Discovery Series

2019-2020
Resource Guide

VICTORIA THEATRE ASSOCIATION

NEWTON'S APPLE

Thursday, February 20, 2020
9:30 a.m. or 11:30 a.m.
Victoria Theatre

Written by Scott Wichmann
Music by Jason Marks
Produced by Virginia Rep on Tour

Discovery Series

Welcome to the 2019-2020 Discovery Series at Victoria Theatre Association. We are very excited to be your education partner in providing professional arts experiences to you and your students!

Thank you for joining us for NEWTON'S APPLE here at the Victoria Theatre! Isaac Newton came up with scientific principles that still very much influence modern day science. He was a pioneer in astronomy and physics. Throughout his life-long dedication to science, he was able to make discoveries, such as the laws of motion, that we still study today! NEWTON'S APPLE will present these scientific principles and the man who changed the world with music and exciting science experiments!

The information and activities in this resource guide have been carefully crafted to help you and your students explore the many ways a live theatre experience can open up learning opportunities. Grade level icons will help you determine which activities are good for students, too. And don't forget to take advantage of the local resources listed inside to extend the play-going experience and make even more curricular connections for you and your students. Thank you again and welcome!

The Education & Engagement Team

Curriculum Connections

You will find these icons listed in the resource guide next to the activities that indicate curricular connections. Teachers and parents are encouraged to adapt all of the activities included in an appropriate way for your students' age and abilities. NEWTON'S APPLE fulfills the following Ohio and National Education Standards and Benchmarks for second through eighth grade.

Ohio's New Learning Standards Related to NEWTON'S APPLE

Science: Changes in Motion, Matter and Forms of Energy, Light, Sound, and Motion, Forces and Motion

Social Studies: People Working Together, SPATIAL THINKING AND SKILLS

Arts: TH:Re7.1.3.a, TH:Re7.1.4.a, TH:Re7.1.5.a, TH:Re7.1.6. a, TH:Re7.1.8.a

This resource guide was created by Natalie Katona. All activities are available for distribution and use in the classroom or at home.

Table of Contents

About the Play

The world was a different place when Isaac Newton had that apple drop on his head. The English mathematician, astronomer, scientist, author and physicist developed the principles of modern physics, including the laws of motion. Follow along with Newton as he uses scientific methods to conduct experiments and make discoveries that change the world.

Spotlight on Sir Isaac Newton

Sir Isaac Newton had many jobs during his 84 years of life. He was a mathematician, physicist, astronomer, theologian, and author. Newton was the centric person involved with the scientific revolution of the 17th century. For the study of physics, he discovered the composition of white light and how colors can be seen. He also discovered the three laws of motion, gravity, and he is the father of calculus. Some of his biggest influencers were Aristotle, Rene Descartes, and Plato. This guide uses his discoveries to shape the activities and experiments held within it.

Ohio Spotlight

In Columbus, Ohio you can visit the Center of Science and Industry (COSI). This child focused museum has many interactive, scientific exhibits to explore. One way you can put Newton's Laws of Motion to the test is by riding the High Wire Unicycle. Patrons ride the unicycle across an 84-foot cable while being 17 feet above the ground. Another physics-centered exhibit is the Gadgets Exhibit. In this exhibit, you may be able to catch a live demonstration of physics, chemistry, engineering, and energy. You can also explore simple machines and try your hand at building a model bridge to cross a canyon. There are also mechanical gadgets for you to take apart and explore before trying to put them back together. COSI offers field trips, interactive video conferencing, and workshops or assemblies that can happen at your school. To learn more about exploring science at COSI, visit: https://cosi.org/.

Pre-Show Conversation Starters

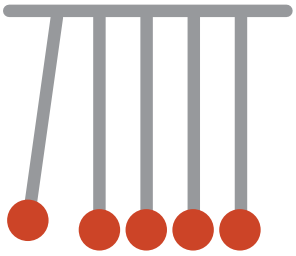
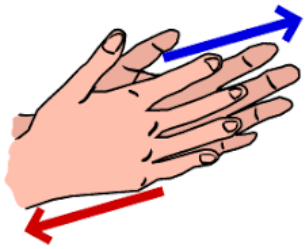
At NEWTON'S APPLE you will learn how mathematics, astronomy, science, and physics all played a role in Newton's life. Before coming to the show, see if you know the answers to these questions :

1) What is the definition of motion?
2) Where does energy come from?
3) What are the different types of energy?
4) Do you know the definition of gravity?
5) How do we measure motion?
6) How do we measure energy?
7) Can you name the three laws in Newton's law of motions?

Important Vocabulary

All the experiments and activities in this guide are about using and studying Isaac Newton's scientific discoveries. You will learn about these laws and discoveries in NEWTON'S APPLE. Familiarize yourself with these terms before the show!

	**Motion**- the action or process of moving or being moved
	**Gravity**- the force that attracts a body toward the center of the earth, or toward any other physical body having mass
	**Force**- an interaction that causes an affected object to be pushed or pulled in a certain direction
	**Acceleration**- the rate of change or the rate and direction of motion

	**Inertia**- when an object remains its resting state or continued its motion in a straight line until another outside force changes its state
	**Friction**- is the force of two objects rubbing together, and causing motion to become slower or stops
	**Energy**- the ability to do work

The Laws of Motion

ENGLISH SCIENCE All Grades

Newton's First Law of Motion- when an object is at rest, it will continue to stay at rest and an object that is in motion will stay in motion in the same direction and at the same speed. An object's motion or lack of motion cannot change until there is an unbalanced force acting upon the object.

Example: A soccer ball will remain on the field until a soccer player comes to kick it. The ball will continue to move until the friction between the ball and grass slows it down to a stop or another player's foot stops the ball or kicks it in a different direction.

Newton's Second Law of Motion- the acceleration of an object, once force is applied to it, is directly related to the magnitude of force and the mass of the object. Heavier objects require more force to continue moving and to speed up.

Example: If you have a boulder and a pebble on a table and need to push or pull both rocks off the table, the boulder will require more force exerted by you to get moving. The pebble will be easy to get off the table.

Newton's Third Law of Motion- for every action there is an equal and opposite reaction. Whenever a force is acting upon an object another force acts upon the object from the opposite direction.

Example: When you bounce a basketball, it bounces back toward you. You exert force on the ball downwards, the air around you exerts force against the ball going in the opposite direction, the ball hits the floor with it's downward force, and the force from the ground bounces the ball back up.

Motion Match

ENGLISH SCIENCE All Grades

Name _____

Read the description of the activity. Focus on where force is acting on the object and the motion of the object. In the answer space write if the activity is an example of **Newton's First Law, Newton's Second Law,** or **Newton's Third Law.**

1) You are sitting in the car in the back seat as a passenger. The drive makes a sudden and sharp tool. Your body begins to slide towards the turn in your seat. _____

2) You're standing in a boat and decide to jump into the river. As you jump to move yourself forward into the water, the opposite force pushes the boat backwards. _____

3) A car and a truck are stranded on the side of the road due to engine failure. The crew takes five minutes to push the car onto the tow truck's platform. It takes the crew ten minutes to push the truck. _____

4) As your cart fills up with groceries, it becomes much harder to push than when it was empty at the front of the store. _____

5) A balloon gets blown up with air. Before it can be tied, the air begins to escape, and the balloon is pushed out of your hands. _____

6) A hockey puck is gliding on the ice towards the north side of the rink. Eventually, the friction between the puck and the ice brings the puck to a stop. _____

7) When a table cloth is pulled quickly from a table, it is possible for the dishes to stay still and not move with the table cloth. _____

8) Your coach serves a volleyball your way for you to put away after practice. You catch the ball and as a result your shoulders are pushed back a tiny bit by the force of the serve. _____

9) It is easier for the adult mother of a child to push a stroller than for the sibling to push the stroller. _____

10) A book is sitting alone on a table. It does not slide off the table or move. _____

Newton's Hashtags

ENGLISH SCIENCE All Grades

Name _____

One of the modern ways we summarize our understanding of new knowledge is through hashtags. When we summarize, we take the bulk of our learning or reading and shorten it down to the main idea. Provide a drawing that explains each of laws of motion. On the lines provided, hashtag your drawing with your summary of the law or motion.

Newton's First Law of Motion

Newton's Second Law of Motion

Newton's Third Law of Motion

Ball Bounce Experiment

Name _____

Goal: Demonstrate Newton's First Law of Motion!

Materials:

- A basketball, soccer ball, or similar bouncy ball
- A smaller bouncy ball such as a tennis ball or racquet ball
- A meterstick
- An outdoor space, gym, or floor space cleared of furniture to run this experiment

Steps and Data collection:

1) Give a **hypothesis** about which ball will bounce higher when you drop it from chest height? A hypothesis is your best guess of what would happen during the experiment. _____

2) Hold the ball at chest height and make sure your partner is ready with a meter stick. When you drop each ball, have your partner ready to measure the bounce height.

a. Ball 1's height: _____

b. Ball 2's height: _____

3) Which ball bounced higher? Using what you've learned in this guide or from NEWTON'S APPLE, provide an explanation as to why you think that ball bounced higher. _____

4) Add a **variable.** A variable is a change the scientist makes to the experiment. What if instead of bouncing the balls separately, you hold the larger ball and stack the smaller ball on top of it? Write a hypothesis of what may happen:

_____

5) Drop the two balls stacked together. Record your **observation**. Observations are what you see, hear, and notice during the step of the experiment. Drop the two balls stacked together three times and record your observations about what changed about the ball.

a. Trial 1: _____

b. Trial 2: _____

c. Trial 3: _____

6) Make a **conclusion**. A conclusion is where you state what you learned and if your hypothesis was correct. What did this experiment teach you about Newton's First Law of Motion? _____

_____

_____

Balloon Travelling

SCIENCE All Grades

Name _____

Goal: Identify all of Newton's Laws in one experiment! To get your balloon to travel the distance between two chairs.

Materials Needed:

- Balloons
- String
- Straw
- Tape
- Two chairs

Procedure:

1) Set up your chairs ten feet apart
2) Thread string through a straw and then tie each end of string to the top of your chair
3) Blow up your balloon with air, do not tie the balloon simply pinch it closed
4) Tape the balloon to the straw so the balloon is attached to the underside of the straw
5) Release your balloon and see how far it gets on the string

Concluding questions:

1) Was the balloon successful in getting to the end of the string? Why? _____

_____

2) For balloons that did not make it across, what could you change about the balloon or straw to make a successful trip all the way across? _____

_____

3) If the chairs move further apart, how will you make sure the balloon can travel further? _____

_____

4) When did the balloon demonstrate Newton's First Law of Motion? _____

_____

5) When did the balloon demonstrate Newton's Second Law of Motion? _____

_____

6) When did the balloon demonstrate Newton's Third Law of Motion? _____

_____

7) Write a brief summary of what you learned about motion during this experiment. _____

_____

Gravity Painting

SCIENCE ARTS All Grades

Name

One of Sir Isaac Newton's key discoveries was the force of gravity. This activity uses gravity to create a beautiful piece of artwork!

Materials:

- Tempera paint
- Medicine dropper or spoon
- White cardstock
- Paint brush
- Markers
- Easel

Steps:

1) Clip your cardstock to the easel so it is standing upright.
2) Mix your paint with water a teaspoon at a time until it is watered down to the point where it can flow easily down the paper
3) When the paint is thin enough, place the medicine dropper into the paint and squeeze the bulb at the top to slowly bring the paint up the pipe. If using a spoon, spoon out some of the paint from the container into the spoon.
4) Starting at the top of your cardstock, drip the paint along onto the cardstock in different patterns.
5) Allow paint to drip down the cardstock using the force of gravity.
6) Allow the paint to dry.
7) Once the paint is dry, use markers to create an entire scene based on what you see in your dripped paint. Add char acters or other elements. You can also extend your understanding of Newton by having your drip painting portray one of his laws.

Laws of Motion Rap

Name

Write a rap about what you have learned from NEWTON'S APPLE and about Isaac Newton's Laws of Motion!

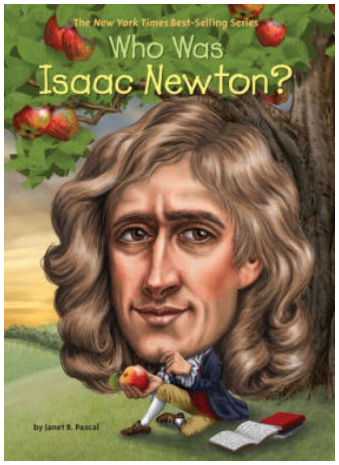
Your rap should:

- Relate to Sir Isaac Newton and his scientific discoveries
- Be 10-12 lines long
- Have a rhyming pattern of your choice (AB, AAB, ABA, etc.)
- Be performed for your classmates!

Here are some examples of songs based on Sir Isaac Newton:

- https://www.youtube.com/watch?v=0xvABAWXqUU- "Newton's Laws of Motion Rap" posted by 2 Minute Classroom
- https://www.youtube.com/watch?v=InowSJ1904M- "Physics Rap: Newton's Laws" posted by Local Adventurer
- https://www.youtube.com/watch?v=yUp4W9htmuY- "Newton's Laws of Motion Song" posted by Jam Campus

Resources for Students and Adults



Books for Students about Sir Isaac Newton:

Who was Isaac Newton?, Written by Janet B. Pascal. Penguin Young Readers Group, 2014.

Giants of Science: Isaac Newton, Written by Kathleen Krull. Penguin Young Readers Group.

Isaac Newton and the Laws of Motion, Written by Andrea Gianopoulos. Illustrated by Phil Miller and Charles Barnett III. Capstone Press, 2007.

Newton and Me, Written by Lynne Mayer. Illustrated by Sherry Rogers. Arbordale Publishing, 2013.

Graphic Science Biographies: Isaac Newton and the Laws of Motion, Written and Illustrated by Jordi Bayarri. Graphic Universe, 2020.

Publications for Teachers and Parents:

The Ocean of Truth: The Story of Sir Isaac Newton, Written by Joyce McPherson. Greenleaf Press, 1997.

I Like to Move It! Physical Science Book for Kids: Newton's Laws of Motion, Written by Professor Beaver. Professor Beaver, 2017.

The Laws of Motion: Physics for Kids, Written by Baby Professor. Baby Professor, 2017.

Revolutionary Discoveries of Scientific Pioneers: Laws of Motion and Isaac Newton, Written by Fred Bortz PH.D. Rosen Classroom, 2014.

Awesome Physics Experiments for Kids: 40 Fun Science Projects and why the Work, Written by Eric L. Colón P.H. D. Rockridge Press, 2019.

Websites for Teachers and Students:

http://www.physics4kids.com/files/motion_intro.html- This website gives students a kid-friendly way to understand physics with a focus on motion. It offers vocabulary definitions and examples of each of the terms students need to grasp to understand how Newton's Law of Motions apply to everyday activities. There are also related quizzes and videos to each section.

http://www.sciencekids.co.nz/physics.html- Students can do a deeper exploration of friction, gravity, and Newton on this site. Teachers can gain inspiration for their lesson plans and create quizzes using the example questions this site posts.

https://www.real-world-physics-problems.com/physics-for-kids.html- This site offers teachers and students a real-world application to force and motion. It combines a scientific principle with a popular toy that offers students a practical example of the scientific vocabulary they are studying. Some of the toys presented for motion are a boomerang, slinky, and spinning top. Each toy has its own page where it is explained why the toy is an example of the scientific principle.

https://www.theschoolrun.com/homework-help/sir-isaac-newton- This site has a biography, trivia, videos, and activities dedicated to Sir Isaac Newton. It offers a timeline of Newton's life and discovery as well as a gallery of visuals to help students understand his scientific contributions.

Victoria Fuse's Local Resource

Boonshoft Museum of Discovery

Boonshoft Museum of Discovery offers in-museum workshops to extend students' understanding of Physical Science. For preschoolers and kindergartners, the workshop Science Senses would have students using their investigation and observation skills to make discoveries with their five sense. First through third graders are provided a workshop on Motion. Students will have a hands-on experience with creating force and observing gravity and friction's affect on objects. This workshop is extended for fourth through sixth graders in Use the Force. Students will run experiments where they can learn about speed and kinetic energy. These workshops would allow students to put their Newton knowledge to work! To learn more about booking a workshop with Boonshoft Museum of Discovery, visit https://www.boonshoftmuseum.org/experience-more/workshops.

Brought to you by

VICTORIA THEATRE ASSOCIATION
VICTORIA • SCHUSTER • MAC/LOFT • ARTS ANNEX • ARTS GARAGE

138 North Main Street
Dayton, OH 45402

The Education & Engagement programs of Victoria Theatre Association are made possible through the support and commitment of The Frank M. Tait Foundation and the following sponsors and donors whose generosity have opened the door of live theatre to the students of the Miami Valley:

PROGRAM SPONSORS

American Testing Services
The Berry Family Foundation
Steve and Kate Hone
The Kuntz Foundation
Perfection Group
The Frank M. Tait Foundation
Merle F. Wilberding
Ray Wylam

SUPPORT FOR FUELING EDUCATION IS GENEROUSLY PROVIDED BY

Greater Dayton Regional Transit Authority
Speedway LLC

BROADWAY EDUCATION PROGRAMS

EDUCATION PROGRAMS

Broadway Camps & Intensives
Broadway Master Classes

SUPPORT FOR BROADWAY EDUCATION PROGRAMS IS GENEROUSLY PROVIDED BY

The Vectren Foundation

OTHER BROADWAY PROGRAMS:

Background on Broadway
Bagels & Broadway

VIRGINIA rep

Virginia Rep's Children's Theatre is a nonprofit, professional theatre in Richmond, Virginia. Since 1975 they have created exciting and innovative theatrical productions for young audiences. Each year they stage six shows at our intimate Children's Theatre in Richmond, and tour national-caliber, educational plays to schools and public venues in Virginia and across the country.

DON'T FORGET

All schools that receive scholarships for a show and/or transportation are asked to create thank-you letters or cards for our sponsors. Please address your students' thank-you notes to:

DISCOVERY Sponsors
c/o Victoria Theatre Association
138 North Main Street
Dayton, OH 45402

Ohio Arts Council
MONTGOMERY COUNTY