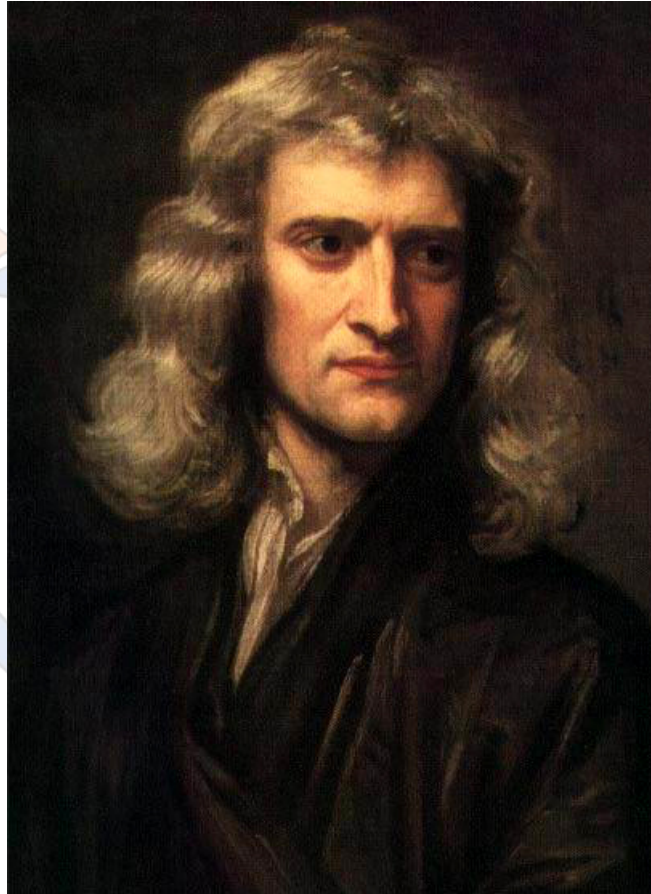


Newton



A Study Guide to *The Adventures of the Open Dream Ensemble:* *Isaac Newton*

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Open Dream Ensemble is a project of the Thomas S. Kenan Institute for the Arts, whose mission is to incubate projects that sustain artists at every point in their creative development through strategic partnerships that capitalize on visionary thinking in the arts.

Dear Educator,

This study guide provides suggestions for classroom activities and lessons that connect to our original web series, *The Adventures of the Open Dream Ensemble: Isaac Newton*. It includes biographical information about Isaac Newton, ways to explore his Three Laws of Motion, some questions and ideas that might lead to deeper noticing of the web series, and more!

Open Dream Ensemble is comprised of professional actors, dancers, and musicians trained at the University of North Carolina School of the Arts. Together we create and perform original musical theater productions for youth and carry out arts-integrated residencies that connect to the standard curriculum.

For more information about Open Dream Ensemble and the work we do, please visit our website: <http://opendreamensemble.com/index.html>

We hope this guide is helpful for you and that you enjoy our web series!

Rebecca Nussbaum
General Manager, Open Dream Ensemble

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Facts about Isaac Newton

🍏 Isaac Newton was born on Christmas

Isaac Newton was born in Woolsthorpe, Lincolnshire, England on December 25, 1642.

🍏 Sir Isaac Newton is the son of Isaac Newton.

Isaac Newton was named after his father, a yeoman (land-owning farmer), who died three months before baby Isaac was born. His mother was Hannah Ayscough Newton. When Isaac was three years old his mother remarried and Isaac went to live with his grandmother.

🍏 Baby Isaac could have fit in a quart mug.

Baby Isaac was born prematurely. He was so tiny it was predicted he would not even survive his first day of life. Yet he lived for 84 years and became one of the most influential thinkers of all time.

🍏 A bully was one of Isaac's motivations in studying hard at school.

Newton was not a star student when he started at the King's School, Grantham. A bully challenged him to a fight and this event made Newton decide the best way to win was to do well in school. He began to focus on studying and became the top ranked student at King's School.

🍏 Young Newton was smart, diligent, and highly curious.

When his stepfather died in 1653, Newton's mother withdrew him from school to run the family farm. Rather than tending the animals and crops, he spent his time reading and studying. He was a terrible farmer. The principal of King's School persuaded Isaac's mother to allow him to quit farming and continue his education.

🍏 In 1661 he entered Trinity College, Cambridge University.

While at Trinity College, he read modern thinkers such as Copernicus, Galileo, and Kepler. During this time, his talents for mathematics and physics were recognized and in 1664 he was elected a "scholar" at Trinity College and granted four years of financial support.

🍏 In 1666, he arrived at the notion of gravity when he saw an apple falling from a tree.

While Newton had been thinking about a "force" that keeps the moon in orbit around the earth since he was 18, it was not until six years later he realized that the force which pulled the apple towards the earth must be the same one that keeps the moon on its orbital around the earth. He decided to call the force "Universal Gravitation" from the Latin word that means weight, *gravitas*.

🍏 While considering the workings of gravity, Newton arrived at his Three Laws of Motion.

Newton's Three Laws of Motion were an important scientific discovery that opened the door to advanced inventions and led to the Industrial Revolution and modernization.

🍏 Among his many accomplishments, Newton developed a form of mathematics called calculus, invented a powerful refracting telescope, created a theory about the properties of light, became a member of the British Parliament, and the headed British mint. He also had an interest in alchemy (a precursor to chemistry) and religion.

🍏 In 1705, Newton was knighted by Queen Ann for his many great accomplishments. Knighthood bestows the title "Sir".

Greetings Young Dreamers and welcome to *The Adventures of the Open Dream Ensemble: Sir Isaac Newton!*

Below are some questions for you to answer once you have viewed the web series.

- What is the mission given by Professor Poople to the Open Dream Ensemble?
- What are Dr. Disrupto's plans?
- Where and in what century did Isaac Newton live? How does the Open Dream Ensemble travel to meet him?
- Compare how Isaac Newton dressed to how we dress today.
- How did Isaac Newton discover gravity? What does earth's gravity cause? Why do planets orbit around the sun while the moon orbits around the Earth?
- What is Quarkster's magic trick? What is Brandon's magic trick? How does Brandon's trick help Isaac Newton discover the first Law of Motion?
- What does Jon do to the Quarkster that helps Newton discover his second Law of Motion?
- What does Julianne do to help Newton discover his third Law of Motion? What are the other examples of Newton's third Law of Motion?
- How does Bryn help Isaac Newton and what does she earn as her reward?
- Can you name some of other Newton's discoveries that are mentioned in our adventure?



Laws of Motion - Activity Page

Please note: Parent or teacher supervision is needed for each of these activities!

Put on your thinking caps because it's time to think like a scientist! Be ready to make observations and test predictions. Taking notes and measurements might be helpful.

Law No. 1 - The Law of Inertia

Activity 1

Place a ball on the ground. Kick the ball so it rolls. Wait until the ball stops moving.

Now kick the ball towards a big unmoving object (like a wall or a big tree). Then have another person kick the ball towards you and while the ball is moving, try to make it go in a different direction with your foot.

Kick the ball different types of surfaces. Pay attention on how the ball rolls and the speed and distance it is rolling.

Discussion

- 🍎 What happened when the still ball is kicked?
Compare to what happened in the Web Series Episode 3.
- 🍎 What happened when the moving ball hits a big, unmoving object or your foot?
- 🍎 What happened when you kick the ball on the grass or other unsmooth surfaces?
- 🍎 Does the ball roll with the same speed on every surface? Which surface causes the ball to roll the slowest? The fastest?

Grass, sand, and other unsmooth surfaces cause **friction** with the ball. Friction causes the ball to slow down.

The **first part of Newton's First Law of Motion** explains what happened when you kicked the ball that was previously still.

An object (the ball) at rest (which is still) will remain at rest (unmoving) unless acted on by an unbalanced force (your kick that causes the ball to move).

The **second part of Newton's First Law of Motion** is explored when something stops the ball from moving.

An object (the ball) in motion (that is moving) will continue to be in motion with the same speed and in the same direction unless acted upon by an unbalanced force (hit another object, kicked toward a different direction, or stopped by friction).

Law No. 2 - Force = Mass x Acceleration ($F = ma$)

Activity 2

Get a **toy car**. Stack a few **hardcover books** on the floor. Stand a few feet away from the stack (and mark where you stand so you will remember where it is) then push the toy car so that it hits the stack.

Replace the books with a stack of **plastic bags**. Now stand at the same place as you were before and push the car strongly. If the stack scatters, stack it back then try to push the toy car from the same distance but this time more gently.

Discussion

- What happened when the toy car hits the stack of books? What happened when the toy car hits the stack of plastic bags? Compare what happens when the toy car hits the book stack and the plastic bag stack.
- Predict what happens to when a real car hits a wall or a tree. What causes the damage? Which do you think will cause the worst damage:
 - when a car hits a hard surface or when it hits a softer surface?
 - when a car hits a bigger car or a smaller car?
 - when a car hits with a higher speed or with a lower speed?

What happened explains the **Newton's Second Law of Motion**.

FORCE equals the MASS of the object times its ACCELERATION ($F = ma$), which also means:

- a. **The greater the mass, the bigger the force needed to accelerate (or move) the object.**
When the toy car hits a stack of hardcover books, the stack might not move at all or might just move a little bit. But when the same toy car hits the plastic bags they will move more because they have less mass. A greater force is required to push the heavier mass of books as compared to the light stack of bags.
- b. **An object with greater mass will create a bigger force than an object with a smaller mass if both are accelerating at the same rate.**
A bigger car causes bigger damage when it hits a smaller one because it has bigger force. So when a car hits a scooter, it is more likely for the scooter to suffer greater damage.
Consider what happens in Episode 4 when the Quarkster (Dr. Disrupto's man) hits Brandon with his fist, and Jon hits the Quarkster with the frying pan.

Law No. 3 – For every action there is an equal and opposite reaction.

In episode 5 pay careful attention on Julianne's tap dancing and when she snaps the piece of wood. Now try to remember what happened in Activity 2 and what came up in the discussions. Answer the following questions:

1. Why is the stack of hardcover books is less likely to move or scatter than the stack of plastic bags?
2. Why is it that when a car hits a wall, it is unlikely to make a hole through the wall but when a giant steel wrecking ball hits a building, it can tear the building down?

And these are some explanations...

1. A stack of hardcover books can resist a greater force because it has greater mass compared to the stack of plastic bags (remember $F = ma$, the greater the mass is, the greater the force it can produce). The opposite reaction (force) produced by the stack can be seen by a car that moves backward after it hits the stack. But because of the friction that happens between the car and the surface it is on (remember friction causes a slowing down), the car does not have the same amount of acceleration anymore, which means it does not have the same amount of force when it hits the books compared to when it was first released. Therefore the toy car does not move back to its original place when it hits the stack.
2. Because the wrecking ball has a much larger force due to its much larger mass, the wall or building cannot resist the force and breaks.

Do you get it right? 😊

All the things happened in Episode 5 and answers to all the questions above explains Newton's Third Law of Motion: **For every action there is an equal and opposite reaction.**

That also means **the greater the force applied by object 1 to object 2, the greater the force in an opposite direction object 1 will receive from object 2.**

For example, if you bounce a ball gently to the floor of your gym, it will not bounce back really high. But if you bounce the ball really hard, it will bounce back higher. When you bounce the ball gently, it will take lesser amounts of bouncing back until it finally stops bouncing, than when you bounce the ball hard. Also when you catch the ball that bounces back, the harder you bounce the ball, the stronger the Force you feel on your palm.

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Word Jumble

Find these words in the word jumble! Do you know what each word means?

NEWTON
GRAVITY
APPLE
WEIGHT
MOTION

INERTIA
FORCE
MASS
ACCELERATE
ROCKET

LIGHT
COLOR
RAINBOW
SCIENTIST
ALCHEMY

ENGLAND
ENSEMBLE
ACTING
MUSIC
TAP DANCE

K	A	D	V	E	N	T	U	A	L	I	Z	E	R	G
W	Z	I	A	L	C	H	E	M	Y	A	J	D	E	F
I	F	M	D	P	E	N	C	I	N	X	A	T	H	Y
V	O	O	X	P	S	H	A	R	E	Q	S	A	E	P
M	R	T	R	A	I	N	B	O	W	R	E	P	L	D
A	C	I	V	C	N	M	X	C	T	E	U	D	B	N
S	T	O	Q	C	E	A	A	K	O	A	L	A	M	A
J	I	N	L	E	R	S	M	E	N	S	K	N	E	L
O	O	T	K	L	T	S	I	T	N	E	I	C	S	G
B	N	H	I	E	I	Y	B	U	B	B	I	E	N	N
J	S	G	G	R	A	V	I	T	Y	S	H	I	E	E
E	H	I	J	A	E	R	B	M	U	X	T	H	Y	M
T	K	E	O	T	H	G	I	M	E	C	R	E	A	T
S	L	W	F	E	T	C	N	J	A	R	O	L	O	C

Vocabulary Builder

Fill in the answers to the boxes!

1. A state of equilibrium or equal distribution of weight.
2. A force discovered by Newton when he saw an apple falling from its tree. This force pulls everything towards it.
3. There are Three ____ of Motion by Isaac Newton.
4. Newton said that ____ is equal to mass times acceleration.
5. ____ causes moving things to slow down.
6. Newton's first name.
7. Newton is a _____.
8. For every action there is an equal opposite _____.
9. Newton used a transparent glass _____ to refract white light into rainbow-color lights.
10. An _____ at rest will remain at rest unless acted upon an unbalance force.
11. Planets in our solar system orbit in this shape.
12. Precursor of chemistry.

(**clue: if you forget the words, check the answer box below using a mirror**)

1.									
2.									
3.									
4.									
			5.						
			6.						
7.									
			8.						
			9.						
10.									
		11.							
			12.						

What are the words formed on the highlighted column?

Law	Object	Fiction	Prism	Isaac	Force
Reaction	Ellipse	Alchemy	Gravity	Scientist	Balance
Answers:					



Let's Have An Adventure!

Ask students to research the following questions and have a class role-play based on what they find!

Newton lived from 1642 - 1727.

How did people in England live in that time period? How did they dress up? How did they travel? What did they eat? What were some of the main occupations of the people? How did they purchase something? What books were being written and read? What music was being written and performed? What were some of the popular dances? Who were some of the famous artists?

Who are some of the important people of the time? Why?

What are some of the historical events that took place in that century? What are the impacts of these events to our world today?

Recognize how Isaac Newton in the Web Series speaks with British accent. What are some differences students can find between the British and American English?

Once the research is complete, break the students in to teams of 5 – 6 and have them create characters and a scene based on their research. They should pay attention to details of the time period as well as to the tools of an actor: voice, body and imagination.

When all the students have had the opportunity to put on their skits, have them discuss what they observed and how that connects to the life and times of Sir Isaac Newton.

Sources and Links

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