorestandards.org)](thecorestandards.org)

2nd grade-

CCSS.Math.Content.2.MD.A.1

Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes

CCSS.Math.Content.2.MD.A.3

Estimate lengths using units of inches, feet, centimeters, and meters

CCSS.Math.Content.2.MD.A.4

Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

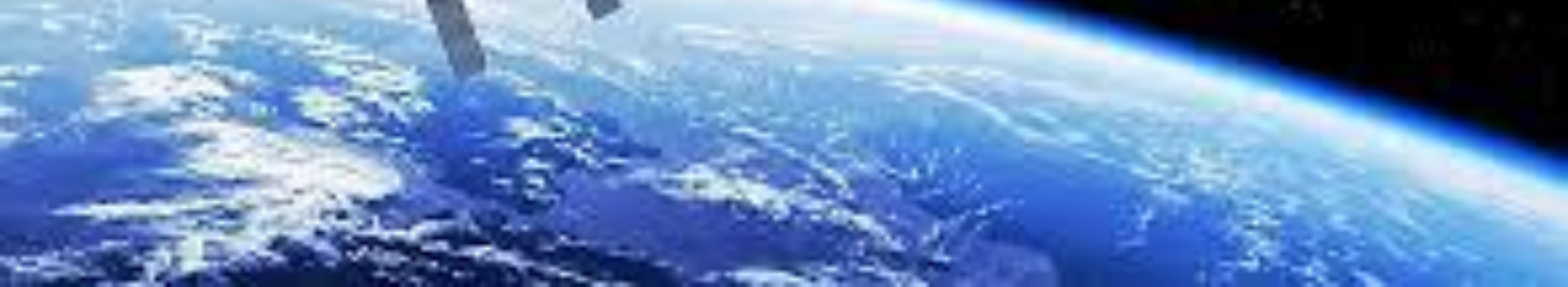
3rd grade-

CCSS.Math.Content.3.MD.B.4

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters

CCSS.Math.Content.3.G.A.2

Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.



4th grade-

CCSS.Math.Content.4.MD.A.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36),

CCSS.Math.Content.4.MD.C.5Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: CCSS.Math.Content.4.MD.C.5.aAn angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles

CCSS.Math.Content.4.MD.C.6 Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.

CCSS.Math.Content.4.G.A.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

5th grade-

CCSS.Math.Content.5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. CCSS.Math.Content.5.NF.B.6. Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem. CCSS.Math.Content.5.G.B.3. Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles. CCSS.Math.Content.5.G.B.4. Classify two-dimensional figures in a hierarchy based on properties.

Middle School common core math standards

6th grade- CCSS.Math.Content.6.RP.A.3.d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. CCSS.Math.Content.6.NS.A.1. Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. CCSS.Math.Content.6.NS.C.6 Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. CCSS.Math.Content.6.G.A.4 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems. CCSS.Math.Content.6.G.A.1 Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems. CCSS.Math.Content.6.SP.B.5 Summarize numerical data sets in relation to their context, such as by: CCSS.Math.Content.6.SP.B.5.a Reporting the number of observations. CCSS.Math.Content.6.SP.B.5.b Describing the nature of the attribute under investigation, including how it was measured and its units of measurement

7th grade-CCSS.Math.Content.7.RP.A.1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.CCSS.Math.Content.7.RP.A.2. Recognize and represent proportional relationships between quantities.. CCSS.Math.Content.7.RP.A.2.a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whCCSS.Math.Content.7.G.A.1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.. CCSS.Math.Content.7.G.A.2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.. CCSS.Math.Content.7.G.A.3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids . ether the graph is a straight line through the origin. CCSS.Math.Content.7.G.B.4 Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. CCSS.Math.Content.7.G.B.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. CCSS.Math.Content.7.G.B.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Middle School common core math standards

8th grade-CCSS.Math.Content.8.G.A.4 . Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. CCSS.Math.Content.8.G.A.5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.

CCSS.Math.Content.8.G.A.1. Verify experimentally the properties of rotations, reflections, and translations:

CCSS.Math.Content.8.G.A.1.a. Lines are taken to lines, and line segments to line segments of the same length.

CCSS.Math.Content.8.G.A.1.b. Angles are taken to angles of the same measure.

CCSS.Math.Content.8.SP.A.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

Elementary Math Standards for Georgia

MGSE2.MD.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

MGSE2.MD.2 Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen. Understand the relative size of units in different systems of measurement. For example, an inch is longer than a centimeter. (Students are not expected to convert between systems of measurement.)

MGSE2.MD.3 Estimate lengths using units of inches, feet, centimeters, and meters.

MGSE2.MD.4 Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard-length unit.

MGSE3.MD.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units – whole numbers, halves, or quarters.

MGSE4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. a. Understand the relationship between gallons, cups, quarts, and pints. b. Express larger units in terms of smaller units within the same measurement system. c. Record measurement equivalents in a two-column table.

MGSE4.MD.2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

MGSE5.MD.1 Convert among different-sized standard measurement units (mass, weight, length, time, etc.) within a given measurement system (customary and metric) (e.g., convert 5cm to 0.05m), and use these conversions in solving multi-step, real word problems.

2nd Grade NGSS Science standards covered in this lesson

K-PS2-1.Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

PS2.A: Forces and Motion. Pushes and pulls can have different strengths and directions.

Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.

ETS1.A: Defining Engineering Problems. A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

K-PS2-2.. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

3rd Grade NGSS Science Standards covered in this lesson

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

PS2.A: Forces and Motion. Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)

PS2.B: Types of Interactions. Objects in contact exert forces on each other.

3-PS2-2.. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

PS2.A: Forces and Motion. The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.

3-PS2-3., Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

PS2.B: Types of Interactions. Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

3-PS2-4., Define a simple design problem that can be solved by applying scientific ideas about magnets.

PS2.B: Types of Interactions. Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

4th Grade NGSS Science standards covered in this lesson

3-PS2-3.Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.

PS2.B: Types of Interactions. Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.*

PS2.B: Types of Interactions. Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

5th Grade NGSS Science standards covered in this lesson

5-PS2-1.Support an argument that the gravitational force exerted by Earth on objects is directed down.

3-PS2-3.Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force. **PS2.B: Types of Interactions.** Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.**3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.*** PS2.B: Types of Interactions. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).. Support an argument with evidence, data, or a model.

Middle school NGSS Science standards

*MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**

PS2.A: Forces and Motion. *For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).*

Constructing Explanations and Designing Solutions. *Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.*

MS-PS2-2.Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

PS2.A: Forces and Motion. *The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared*

MS-PS2-3.Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

MS-PS2-4.Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

MS-PS2-5.Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

PS2.B: Types of Interactions. *Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).*

MS-ESS1-2.Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

ESS1.B: Earth and the Solar System. *The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.*

Elementary Science standards

SKP2. Obtain, evaluate, and communicate information to compare and describe different types of motion. a. Plan and carry out an investigation to determine the relationship between an object's physical attributes and its resulting motion (straight, circular, back and forth, fast and slow, and motionless) when a force is applied. (Examples could include toss, drop, push, and pull.) b. Construct an argument as to the best way to move an object based on its physical attributes.

S1P2. Obtain, evaluate, and communicate information to demonstrate the effects of magnets on other magnets and other objects. a. Construct an explanation of how magnets are used in everyday life. (Clarification statement: Everyday life uses could include refrigerator magnets, toys, magnetic latches, and name tags.) b. Plan and carry out an investigation to demonstrate how magnets attract and repel each other and the effect of magnets on common objects.

S2P2. Obtain, evaluate, and communicate information to explain the effect of a force (a push or a pull) in the movement of an object (changes in speed and direction). a. Plan and carry out an investigation to demonstrate how pushing and pulling on an object affects the motion of the object. b. Design a device to change the speed or direction of an object. c. Record and analyze data to decide if a design solution works as intended to change the speed or direction of an object with a force (a push or a pull).

S4P3. Obtain, evaluate, and communicate information about the relationship between balanced and unbalanced forces. a. Plan and carry out an investigation on the effects of balanced and unbalanced forces on an object and communicate the results. b. Construct an argument to support the claim that gravitational force affects the motion of an object. c. Ask questions to identify and explain the uses of simple machines (lever, pulley, wedge, inclined plane, wheel and axle, and screw) and how forces are changed when simple machines are used to complete tasks. (Clarification statement: The use of mathematical formulas is not expected.)

S5P3. Obtain, evaluate, and communicate information about magnetism and its relationship to electricity. a. Construct an argument based on experimental evidence to communicate the differences in function and purpose of an electromagnet and a magnet. (Clarification statement: Function is limited to understanding temporary and permanent magnetism.) b. Plan and carry out an investigation to observe the interaction between a magnetic field and a magnetic object. (Clarification statement: The interaction should include placing materials of various types (wood, paper, glass, metal, and rocks) and thickness between the magnet and the magnetic object.)