CANADIAN BUSHPLANE HERITAGE CENTRE

CBHC Grade Five Aviation Program

INTRODUCTION

At the Canadian Bushplane Heritage Centre we are passionate about our Northern Ontario heritage. We are also very excited about educating the public on our many historical aircraft exhibits as well as forests and forest firefighting exhibits. Our Education Program will allow you to engage your students and give them a personalized, relevant and exciting new take on the curriculum.

Our program is developed with teachers in mind and will allow you to build on curriculum expectations before and after the tour that all tie into the materials presented in the tour. We would love to partner with you to allow your students to discover and learn about their Northern Ontario heritage and the exciting life as a bushplane pilot or forest fire fighter. Our tour guides are retired educators, MNR workers and/or pilots who love working with kids and students. Our experts make the experience one you and your students will never forget!

Our Grade Five Program focuses on the structures and mechanisms of a bushplane and the forces acting upon them. Students will have a chance to climb inside, play, touch and even "fly" with their classmates in an old Saunders passenger aircraft. Students will also discover how bushplanes help fight forest fires and will get a chance to climb a fire tower to put out a forest fire on their own. We will ignite your student's imaginations and interest. Your class will learn quickly that adventure takes off at the Canadian Bushplane Heritage Centre!

For more information and preparation lessons please visit us at:
www.bushplane.com/education/lessons/gradefive

You may also speak to someone for more information or to book your school tour at
Toll Free: 1-877-287-4752
Local: 705-945-6242

OVERVIEW OF CURRICULUM EXPECTATIONS

The following is a list of expectations from the grade five curriculum that will be met by following the Canadian Bushplane Heritage Centre Grade Five Program.

Big Idea:
Structures and mechanisms throughout our environment have forces that act on and within them.

Overall Expectation:
Analyse social and environmental impacts of forces acting on structures and mechanisms.

Specific Expectation:
Analyze the effects of forces from natural phenomena on the natural and built environment.

How:

Our experts will guide the students through a memorable experience at the Canadian Bushplane Heritage Centre. The students will discover the forces that allow a bushplane to fly as well as how the bushplane has evolved and adapted to meet the needs of the environment, the pilots and the passengers.

Big Idea:
Structures and mechanisms throughout our environment have forces that act on and within them.

Overall Expectation:
Analyse social and environmental impacts of forces acting on structures and mechanisms.

Specific Expectation:
Evaluate the impact of society and the environment on structures and mechanisms, taking different perspectives into account and suggest ways in which structures and mechanisms can be modified to best achieve social and environmental objectives.

How:

Our Children's Flight Centre creates a new learning environment with activities for students to play and interact with. The Children's Flight Centre includes investigative air activities, a simulation aircraft ride and aircraft matching games.

While the tour is being given, discussion of various aspects of the aircraft that allow it to fly will take place. Students will be engaged in questioning that will allow them to discover that if a aircraft was not built a certain way it would not be able to fly.

Big Idea:
We can measure forces in order to determine how they affect structures and mechanisms. This information can be used to guide the design of new structures and mechanisms.

Overall Expectation:
Investigate forces that act on structures and mechanisms.

Specific Expectation:
Measure and compare, quantitatively and/or qualitatively, the force required to move a load using different mechanical systems and describe the relationship between the force required and the distance over which the load moves.

How:

In the provided lesson on force students will learn about opposing forces and the force required to move a load.

Big Idea:
We can measure forces in order to determine how they affect structures and mechanisms. This information can be used to guide the design of new structures and mechanisms.

Overall Expectation:
Investigate forces that act on structures and mechanisms.

Specific Expectation:
Use appropriate science and technology vocabulary in oral communication.

How:

We create an environment where students experience new terminology and where they see things they have never seen before. Our expert guides allow and encourage questioning while students discover all of this new and exciting information.

Big Idea:
Forces that result from natural phenomena have an effect on society and the environment.

Overall Expectation:
Identify forces that act on and within structures and mechanisms and describe the effects of these forces on structures and mechanisms.

Specific Expectation:
Identify internal forces acting on a structure and describe their effects on the structure.

How:

Students will discover throughout the tour the difference between a bushplane and a pressurized aircraft showing the effects on each. Bushplanes do not typically fly very high so when we open the door or hatch you are able to drop things out or sky dive, unlike a pressurized passenger aircraft where you would be unable to open a window or door due to the pressure at such a high altitude.

Big Idea:
Forces that result from natural phenomena have an effect on society and the environment.

Overall Expectation:
Identify forces that act on and within structures and mechanisms and describe the effects of these forces on structures and mechanisms.

Specific Expectation:
Identify external forces acting on a structure and describe their effects on the structure using diagrams.

How:

The students will view the film Wings Over the North in our Object Theatre which will depict the effects of rain, wind, lightning and weather on a bushplane.

Throughout the tour students will learn why a bushplane is designed in the manner that it is which allows for it to survive though many different weather and terrain conditions.

Big Idea:
Forces that result from natural phenomena have an effect on society and the environment.

Overall Expectation:
Identify forces that act on and within structures and mechanisms and describe the effects of these forces on structures and mechanisms.

Specific Expectation:
Explain the advantages and disadvantages of different types of mechanical systems.

How:

Students will discover during the tour how bushplanes have evolved over time with new technical advancements to allow pilots to be safe and in control of the aircraft, allow for more passengers and cargo to be carried as well as the ability to hold more water in order to put out a forest fire.

Big Idea:
Forces that result from natural phenomena have an effect on society and the environment.

Overall Expectation:
Identify forces that act on and within structures and mechanisms and describe the effects of these forces on structures and mechanisms.

Specific Expectation:
Describe forces resulting from natural phenomena that can have severe consequences for structures in the environment and identify structural features that help overcome some of these forces.

How:

The students will view the film Wings Over the North in our Object Theatre which will depict the effects of rain, wind, lightening and weather on a bushplane.

Throughout the tour students will learn why a bushplane is designed in the manner that it is which allows for it to survive though many different weather and terrain conditions.

GRADE FIVE LESSONS

Associated lessons are encouraged before and the field trip. Many students may not have been to a museum and it is helpful to establish the rules of a museum as well as get them excited to come and experience all the fun adventures they are about to have. The following activities are all optional; our tours are developed to be stand-alone and pre or post lessons are not required to experience a field trip at the Canadian Bushplane Heritage Centre.

You can use one lesson or a combination of lessons to aid your students in their experience. All the resources for the activities are supplied and most of the suggested books may be lent out through our own library for up to one week. Some books are also noted to be in the Public Library for teachers to take out for longer periods of time.

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Lesson 1

Students Will Discover:

- Friction is a force that opposes motion or makes it difficult for an object to move across a surface.
- The amount of friction depends on the surface type and the force pressing two surfaces together.
- Everyday life provides examples of how friction both helps and hinders everything we do.

Materials:

- Several matchbox cars of the same size (three to four for every team)
- Several large, thick books, such as encyclopedias (when stacked, they should be about 1 foot high)
- Large piece of foam board
- Beach towel
- Yardstick
- Masking tape
- Textbooks
- Pencils
- Chalkboard, overhead projector or chart paper
- Crayons, markers, colored pencils
- Friction Activity Sheet (one for each student)

Lesson Plan:

1. Create a learning web with your students on what stops motion. On an overhead, chalkboard or chart paper write “Motion stops because . . .” and draw a circle around it. Elicit students' responses and write their responses as “branches” off of the web. Focus student responses by providing prompts, such as: What would make a car stop? A dancer? A football? A plane? A baseball player sliding into home?
2. Tell your students that the web they have created shows examples of forces that may slow down, stop or make it hard for an object to move. Explain that these forces acting on objects and people are called friction. Refer back to the web and underline those ideas that clearly demonstrate the role that friction plays in stopping motion. Ask students in what context they have heard the word friction before. (They may offer the following contexts: friction between people in a fight or rubbing hands together.)
3. Explain to students that the amount or force of friction depends on two things: the type of surfaces that are touching (e.g., waxed kitchen floor versus rocky pavement) and the force pressing the surfaces together (e.g., pulling an empty wagon versus one filled with bricks).
4. Now divide the class into groups of four to five students. Explain to students that the following activity will help them understand how friction can be increased and decreased. Each group should receive three to four matchbox cars, foam board, a beach towel, masking tape, a yardstick, several large, thick books (that equal about a foot when stacked), two textbooks and a Friction Activity Sheet. The groups will be observing and recording how the matchbox cars move on two surfaces: a smooth surface and rough surface.
5. Read the first activity question to the class: “Will the matchbox car move faster on the smooth surface or the rough surface?” Then show them the two surfaces they will be testing, the plain foam board and the beach towel.
6. Next, have students create a “ramp” by placing a stack of books (about 1 foot high) under one end of the foam board. (You may want to place a heavy object at the other end to keep the board from sliding.)
7. Students will be looking at how a surface can affect car speed. In order to gauge the results of this activity accurately, they will need to use matchbox cars that travel at about the same speed. Have

students “race” the matchbox cars they've been given down their ramp to find two that move at generally the same speed. To do this, line up the cars at the top of the ramp and hold them back with the yardstick. Have one student hold the yardstick at each end and lift it suddenly to let the cars race down the ramp. Do this a few times to make sure the two cars you select move at about the same speed.

8. Now have each group cover the left-hand side of its foam board with the beach towel, using masking tape to secure the towel to the back of the board (to keep it from slipping). Their foam boards should now have two “tracks”—a plain track and a towel track.
9. Before students perform their race, have them complete the prediction portion of their activity sheets. Students should write one sentence indicating which surface they believe the car will travel faster on.
10. Now have the students race the two cars they chose (that were about the same speed). Using the yardstick to ensure the same “start time,” have students race one car on the plain (smooth) track and the second on the towel (rough) track. They will need to write one to two sentences that describe how the two cars moved. Then have them determine on which surface they saw more friction.
11. Gather students together to discuss their findings and observations. Focus students' attention to the relationship between the surface type and the amount of friction there is between the car and surface, as demonstrated by the ability of the car to move across each surface. (The rougher the surface, the more friction there is.)
12. Read the second activity question to students: “Will it be easier to move one or two textbooks across your desk with your pinky?” Demonstrate how students will move the textbooks across their desks and have them complete the prediction section of their activity sheets. Remind students to record their observations on the activity sheet as they did in the first activity.
13. Gather students together to discuss the second activity. Ask students to share their observations. Encourage students to think about the relationship between the size/weight of an object and how easily it moves across a surface. Ask students if they needed to use more force from their pinkies to push two textbooks than just pushing one across the desk.
14. To reinforce the concepts demonstrated in the hands-on activities, on the board list the two factors that determine the amount of friction there is between two surfaces (surface type and force on a surface). Explain that friction plays many roles in our everyday lives. Sometimes we try to increase friction, while other times we try to decrease the amount of friction.
15. Use sports as a starting point to think of some examples. In some sports and recreational activities, you may want to increase or decrease the amount of friction present. Using what students have learned about surface type and force on the surface, create a T chart of sports and activities where increasing the amount of friction is helpful and those in which it is better to reduce the amount of friction. (For example: gymnasts use chalk on their hands to reduce friction between their hands and uneven bars; cleats help football players have better traction while running; bobsledders need to be light to travel faster in the Olympics; swimmers shave their arms and legs to increase their speed in races.)
16. Have students create a mini news article for a recreation or sports magazine about how friction plays a role in a sport of their choice. Students will need to include a colorful, creative picture of the sport in action and describe in a paragraph of four to six sentences how friction affects a player's performance in that sport. Have students present their articles.

Discussion Questions:

1. Explain how surface type influences the amount of friction there is.
2. Discuss the relationship between the size and weight of an object and the amount of friction that is present.
3. Analyze how friction can be both a positive and negative aspect in our everyday lives. Use examples to support your statements.
4. Sports such as soccer involve running, stopping, jumping and kicking. Discuss how friction helps players.
5. Describe a situation in which using wheels would reduce friction between a moving object and the surface over which it travels.
6. Hypothesize what your life would be like if there were no friction. Which actions would be more difficult? Which would be easier?

Name: ___________________________________

Friction Activity Sheet

Activity 1: Matchbox Cars

Will the matchbox car move faster on a smooth surface or a rough surface?

1. Prediction:

____

____

2. Observations:

a) Car moving on smooth surface (plain foam board):

____

____

b) Car moving on rough surface (beach towel):

____

____

3. Where is more friction present?

____

____

Activity 2: Moving Textbooks

Will it be easier to move one book or two across the desk with just your pinky?

1. Prediction:

____

____

2. Observations:

c) Moving one book with pinky:

____

____

d) Moving two books with pinky:

____

____

3. Where is more friction present?

____

____

Lesson 2

Students Will Discover:

- What force is and how to measure it in simple terms.

Materials:

- A rope
- An object such as a book
- Students to be a visual demonstration

Lesson Plan:

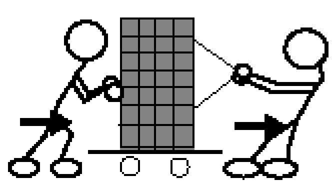
Pre lesson discussion:

- One way to start a class dialog on force is to ask students to give examples from their own experience of a force. Responses might include a hit or some sort of forceful contact; others might be more group-oriented, like the Air Force; another possibility is The Force from the Star Wars movies. There are very few wrong answers to this question and some reflection on their own experiences often helps students when they try to grasp the slightly more formal definition below.
- Explain to students that a force is defined in its simplest sense as a push or a pull. These definitions do not imply a direction. Students can pull in any direction as they can push in any direction! The terms are frequently used because students can readily identify with the actions of pushing and pulling and the fact that these actions usually have an effect on what they are pushing or pulling.
- Review with students that there are two parts to the definition of a force. In fact, when a force is defined it must have both parts - one is not enough! The two parts are: magnitude (a quantity that can be measured) and direction. The direction of a force is self-explanatory and again, has nothing to do with the terms push or pull.
- The magnitude of a force can be described as how hard the force is or how much power the force has. For example, a force of magnitude 10 can be described as a stronger force than one of magnitude 2, which can be described as a weaker force.
- Special note: When working with this lesson, it is very important that students learn to draw accurate pictures of the events described!

1. Ask for 2 volunteers. Have them each take an object for example a book. Ask one to pull to the right and the other to push to the right. Have students observe what happens when they do so.

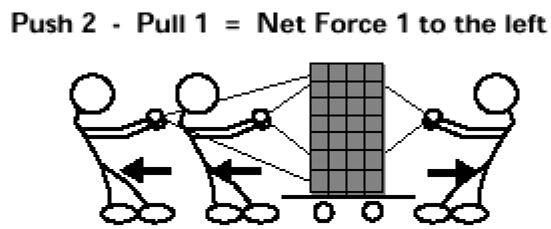
   - When two forces are acting in parallel and in the same direction, measure them by adding the magnitudes together.
     In the example below, a push of magnitude 1 added to a pull of magnitude 1 equals a net force of magnitude 2. The cart will then move in the direction of the greatest magnitude - in this case to the right.

Push 1 + Pull 1 = Net Force 2 to the right

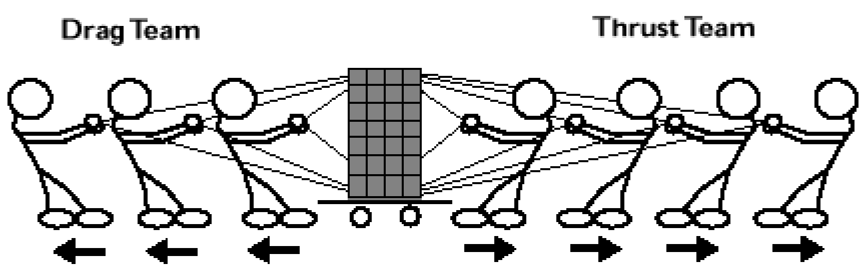


2. Now have your two volunteers (using the same object) one push to the right and the other push to the left. Have students observe what happens. Now ask for another volunteer have that person choose a side and do what that person is doing. Have students observe what happens now.

    - When two forces act in parallel in the opposite direction, measure them by subtracting the magnitudes. In the example below, a pull of magnitude 1 is acting opposite to a pull of magnitude 2. The cart will move in whichever direction has the greatest magnitude. In this case the cart will move to the left.



3. The oppositional forces can be introduced as a game of tug-of-war. Teams can be named as the four forces. For example, a tug-of-war can be set up between a thrust team and a drag team. This would be great to do in the gymnasium to demonstrate. Make sure to demonstrate uneven oppositional pairs.
    - Forces that act in opposite directions are called oppositional forces. Four of the forces in aeronautics (lift, drag, weight and thrust) can be thought of as oppositional pairs. Thrust acts in a direction opposite to drag, lift acts in a direction opposite to weight.



    - In the above graphic, the Thrust Team has a magnitude of 4 and the Drag Team has a magnitude of 3. The net force will be Thrust 4 - Drag 3 = Net Force 1 to the right. Since the Thrust Team has the greater magnitude, the cart will move in the direction that the Thrust Team is pulling, in this case to the right.

4. Have students complete the following force worksheet being careful to draw accurate drawings of the examples of force.

Worksheet

1. Define the word force.
   ____
   ____
   ____
   ____

2. Complete the sentences below by filling in the blanks.
   A force can move in different ________________.
   A force has strength or ______________________ that can be ______________________.
   Parallel forces can be added or __________________.

3. An F-14 is flying west. Its engines are creating a thrust force of magnitude 4,000. A strong headwind is blowing to the east creating a drag force on the F-14 of magnitude 1,000.
   What is the net force on the F-14? ____________________
   In what direction will the F-14 fly? ____________________

   Draw a picture of this event. Make sure you include the F-14, the wind, arrows to represent the magnitudes and the equation that gives the net force. Draw one arrow for each 1,000 units of magnitude.

4. After the Space Shuttle is launched, its huge rocket engines lift it upward with incredible force. As it blasts through the top of the atmosphere into outer space, the engines are creating a force pushing up into space with a magnitude of six times the force of gravity. We write this as 6g.
   The gravity force is pulling the Shuttle back down in the direction of the earth with a magnitude of one times the force of gravity. We write this as 1g.
   What is the net force on the Space Shuttle? _____________

   Draw a picture of this event to help you answer the question. Be sure to include the Shuttle, the Earth, arrows to represent which direction the engines and the earth are pulling and the equation that gives the net force. Draw one arrow for each g.

5. Four people are pulling on ropes attached to a cart. Each person is pulling with a magnitude of 1. Two people are pulling to the right and two people are pulling to the left.
   What is the magnitude of the net force? _________________
   In which direction will the cart move? ____________________

   Draw a picture of this event to help you answer the questions. Be sure to include the cart, the people, arrows to represent the directions that the people are pulling and the equation that gives the net force. Draw one arrow for each unit of magnitude.

Worksheet Answer Key

Question 1: A force is a "push" or a "pull". It has two parts: magnitude and direction.

Question 2: directions
magnitude, measured
subtracted

Question 3: 3,000
West
thrust 4,000 - drag 1,000 = net force 3,000 in the direction of thrust

Question 4: 5g
up 6g - down 1g = net force 5g in up direction **or**
lift 6g - weight 1g = net force 5g in direction of lift

Question 5: 0
neither
pull 1 - pull 1 = net force 0

Suggested Reading:

Planes and Other Aircraft: Learn the Science – Build the Model
Nigel Hawkes, Alex Pang [Illustrator]. Millbrook Press, 1999.

- Using color artwork and photography this book explains the science of flight and how it translates into mechanical principals and aircraft design.

Eyewitness: Train (Dorling Kindersley Eyewitness Books)
John Coiley, Mike Dunning [Photographer]. DK Publishing, 2000.

- More than just a reference book, this offers striking color photography and rich content to describe how trains operate. It is a compelling book that traces the history of locomotives from the early steam trains to today's electromagnetic trains.

Experiments with Force
Trevor Cook, Rosen/Powerkids, 2009.

- Presents over ten experiments demonstrating the properties of physics, including gravity, buoyancy and surface tension and provides explanations of the properties at work.

Forces
Terry Jennings, Smart Apple Media, 2009.

- What are forces? How can friction be useful? What is gravity? How do machines use forces? This book introduces the science of forces and explains the nature of different types of forces. It also shows how forces are used in our everyday world.