

SCIENCE & TECHNOLOGY CONNECTIONS

Created by k2i academy
in support of Young People's Theatre's
The Darkest Dark



Science & Technology Connections Created by:
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in collaboration with Space Place
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Science Study Guide

in Support of *The Darkest Dark*

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Introduction

Let's explore light and dark together! In this study guide, the science of light will be explored through various pre and post show activities. Light is all around us and travels through the Universe. Light can reflect off objects, bend when it encounters different materials, and exist in many different colours. Light is also used in various applications including theatre! The production you are about to see uses light and dark to tell a story and creates an experience that engages audiences.

This guide has a set of activities designed for grade 1 to 3 called *Shadows in the Dark* which will explore the science behind shadows using inquiry and engineering design. There is also a set of activities designed for grade 4 to 6 called *Lights, Space, Action* that investigates how light is used to observe space.

Thematic Overview

From the imagination of Canadian astronaut **Chris Hadfield** comes a ground-breaking new theatrical experience. More than five years in the making, *The Darkest Dark* is inspired by Commander Hadfield's bestselling children's book and brought to the stage by co-writers **Jim Millan** and **Ian MacIntyre**, and renowned illusionist **David Ben**. Weaving theatre, multimedia and magic, *The Darkest Dark* reveals a universe where anything is possible. And where the dark... is for dreaming.

It's 1969 and Apollo 11 is about to land on the moon. Nine-year-old space-loving Chris spends his days dreaming of becoming a brave astronaut. But at bedtime, the night closes in and so too does his fear of the dark. For Chris, watching history being made hinges on conquering his fear – and embracing the unknown.

This guide focuses on science, technology and engineering. It encourages young people to explore the world and universe around them through guided activities before and after the show. Through observations and questioning, youth will discover the science concepts that explain shadows, light, and what we see in space.

Activity for Grade 1 to 3 | Shadows in the Dark

Curriculum Expectations

Grade 1

- Strand A: STEM Skills and Connections
 - A1. STEM Investigation and Communication Skills: Use scientific research process, a scientific experimentation process and an engineering design process to conduct investigations, following appropriate health and safety procedures.
 - A3. Applications, Connections, and Contributions: Demonstrate an understanding of the practical applications of science and technology, and of contributions to science and technology from people with diverse lived experiences.
- Strand C: Matter and Energy - Energy in Our Lives
 - C2.2 demonstrate an understanding that the Sun is Earth's principal source of energy, including how it warms the air, land, and water; is a source of light for Earth; and makes it possible for plants to grow.
- Strand E: Earth and Space Systems - Daily and Seasonal Changes
 - E2.3 describe the changes in the amount of light and heat from the Sun that occur throughout the day and in the four seasons

Grade 2

- Strand A: STEM Skills and Connections
 - A1. STEM Investigation and Communication Skills: Use scientific research process, a scientific experimentation process and an engineering design process to conduct investigations, following appropriate health and safety procedures.
 - A3. Applications, Connections, and Contributions: Demonstrate an understanding of the practical applications of science and technology, and of contributions to science and technology from people with diverse lived experiences.
- Strand C: Matter and Energy - Properties of Liquids and Solids
 - C2.2 describe the properties of liquids and solids
 - C2.4 identify conditions in which the states of liquids and solids remain constant and conditions that can cause their states to change

Grade 3

- Strand A: STEM Skills and Connections
 - A1. STEM Investigation and Communication Skills: Use scientific research process, a scientific experimentation process and an engineering design process to conduct investigations, following appropriate health and safety procedures.
 - A3. Applications, Connections, and Contributions: Demonstrate an understanding of the practical applications of science and technology, and of contributions to science and technology from people with diverse lived experiences.
- Strand C: Matter and Energy - Forces and Motion
 - C2.1 describe different types of contact forces and non-contact forces
 - C2.2 describe different ways a force can be exerted on an object
- Strand D: Structures and Mechanisms - Strong and Stable Structures
 - D2.1 describe a structure as a supporting framework that holds a load and has a definite size, shape, and function, and identify structures in the natural environment and in the built environment.
 - D2.3 describe the strength of a structure as its ability to support a load and describe ways to increase the strength of structures, including ways to increase the strength of different materials used to build them.
 - D2.4 describe the stability of a structure as its ability to keep its shape, maintain balance, float, and/or stay fixed in one spot when a force is applied to the structure, and describe ways to improve a structure's stability.
 - D2.6 describe ways in which different forces can affect the shape, balance, or position of structures.

Before the Show

Pre-show Unit of Study

In this pre-show unit of study, students will have the chance to explore the science of shadows! Students will begin by sharing what they currently know about shadows and will explore how shadows work through inquiry.

Pre-show Discussion Questions

To begin with your students, read the story *The Darkest Dark* and/or introduce them to the themes of the play and explore the following questions:

1. Where have you seen shadows in your life? On the playground? In your room?
 - a. Where did Chris see shadows in the *Darkest Dark*?
2. Do you see shadows on sunny days or cloudy days outside?
3. What do you think shadows are? How do you think they work?

Pre-Show Activity

Here is a classroom-ready slidedeck to use with your students to guide them through the pre-show activity: [Slideshow](#)

The following handout can be downloaded, modified and used as needed to document student thinking and learning: [Adaptable Handout](#)

Gather these materials before the start of the lesson:

Material	Purpose	Alternatives
2 Flashlights per group	To shine on objects to observe shadows	Any direct light source can be used
3 Objects per group	To explore their shadows, <i>*This can be selected during the activity</i>	It can be anything from books, to blocks to chairs or
A metre stick	To measure how far the light source is from the shadow	Can use informal measuring tools or tape
1 Adaptable Handout per group or student	To record their results	Take a look at the handout and adapt for your purpose and for student learning needs
Pencils	To record their results	-

After the activity, leave the students with the follow questions as they watch the play to apply in the post-show unit of study:

- What kind of shadows do you see on stage?
- When do the shadows happen? What do they look like?
- What kind of lights are they using on stage?
- What does the stage look like?

After the Show

Post-show Unit of Study

In this post-show unit, students will be exploring the engineering behind theatre! Students will have the opportunity to apply their learning from the pre-show activity through the engineering design process to design a light system to showcase the play.

Post-show Discussion Questions

To begin with your students, ask them about their experience at the play and explore the following questions:

1. What did you remember from the play?
2. What kind of lights and colours do you remember seeing during the play?
3. What shadows do you remember seeing on the stage?
 - a. What did the shadows look like?
4. What structures were used in the theatre to create the shadows?

Post-Show Activity

Here is a classroom-ready slidedeck to use with your students to guide them through the post-show activity: [Slideshow](#)

The following handout can be downloaded, modified and used as needed to guide students through the engineering design process: [Adaptable Handout](#)

Gather these materials before the start of the lesson:

Material	Purpose	Alternatives
1 Adaptable Handout per group or student	To document their process	Take a look at the handout and adapt for your purpose and for student learning needs
Pencil	To document their process	Any writing utensils
Recyclable or consumable materials	To build their device	Any materials such as cardboard, plastics, popsicle sticks, etc.
Scissors	To cut materials	-
Tape or hot glue	To assemble their designs	Recommend avoiding white glue due to dry time
2 Flashlights per group	To test out their designs	Any direct light source can be used

Activity for Grade 4 to 6 | Lights, Space, Action

Curriculum Expectations

Grade 4

- Strand A | STEM Skills and Connections
 - A1. STEM Investigation and Communication Skills: Use scientific research process, a scientific experimentation process and an engineering design process to conduct investigations, following appropriate health and safety procedures.
 - A3. Applications, Connections, and Contributions: Demonstrate an understanding of the practical applications of science and technology, and of contributions to science and technology from people with diverse lived experiences.
- Strand C: Matter and Energy - Light and Sound
 - C2.1 identify a variety of natural and artificial light sources
 - C2.3 describe properties of light, including that light travels in a straight path and that light can be absorbed, reflected, and refracted
 - C2.6 describe how different objects and materials interact with light energy

Grade 5

- Strand A: STEM Skills and Connections
 - A1. STEM Investigation and Communication Skills: Use scientific research process, a scientific experimentation process and an engineering design process to conduct investigations, following appropriate health and safety procedures.
 - A3. Applications, Connections, and Contributions: Demonstrate an understanding of the practical applications of science and technology, and of contributions to science and technology from people with diverse lived experiences.
- Strand C: Matter and Energy - Properties of and Changes in Matter
 - C2.1 describe matter as everything that has mass and occupies volume
 - C2.2 identify the states of matter, and describe characteristics and properties of solids, liquids, and gases
- Strand E: Earth and Space Systems - Conservation of Energy and Resources
 - E2.1 identify a variety of forms of energy, and describe how each form is used in everyday life
 - E.2.2 demonstrate an understanding of the law of conservation of energy, including how energy cannot be created or destroyed but can only be transformed from one form to another

Grade 6

- Strand A: STEM Skills and Connections
 - A1. STEM Investigation and Communication Skills: Use scientific research process, a scientific experimentation process and an engineering design process to conduct investigations, following appropriate health and safety procedures.
 - A3. Applications, Connections, and Contributions: Demonstrate an understanding of the practical applications of science and technology, and of contributions to science and technology from people with diverse lived experiences.
- Strand C: Matter and Energy - Electrical Phenomena, Energy and Devices
 - C2.2 describe current electricity, and compare and contrast current electricity with static electricity
 - C2.4 describe how technologies transform various forms of energy into electrical energy
 - C2.6 explain the functions of the components of a simple electrical circuit
- Strand E: Earth and Space Systems - Space
 - E2.4 identify the types of bodies in space that emit light and those that reflect light
 - E2.6 identify various technologies used in space exploration, and describe how technological innovations have contributed to our understanding of space

Before the Show

Pre-show Unit of Study

In this pre-show unit of study, students will explore light and how it is used to understand and study the universe. Students will begin by sharing what they currently know about light and space and will further explore these topics through an inquiry-based activity.

Pre-show Discussion Questions

To begin with your students, explore the following questions:

1. What is light? Where do you see light being used? How is light being used around you?
2. Is there light in space? Where are the sources of light in space?
3. How do scientists study space?

Pre-Show Activity

Here is a classroom-ready slidedeck to use with your students to guide them through the pre-show activity: [Slideshow](#)

The following handout can be downloaded, modified and used as needed to guide students through their inquiry on Light and Space: [Adaptable Handout](#)

Gather these materials before the start of the lesson:

Material	Purpose	Alternatives
1 Adaptable Handout per group or student	To document their process	Take a look at the handout and adapt for your purpose and for student learning needs
Pencil	To document their process	Any writing utensils
1 Flashlight per group	To act as the light source	Any direct light source can be used
1 CD per group	To observe how light interacts	If not possible to have one per group, stations can be set up so students can rotate and use objects at different times.
1 Glass of water per group	To observe how light interacts	
A piece of aluminium foil per group	To observe how light interacts	
2 objects from around the classroom	To observe how light interacts	Any objects, ideally colourful ones! Books, blocks, etc.

After the activity, leave the students with the follow questions as they watch the play to apply in the post-show unit of study:

- How do they use light on stage to show Chris is in space?
- What kind of information do they share about space?
- How does Chris get to space?
- What does Chris see in space?

After the Show

Post-show Unit of Study

In this post-show unit, students will be exploring the engineering behind light and space! Students will have the opportunity to apply their learning from the pre-show activity through the engineering design process to design a spaceship that can explore the Universe and all its light.

Post-show Discussion Questions

To begin with your students, ask them about their experience at the play and explore the following questions:

1. What do you remember from the play?
2. What kinds of things did you learn about space?
3. How did Chris get to space?

Post-Show Activity

Here is a classroom-ready slide deck to use with your students to guide them through the post-show activity: [Slideshow](#)

The following handout can be downloaded, modified and used as needed to guide students through the engineering design process: [Adaptable Handout](#)

Gather these materials before the start of the lesson:

Material	Purpose	Alternatives
1 Adaptable Handout per group or student	To document their process	Take a look at the handout and adapt for your purpose and for student learning needs
Pencil	To document their process	Any writing utensils
Recyclable or consumable materials	To build their device	Any materials such as cardboard, plastics, popsicle sticks, etc.
Scissors	To cut materials	-
Tape or hot glue	To assemble their designs	Recommend avoiding white glue due to dry time
Ruler (Ideally metre stick) or measuring tape	To test distance	If you do not have a long enough ruler or measuring tape, tape can be used to mark the distance on the ground

ABOUT k2i academy

The Lassonde School of Engineering launched k2i (kindergarten to industry) academy in June 2020 with a mission to create an ecosystem of diverse partners, committed to dismantling systemic barriers to opportunity for underrepresented students in STEM.

The k2i academy engages with youth by bringing STEM to life – connecting directly to school boards and their classrooms, offering innovative work-integrated learning programs, and partnering with community organizations to provide unique, hands-on STEM learning opportunities. Today, we have grown to reach 6,000+ students, teachers, families, and community members, spending over 175,000 hours in virtual and face-to-face engagements. To support this growth, k2i academy has developed partnerships and collaborations with provincial and federal funders as well as individual and corporate donors. With this support, we are able to offer programs at no cost to youth and their families and work with community-based STEM organizations to reach the youth that need us most. Most importantly, however, we design our work alongside some of the largest and most diverse public school boards in the country, collaborating to dismantle systemic barriers to opportunities in STEM.

ABOUT YPT

Young People's Theatre (YPT) has launched the next stage in the company's 57-year history, co-led by Artistic Director Herbie Barnes and Executive Director Nancy Webster. This new era also marks the unveiling of YPT's expanded and renovated theatre complex, more than 10 years in the making. As Canada's largest and oldest professional theatre for young audiences, the company produces and presents a full season of theatre and arts education programming, serving approximately 150,000 patrons annually. With the purchase of a multi-use building across the street from its historic theatre, YPT 161 Studios, YPT has expanded its footprint, increased its accessibility, refreshed its lobbies, and upgraded the theatrical equipment capabilities of its 450-seat Ada Slight Stage and 115-seat Studio. United in vision, the two facilities now anchor the corner of Front and Frederick Streets in downtown Toronto creating Canada's largest theatre complex for young people. [Learn more.](#)