PLAYLAND

The Science of Fun 2024

May 11, 2024

Orientation: Saturday, May 11: 10am-12:30pm • PNE Hastings Room

Phone: 604-252-3663 or 604-252-3585 • Email: groupsales@pne.ca

The Science of Fun

Science at an Amusement Park
for Elementary School Students

Playland Amusement Park
Pacific National Exhibition

These educational materials were created by *Science Plus*.
For more information on Amusement Park Science
contact Steve Simms
simms_s@surreyschools.ca

Illustrations and graphic design by *Robert Browne Graphics*
Email: rbgraphics@telus.net • Tel: 604-460-2804

Vancouver, B.C., Canada
April 2024

The Science of Fun

and the new Elementary School Curriculum

In recent years, the educational system has seen a shift in the science curriculum and changes to how that curriculum is delivered. The current curriculum is more inquiry based with a focus on questioning, predicting, communication, planning and conducting investigations.

Although the science curriculum is varied at the primary and intermediate level, they do share a strong correlation with having students take an active role in thinking about science and world around them. This could mean just identifying certain relationships or starting to formulate questions and how they could conduct an investigation to answer those questions.

The British Columbia curriculum focus more on students being actively involved in their learning and allowing them to question and interpret their environment. ***The Science of Fun*** offers students opportunities to explore and discover various scientific laws and situations in a safe learning environment. Educators have the flexibility to focus on and identify various topics of discussion for their classes and allow students to get out and really start to thinking about the relationship between what's studies in class and what they experience when being at an amusement park.

The Ministry of Education has identified some curricular competencies that students are expected to meet. All of the below mentioned competencies could be done at ***The Science of Fun***.

Grade 2 Science: "Demonstrate curiosity and a sense of wonder about the world"

"Make and Record Observations"

"Compare observations with predictions through discussion"

Grade 4 Science: "Make predictions based on prior knowledge"

"Suggest ways to plan and conduct an inquiry to find answers to their questions"

"Collect simple data"

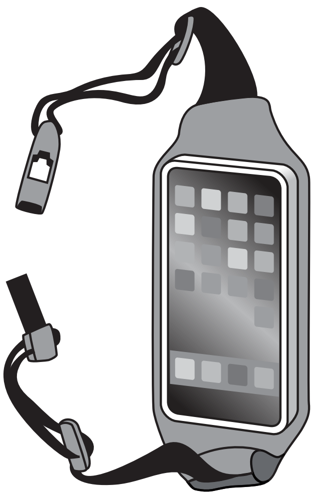
Grade 6 Science: "Identify questions to answer or problems to solve through scientific inquiry"

"Observe, measure, and record data, using appropriate tools, including digital technologies"

"With support, plan appropriate investigations to answer their questions or solve problems they have identified"

The Science of Fun allows students to get out of their classroom and explore real life science applications. Based on the current curriculum, students need to be able to design an investigation from start to finish, this includes data collection, analyst of results and communicating a conclusion.

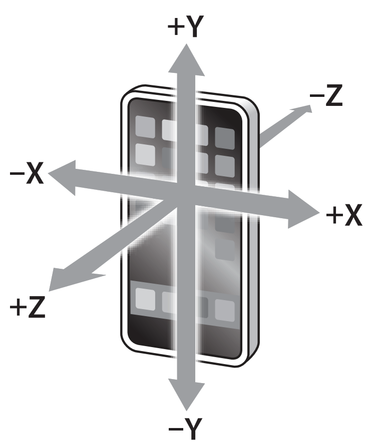
New Safety Regulations at Playland



Due to newly aligned amusement ride safety regulations in BC, hand-held measuring devices, or anything classified as a "loose item", are not permitted on amusement park rides and attractions.

As portable G-Meters and accelerometers are no longer permitted, we recommend the use of a third-party accelerometer app on securely stores cell phones in place of these devices. Seach for "accelerometer" and "roller coaster" to review the options available. Although we don't endorse any specific apps, we have found the free app Phyphox to be effective. Please ensure accelerometer apps are downloaded to all devices in advance as Playland does not have Wi-Fi on site.

To securely store cell phones during ride cycles, students are permitted to bring their own arm bands or hip packs. Playland has a limited number of arm bands or hip packs that can be used by students who do not bring their own. Please ensure students who borrow Playland items return them at the end of each ride cycle.



As students are not permitted to hold devices while the ride is in operation, please ensure the app has been started prior to loading, as use of the app is not permitted while the ride is in motion.

Be sure to know and understand the orientation of the cell phone to properly interpret the data. We suggest you practice using it before coming to the park to understand how the data is interpreted with different orientations. Depending on your level of understanding and familiarity using the app(s), you may want to use the absolute value feature that will allow you to see just the magnitude.

The use of cell phone accelerometers is not required to experience Amusement Park Science. The exciting curriculum provides other questions or investigation opportunities that can be incorporated with many of our rides without the use of these accelerometers.

***Note*: Using your cellphone on a field trip is your responsibility. Playland is not responsible for any lost or damaged items.**

Site Map

Playland Amusement Park

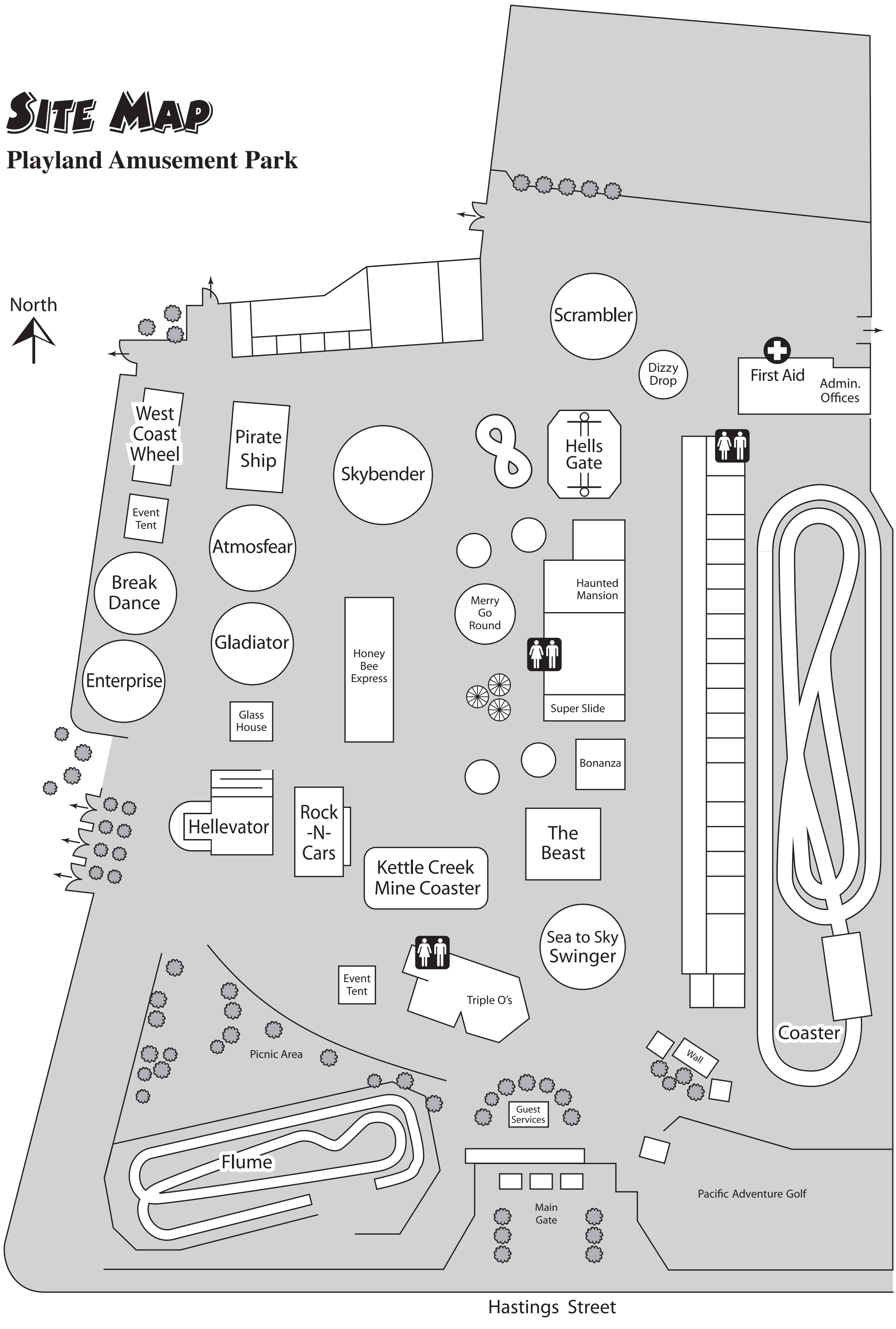


Table of Contents

Introduction

Have you ever wondered how fast a roller coaster goes? Or why you don't fall out of a ride when it goes upside down? How long have amusement parks been around? And what is it that makes the rides something to both fear and love at the same time? What do a ride on the Rainbow and a space shuttle trip have in common? All these questions and more, will be answered by students as they participate in *The Science of Fun*, a new educational program held at Playland Amusement Park and sponsored by the Pacific National Exhibition.

The idea of using an amusement park to teach science is relatively new. The first use began over 25 years ago with the University of Houston's "Informal Science Study." Several amusement park rides were used to simulate conditions encountered in space travel. Since then, similar programs have been started at numerous amusement parks across North America.

Locally, *Amusement Park Science Physics* for students in grades 11 & 12, and *Amusement Park Science* for students in grades 8 & 10 have been running at Playland for over 20 years, with *The Science of Fun* for elementary students almost 15 years ago. In 2008 we added *La Science du Plaisir* for French Immersion and Francophone schools. Over 20,000 students attend these events each year.

The Science of Fun was a natural evolution, to include elementary students as well. In this package you will find background information on the history of amusement parks and the science behind the rides, as well as several pre-visit activities that teachers can do with their students. There are activity sheets for each ride, focusing on the science involved in the ride's operation. Although the focus of the program is on science, the program is fully integrated, involving other curricular areas such mathematics, history, language arts, fine arts and personal planning. As a follow up to the field trip to Playland, there are also post-visit activities and suggestions for assessment and evaluation. The complete package serves as the core for a memorable, hands-on, thematic unit on *The Science of Fun*.

Curriculum Connections

The Science of Fun is not intended replace your students' science experience. This enrichment experience is designed to enhance your students' knowledge and understanding and to demonstrate how the science they learn in the classroom applies to the world around them.

There are several places where this educational experience connects to the current elementary curriculum. The content matches several of the big ideas described in the current BC science curriculum. Some connections include the following:

- GRADE 2 – Forces influence the motion of an object.
- GRADE 4 – Energy can be transformed.
- GRADE 5 – Machines are devices that transfer force and energy.
- GRADE 6 – Newton's three laws of motion describe the relationship between force and motion.

Each ride's activity sheet focuses on several science concepts and can cross grade and subject boundaries. Teachers may want to concentrate on those rides and questions that focus on the science they have covered, leaving the other rides and questions for other grades.

The curriculum materials take a holistic approach to learning and offer opportunities of integrate science with other subjects. These materials include opportunities for students to represent their learning in language arts, fine arts, mathematics, social studies and critical thinking as well.

Materials for The Science of Fun Day

The accompanying materials have been divided into several sections:

- background information
- information concerning measurements
- materials and worksheets on the individual rides
- pre-visit activities
- post-visit activities

Each ride – or set of rides – has an explanation of the science that is featured in the ride. You can use these explanations as part of the student learning.

Students will get more out of the field trip to Playland if they are prepared. You can prepare students by having they do the pre-visit activities, using equipment at your school's playground. These investigations will give the students valuable background information and will help them better understand the concepts presented in the ride activities.

Teachers will need to select materials from the worksheets to fit the students' grade levels, the time available, and the rides represented at the amusement park.

Due to the unusual circumstances in which students are working when making field measurements, coupled with the errors inherent in the estimates they are asked to make, only limited accuracy can be expected of the results students obtain. Emphasis should be placed more on understanding the principles behind operation of the rides than on the numerical answers.

Basic items students will need include:

- ❑ *Packet of activities (assembled from the accompanying materials)*
- ❑ *Pencils and blank paper*
- ❑ *Timing devices for some rides (digital watches with stopwatch mode)*

Teacher Note:

Previously, students used hand-held accelerometers to take measurements on the rides, but due to new safety regulations at Playland, hand-held devices are no longer permitted. You can use an accelerometer app on a cell phone as long as it is secured in an arm band or fanny pack. These apps are effective at measuring acceleration, but they can be difficult for younger students to operate and understand. Teachers will need to decide what is appropriate for their students.

Sample Timeline for the Visit

Time Schedule

9:00	Buses leave school.
9:45	Students arrive at Playland (Playland Amphitheatre).
9:45 – 10:00	Brief students prior to days event.
10:00 – 2:00	Enter park and carry out pre-planned activities involving observation and measurement of selected rides. Arrange a meeting time with your students for problems that arise or questions they have.
2:00	Playland closes. Students reassemble at central point.
2:15	Board buses for return to school.
3:00	Buses return to school.

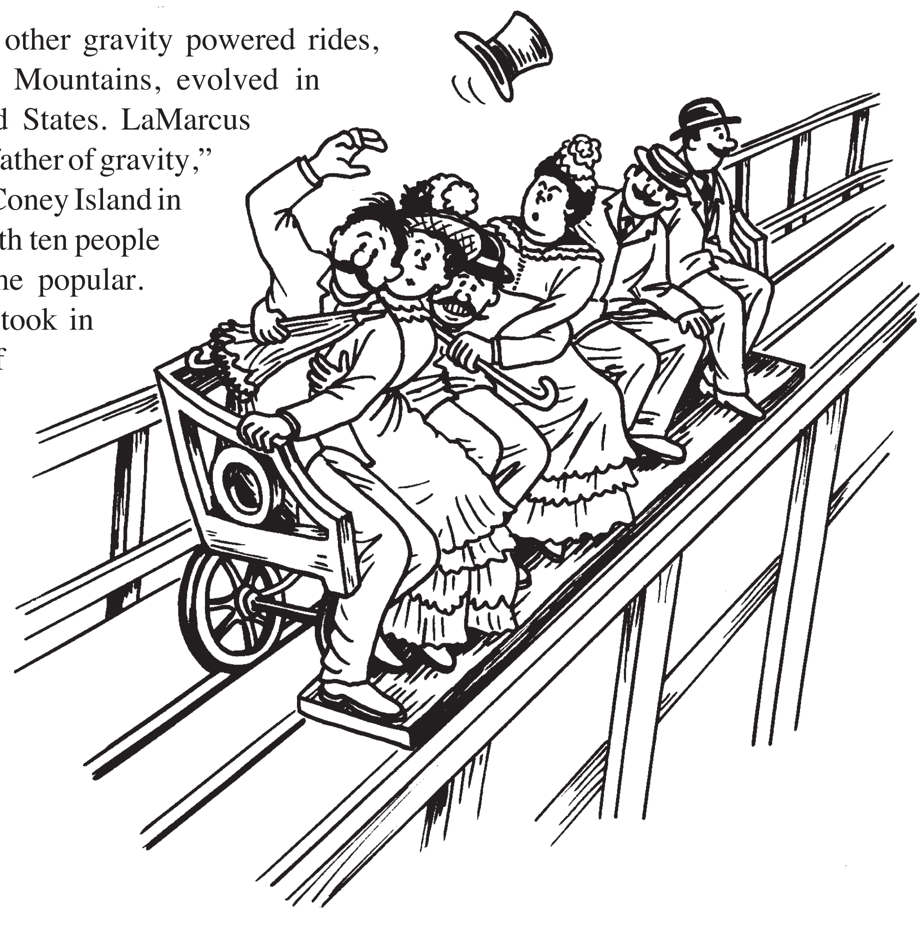
A Brief History of Amusement Parks

A common question arises when visiting an amusement park – why would anyone invent such a thing? When did the rides first show up? The parks themselves evolved from earlier city parks and gardens where people could walk, talk and eat. Even Coney Island, in the United States, was a popular vacation destination at the time of the Civil War, long before it became an amusement park.

Roller Coasters

Current amusement park rides have their origins in several places. For the roller coaster, the short answer is that the Russians started them in the 15th century. They built ice slides in St. Petersburg that were the precursors to modern roller coasters. A seventy-foot wooden frame was packed with snow, watered down to create ice, with sand added near the end of the run to stop the "sleds." Originally, sleds were made from two-foot blocks of ice with a carved out place that was filled with straw for insulation. The trip was so scary that passengers sometimes had to have a guide for the trip. The passenger would sit in the guide's lap and together they would speed down the hill. When the ride was finished, the passenger had to carry the sled back to the top of the hill.

From this early beginning, other gravity powered rides, sometimes known as Russian Mountains, evolved in Europe and then in the United States. LaMarcus Thompson, called by some the "father of gravity," created the first roller coaster at Coney Island in 1884. His "Scenic Railway," with ten people per coaster car, quickly became popular. At a nickel a ride, the railway took in $600 a day and paid itself off in three weeks. The ride was tame by today's standards. As their name implies, it was a way to ride on the beach and see the sights. The riders rode sideways to better see the ocean and rolled at the death defying speed of six miles per hour! But it was popular, and by 1888 Thompson had built nearly fifty coasters in North America and Europe.



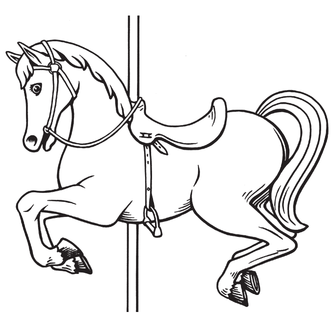
Others quickly entered the coaster market and the competition led to design improvements. Charles Alcoke invented the first oval track coaster that returned passengers non-stop to their starting point. Phillip Hinckle's coasters added a chain elevator system that carried the loaded cars up the first hill. This advancement sparked the development of the giant coasters that still dominate today's amusement parks.

In further innovations, Thompson linked two cars together forming the first coaster train, which doubled rider capacity and made a better financial investment. Between 1884 and 1887, Thompson patented thirty improvements to the coaster ride. He also was the first to construct a tunnel over a portion of the track to create frightening darkness. Nearly a hundred years later, Walt Disney would exploit this same sudden darkness in Disneyland's Matterhorn. Space Mountain would take this coaster format to its ultimate by having riders in total darkness.

Demand for steeper hills, faster speed and increased passenger capacity continued to grow. In the early 1900s John Miller designed and built the biggest coasters with higher hills, steeper inclines and more terrifying speeds. Along with these bigger coasters came the need for more safety devices and Miller invented "undertrack wheels" that prevented the cars from jumping off the tracks while speeding over the tops of hills.

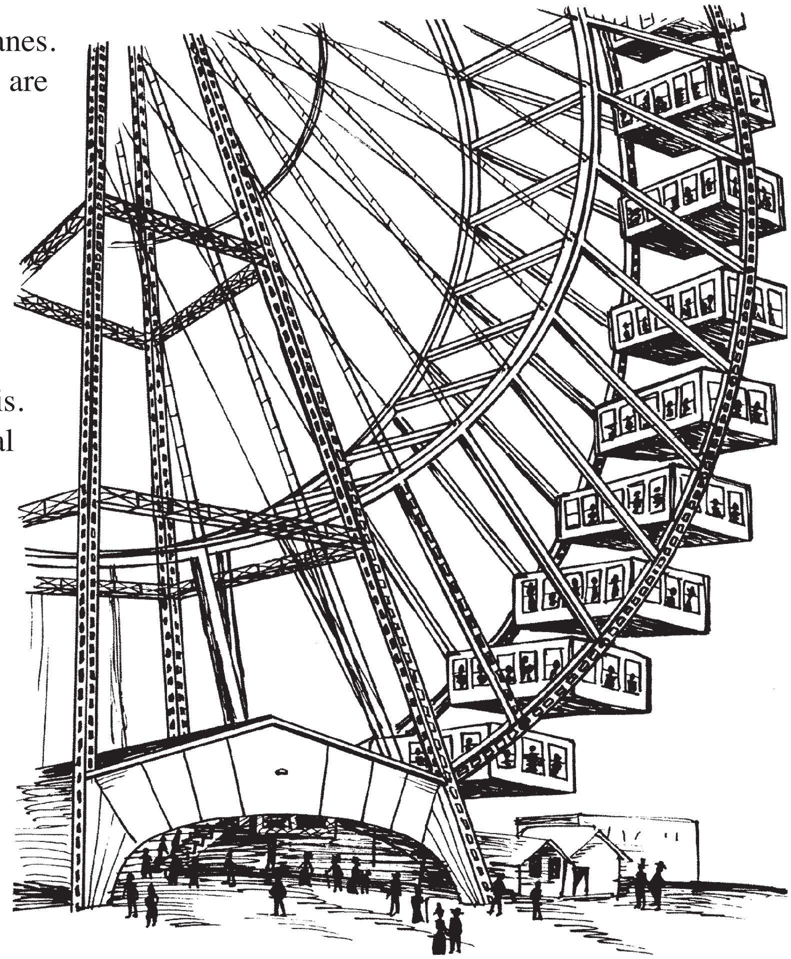
The Roaring Twenties, with its drive for reckless excitement, ushered in the Golden Age of the roller coaster. The scream machines of the period reflected the culture, when people sought sensual thrills and the automobile gave them a taste for speed. Coasters increased in size and number. By one estimate, North America had at least 1,500 of them before the coaster's popularity declined during the Depression. As money became scarce and later, during World War 2, as wood and rubber were rationed, most roller coasters slowly became silent, rotting wooden dinosaurs.

The Merry-Go-Round



The Merry-Go-Round, or Merry-Go-Round, has its origins in 17th century England. Large wooden wheels with carved wooden horses attached to their outsides were turned by servants so that young lords could practice their jousting techniques. As the young lords rode around, they carried lances and tried to spear stationary rings. This is not too different from later Merry-Go-Round rides in which riders tried to grab brass rings as their horses moved in a circle.

In the 19th century, Frederick Savage, a machinist worker in King's Lynn, England, put a steam engine on the Merry-Go-Round. At about the same time, in the United States, Eliphert Scripture of Green Point, New York, attached the rear of the horses to a pivot and moved the front of the horse up and down to create a riding motion. Popularity boomed when carver Salvatore Cernigliaro applied his marvellous craft to Merry-Go-Round design and greatly increased the beauty of the ride. He carved Merry-Go-Round animals of all kinds and added jewels and colour. The most popular of his creations were his galloping horses with their flowing manes. Many of his carved and decorated horses are now being restored to their original beauty.



Ferris Wheel

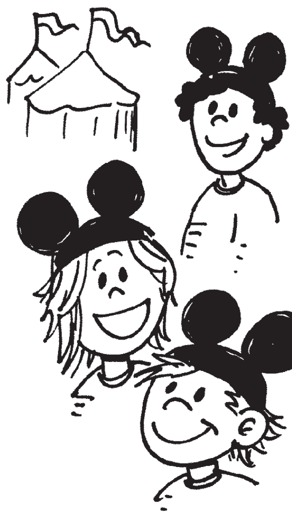
Of prime importance in the development of amusement parks was the creation of the Ferris wheel. The first "Ferris" wheel, built for the 1893 Chicago Columbian Exposition, was envisioned by George Washington Gale Ferris. Ferris's wheel was modelled after the structural principles of the bicycle wheel. This first wheel was enormous – nearly 300 feet tall and 30 feet wide. It had thirty-six pendulum cars, each able to hold sixty passengers. The axle of the incredible structure was a manufacturing feat without parallel – the largest single piece of steel ever forged to date. Produced by the Bethlehem Iron Company, the axle was over forty-five feet long, almost three feet in diameter and weighed forty-five tons. The entire structure weighed 1,200 tons, was driven by two 1,000 horsepower reversible engines and could carry 2,160 riders.

No steel company could handle the manufacturing job alone. Ferris had to contract with a dozen companies to produce the bars, trusses and girders, which were meticulously planned to fit together like giant Tinkertoys when assembled at the site.

The construction cost of the original Ferris Wheel was nearly $350,000 and the technology to build it had never been used before. Thus, investors were difficult to find at first. Nevertheless, Ferris pulled off the deal and by the closing of the Chicago Exposition 1,453,611 customers had paid the exorbitant fee of 50¢ for a 20-minute ride. Ferris showed the world that technology could be used on a grand scale simply for fun. In 2007 Playland added a 50' tall Ferris Wheel.

Modern Amusement Parks

Few things have survived changing times and tastes like amusement parks. With the success of the 1893 Columbian Exposition, the modern concept of the amusement park began developing at Coney Island in Brooklyn, New York. By the early 1900s many major cities in North America could boast of one or more amusement parks with a Merry-Go-Round, a Ferris wheel, a penny arcade and fireworks displays. These parks also emphasized band concerts and other entertainment. By 1919 over 1,500 amusement parks existed in North America.



This spectacular growth began to decline after World War I, as did all outdoor entertainment. After the stock market crash in 1929, people didn't have any extra money to spend in amusement parks. In the 1930s the Depression brought a few new patrons seeking escape from their dreary lives, but this only slowed the decline. Popularity continued to fall after World War 2.

The salvation of the amusement park came in its mutation, the theme park. The theme park was originally the brain child of Walt Disney. The notion of organizing amusement parks around a theme offered an entirely new gimmick. Initially, people scoffed at Disney and he had a difficult time financing the project. He struck an unusual deal that tied his theme park to newly created television shows, the Mickey Mouse Club and The Wonderful World of Disney. Disneyland the theme park and Disney's television shows both took off in popularity and amusement parks have never been the same since.

Playland Amusement Park

Although Playland Amusement Park has been at its current location on Hastings Street since the Pacific National Exhibition opened in 1958, its origins go back much further. The first proposals for a regional exhibition that would provide entertainment for local residents and a forum for agricultural excellence came in 1890.

The Vancouver Exhibition Association was formed in 1907 by local businessmen, and in 1910 Vancouver held its first exhibition. This inaugural exhibition was opened by Sir Wilfrid Laurier, prime minister of Canada, and Sir Robert Baden-Powell, founder of the Boy Scout movement. In addition to the entertainment that was provided daily at the exhibition, there was an extravaganza of games, sideshows and rides.

By 1915, a scenic railway (roller coaster) and a Merry-Go-Round had been permanently been added to the site, just south of the race track, with other rides brought in during the exhibition each year. To increase revenue for the exhibition, the amusement area was kept open in the summer months and was named "Happyland." Happyland increased in popularity in the 1920s, along with other amusement parks in North America. However, it too suffered through the Depression. Its roller coaster, the Big Dipper, was once a very popular ride, but had to be demolished for safety reasons after amusement park revenues declined.

After World War II, the exhibition association decided to revitalize the summer event and renamed it the Pacific National Exhibition (PNE), symbolizing its provincial and national nature. With its broader scope, the exhibition expanded and attendance soared. Happyland continued to be open in the summer months, operated by various amusement park companies.

In 1955, the PNE took control of Happyland's management and two years later, in a comprehensive development plan, relocated the amusement area to its current location and renamed it Playland. The centrepiece for Playland has always been its roller coaster, still ranked as one of the best wooden coasters by the American Roller Coasters Enthusiasts organization.

Playland added three new rides in 2000, including the hair-raising Hellevator in which riders experience the "beyond free-fall" floating negative G force, Hell's Gate, where riders loop within loops at 30 km/h and risk getting drenched in the water fountain, and Revelation, an extra price ride, which is a 160 ft. (50 meter) tall spinning propeller ride which is among the fastest, most exhilarating extreme rides in the world.

In 2004, Playland added The Kettle Creek Mine Coaster, where adults and children alike can experience the thrills and excitement of a mine car adventure through a rough and rugged terrain. In 2006, Playland added the Gladiator and Break Dance, both rides involve two rotating axes with thrilling spins. In 2011, Playland added the exciting new ride Atmosfear. It's like riding on the wave swinger at 60 m off the ground, giving you a great view of Vancouver if you're brave enough to open your eyes! In 2022 Playland added Skybender, spinning riders in circles at 65 km/h, making it the fastest single-rider ride in Canada! Playland's newest ride will be Canada's fastest launch coaster – opening in 2024!

The Pacific National Exhibition has been around for over 100 years. Playland continues to provide thrilling rides and excitement on weekends from the end of April to the end of September and daily in July and August. *The Fair at the PNE* brings in even more rides as well as 800 free-with-admission shows, exhibits and attractions during the last two weeks in August through to the Labour Day weekend. For more thrills, *Fright Nights* comes to Playland in October.

Curriculum Integration Activities

1. Create a time line which represents the history of the amusement park.
2. Discuss the historical event which had an effect on the amusement park's evolution (eg. the Roaring 20s, the Great Depression, World War 2, etc.).
3. Imagine that you are a newspaper editor in 1910. Write an editorial which supports or criticizes the "current rage" for roller coasters.
4. Brainstorm a list of modern "thrill" sports (eg. bungie jumping, parasailing, skydiving). Discuss the ways in which early amusement park rides were similar in their appeal to thrill seekers.
5. Create a 1920s style poster to advertise a "new, exciting" ride at Happyland. It could publicize the Big Dipper, their roller coaster.
6. After you return from your visit to Playland, write an article for your school newspaper about your experience. One technique used to organize a newspaper article is called the 5Ws – Who, What, When, Where, and Why. Use it to cover the main points of your field trip. Be sure to include several things you learned and what part of the field trip you most enjoyed.

Making Measurements at the Park

Time

The times that are required to work out the problems can easily be measured by using a watch with a second hand or a digital watch with a stop watch mode. When measuring the period of a ride that involves harmonic or circular motion, measure the time for several repetitions of the motion. This will give a better estimate of the period of motion than just measuring one repetition. You may want to measure the time two or three times and then average them.

Distance

Since you cannot interfere with the normal operation of the rides, you will not be able to directly measure heights, diameters, etc. All but a few of the distances can be measured remotely using the following methods. They will give you a reasonable estimate. Try to keep consistent units, i.e. metres, centimetres, etc., to make calculations easier.

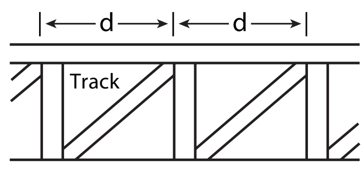
Pacing

Determine the length of your stride by walking at your normal rate over a measured distance (for example, 100 metres). Divide the distance by the number of steps and you can get the average distance per step. Knowing this, you can pace off horizontal distances.

My pace = ____________ m

Ride Structure

Distance estimates can be made by noting regularities in the structure of the ride. For example, tracks may have regularly spaced cross-members as shown



here. The distance **d** can be estimated, and by counting the number of cross members, distances along the track can be determined. This method can be used for both vertical and horizontal distances.

Speed

In linear motion, the average speed of an object is given by:

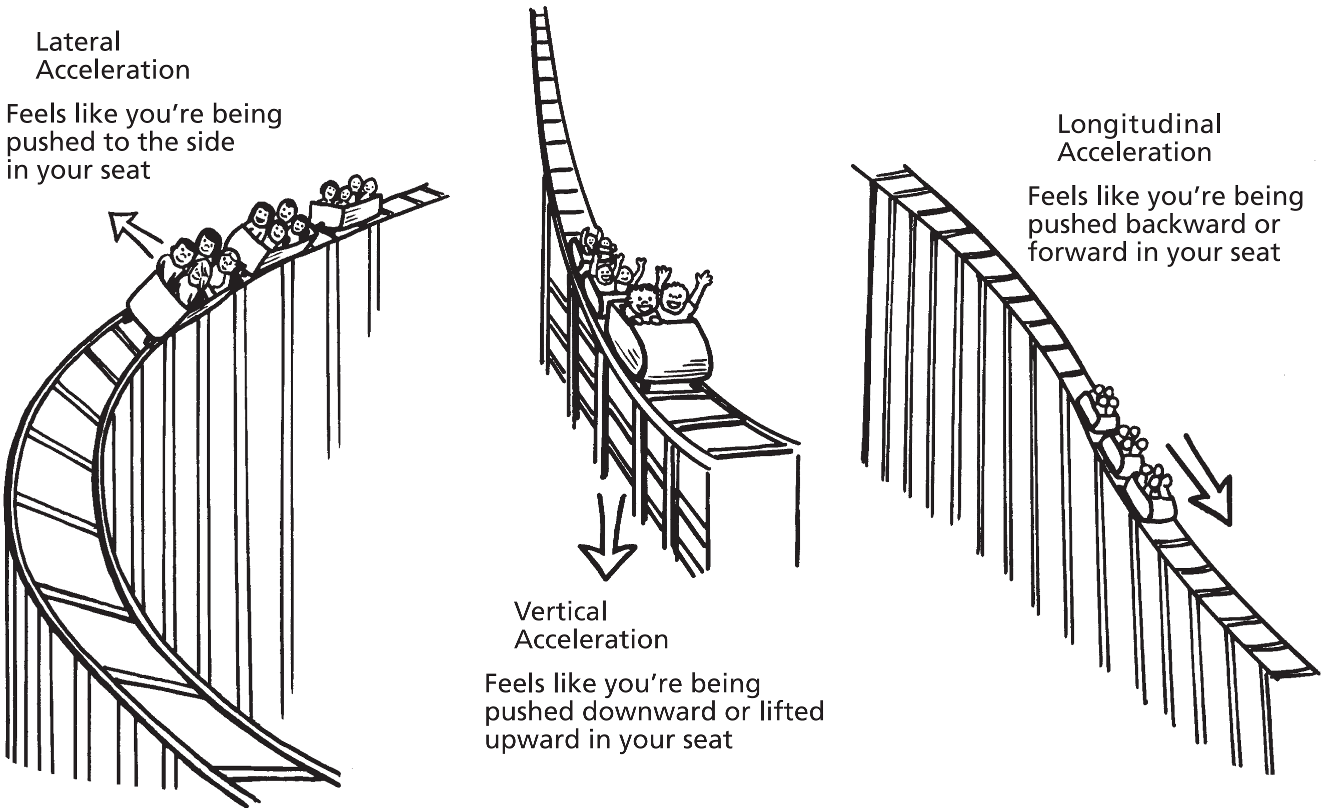
$$V_{ave} = \frac{\Delta d}{\Delta t} = \frac{\text{distance travelled [in m]}}{\text{time for trip [in sec.]}}$$

In circular motion, where speed of rotation is constant:

$$V_{ave} = \frac{\Delta d}{\Delta t} = \frac{2\pi r}{\Delta t} = \frac{\text{distance in circumference of a circle [in m]}}{\text{time for one revolution [in sec.]}}$$

Acceleration

Accelerometers are designed to record the **g** forces felt by a passenger (force of gravity). Accelerometers are usually oriented to provide force data perpendicular to the track, longitudinally along the track, or laterally to the right or left of the track (see below).



Accelerometers are calibrates in **g**'s. **A reading of 1 g equals an acceleration of 9.8 m/s^2.** As you live on earth, you normally experience 1 g of acceleration vertically (no g's laterally or longitudinally). Listed below are the sensations of various'g forces'. These are rough estimates, but may be helpful in estimating accelerations on the various rides.

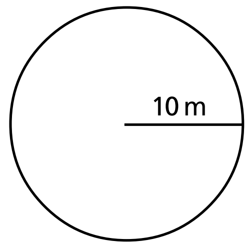
Accelerometer Reading	**Sensation**
3 g	3 times heavier than normal (maximum g's pulled by space shuttle astronauts)
2 g	twice normal weight
1 g	normal weight
0.5 g	half-normal weight
0 g	weightlessness (no force between rider and coaster)
–0.5 g	half-normal weight – but directed upward away from coaster seat (weight measured on bathroom scale mounted at rider's head!)

Useful Formulae

Circumference of a circle

$C = 2\pi r$ $\pi = 3.14$
r = radius of the circle

Example: What is the circumference of a circle with a radius of 10 m?



$C = 2\pi r$
$= (2)(3.14)(10)$
$= 62.8$ m

Speed of an object in a straight line

$v = \frac{d}{t}$ Speed = $\frac{\text{distance travelled}}{\text{time for the trip}}$

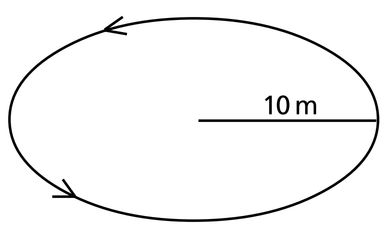
Example: What is the speed of a roller coaster if it takes 53 seconds to make a trip of 700m?

$v = \frac{d}{t}$
$= \frac{700\text{m}}{53\text{ sec}}$
$= 13.2 \frac{\text{m}}{\text{sec}}$

Speed of an object in a circle

$v = \frac{2\pi r}{t}$ Speed = $\frac{\text{distance travelled}}{\text{time for the trip}}$ (t = time for one revolution)

Example: What is the speed of a car around a ride that has a 10m radius and takes 6.1 sec to make one revolution?



t = 6.1 s

$v = \frac{2\pi r}{t}$
$= \frac{2(3.14)(10\text{m})}{6.1\text{ s}}$
$= 10.3$ m/s

Pre-visit Activities

Classroom & Playground Unit

Activity 1

Name: ______________________

Date: ______________________

The Slide

The following experiments involve a slide which you can find at the school playground.

Part 1 The Straight Slide

Procedure

1. First ride the slide from the very top all the way to the bottom.
2. Next, slide half-way down then stop yourself by *carefully* grabbing the sides. Now let yourself slide the rest of the way down. Make sure you don't do any extra pushing.
3. How does your final speed in the first case compare to the speed in the second?
4. Try the same experiment with a smooth ball. Do you have the same results?

Data and Questions

When you slide from the top of the slide, you …______________________

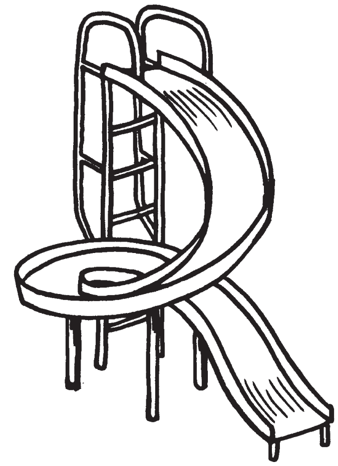
When you slide from half-way down the slide, you … ______________________

When you experimented with the ball the results were… ______________________

Your conclusions from this experiment are… ______________________

Part 2 The Curved Slide

Some playgrounds have slides that make a twisting curve on the way to the bottom. If you have a slide like that, try the next investigations as well.



Procedure:

1. Go to the top of the straight slide with a small ball.
2. Place the ball on the middle of the slide and let it go. Watch what happens.
3. Where does the ball go?
4. Do the same thing on the curved slide.
5. What happens to the ball this time? Does it stay in the middle of the slide or move to the sides of the slide? Can you think why?
6. Go do the slide yourself.

Data and Questions

On the straight slide, the ball … ______________________________

____

____

On the curved slide, the ball … ______________________________

____

____

The ball moves this way because … ______________________________

____

____

____

Do you go faster or slower on a twisting slide? ______________________________

Do you slide on the inside or the outside of the slide as you go down? ______________________________

Why do you get dizzy? ______________________________

____

____

____

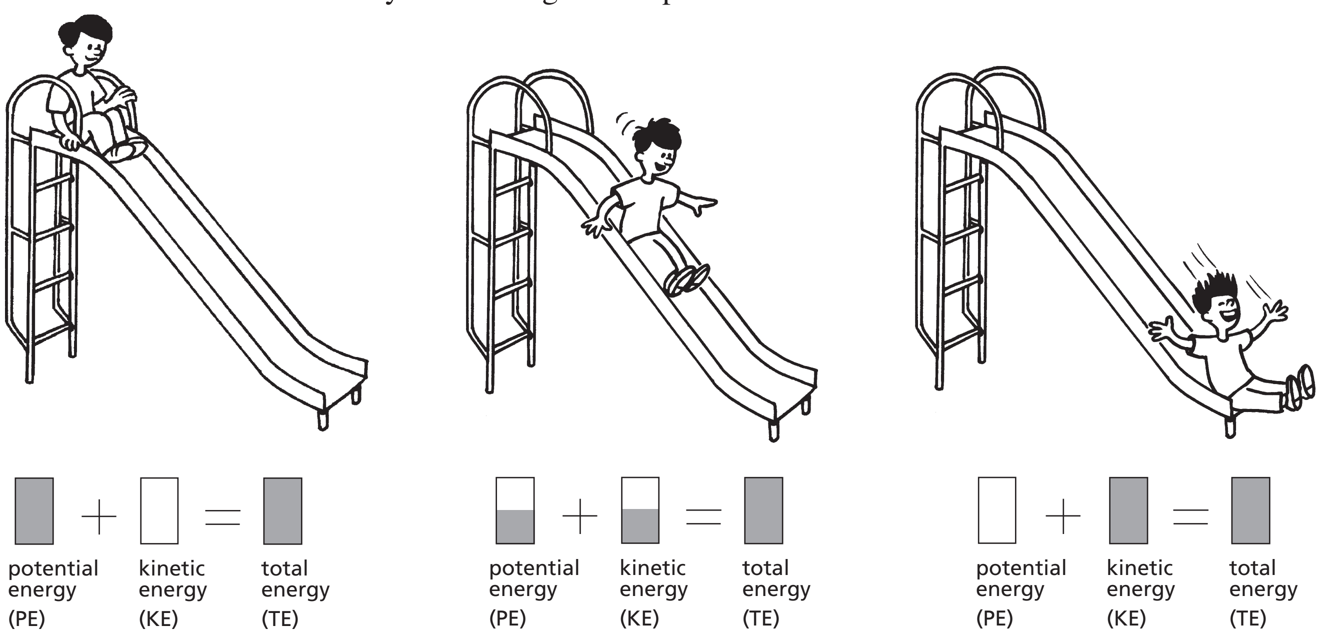
____

The Explanation

The slide is a perfect place to show the *Law of Conservation of Energy*. The Law of Conservation of Energy says that energy can change from one form to another but it cannot be created or destroyed.

After you climbed up the stairs to the top of the slide, you have a type of energy called *potential energy* (PE). It is potential energy because it is a stored energy that can be used later. When you get on the slide surface and begin to slide down it, your movement shows another type of energy. Kinetic energy (KE) is energy that is being used, the energy of motion.

But where did the kinetic energy come from? The Law of Conservation of Energy says that energy cannot be created from nothing – it has to come from someplace else. It comes from changing some of the potential energy into kinetic energy. The farther you slide, the more potential energy you have converted into kinetic energy. At the bottom of the slide, just before your feet touch the ground, all the potential energy was changed into kinetic energy and you had the greatest speed.



The diagrams above show the conversion of potential energy (PE) into kinetic energy (KE) during a slide ride.

When you go down a curved slide, centripetal force comes into play. Your body still tries to go down the slide in a straight line, but the slide curves. You think you are being thrown to the outer edge of the slide but you are really just trying to go straight on a curved slide. The ball does the same thing.

Can you think of any other examples which illustrate centripetal force?

Part 3 Friction on the Slide

Try this next experiment on the slide as well.

Procedure

1. First, ride the slide from the very top to the bottom.
2. Next, ride the slide from the very top to the bottom, only this time ride on a piece of waxed paper.

Data and Questions

Which ride was fastest? ______________________________

When you slide *without* waxed paper, you . . . ______________________________

____

____

When you slide *with* a piece of waxed paper, you . . . ______________________________

____

____

Your conclusion from this experiment is . . . ______________________________

____

____

____

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The Explanation

This is a good example of friction. Friction can come in many forms, but it resists any motion. Friction depends mainly on the materials involved. Waxed paper helps to decrease friction. Can you think of any other way that you could decrease friction?

Activity 2

Name: ______________________________

Date: ______________________________

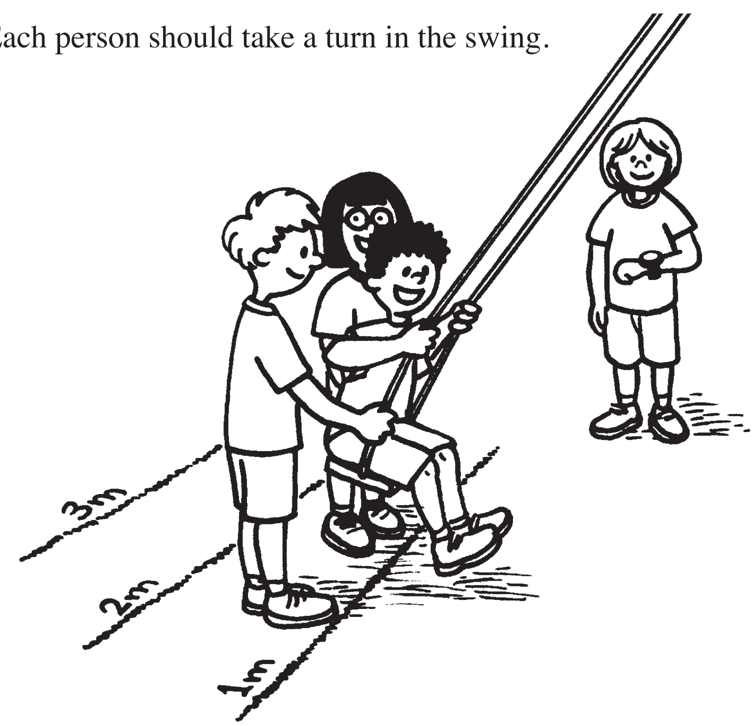
The Swings

Playground swings are examples of a pendulum. Go to the school playground and try the following activities. You'll need several friends and a stop watch. Write down each person's weight before you go to the playground.

Part 1

Procedure

1. Find a tall swing.
2. Let the swing hang straight down. Mark off a place about two metres behind the swing when it is standing still.
3. Let one friend sit in the swing. Have two others, one on each side of the swing, pull the swing backwards until the swing's centre is over the mark you made.
4. When the timer says go, the two friends should release the swing.
5. The timer records how long it takes for the swing to go back and forth 5 complete times (i.e. to go forward and back to the starting point). *One complete cycle is called the period of the pendulum.*
6. The rider must remain completely still and not "pump" the swing as it moves.
7. Each person should take a turn in the swing.



Data and Questions

Person	Weight	Time for 5 swings

Does the weight (more accurately called *mass*) of the swinging person have any effect on the time it takes for the swing to make 5 complete swings?

How can you illustrate your understanding of the pendulum back in the classroom, using a pendulum model?

Part 2

Whoever is the smallest gets to do the next experiment.

Procedure

1. Let the swing hang straight down again. Make several marks behind the center of the swing – one at 1 metre, one at 2 metres, and one at 3 metres.
2. With the smallest person in the swing, have two others pull the swing back to the first mark.
3. When the timer says go, the two should release the swing.
4. The timer will record the time for 5 complete swings as before.
5. Repeat the activity for the other two release marks.

Data and Questions

Person	Time for 5 swings from a release point of: 1 metre	2 metres	3 metres
______________________	________	________	________
______________________	________	________	________

Does the release point affect the pendulum's period, the time to complete one full cycle?

____

____

____

____

Try letting the person in the swing "pump". Does pumping have any affect on the period of the swing? If so, how?

____

____

____

____

Part 3

Your playground will need to have several sets of swings, with different lengths of chain between the crossbar and seat, to perform the following investigation.

Procedure

1. Use the light-weight swinger and a 2 metre release point.
2. Have the timer record the period for the swing the same as previous experiments.
3. Repeat the experiment on each swing that has a different length of chain.

Data and Questions

Person	Time for 5 swings in a: tall swing	short swing
______________________________	____________	_____________
______________________________	____________	_____________

Does the length of chain have an affect on the period, the time for one complete cycle of the pendulum swing?

____

____

____

If 5 different kids that had different weights were all riding swings with different lengths of chain and were pumping different amounts, whom would you predict would take the longest time to swing back and forth?

____

____

____

The Explanation

The swing is a pendulum. The only thing that will affect the period of a pendulum (the time to make one complete swing) is the length of the string (or chain in this case) that holds it. The weight (mass) at the end of the pendulum does not affect the period. Pumping while you swing changes the period because it adds energy into each swing.

Part 4

How does pumping a swing work?

Once you get a swing started, why does pumping make you go higher?
Try the following investigation to find out.

Procedure

1. Make a pendulum – a small mass on the end of a string about 50 cm in length. Hold the pendulum in front of you.
2. Start it swinging by pulling it a few centimetres and then letting go.
3. As the pendulum reaches the bottom of its swing, gently lift the pendulum's string about 3 cm or so. As the pendulum continues its arch and begins to rise, return the pendulum and string to their normal height.
4. Continue this rise and fall of the pendulum for each swing.
5. Get on a swing and pump it as high as you can.

Questions

In the pendulum example, what happens to the arch the pendulum is following? Why?

In your own words, explain how you pump a swing.

When you pump a swing, what forces do you feel?

Do you have a place where you feel lighter? Explain.

Do you have a place where you feel heavier? Explain.

When do you pump the swing? Explain your actions.

How does the example of the pendulum relate to pumping a swing?

The Explanation

With both the pendulum and pumping, you are raising the centre of the mass. This is more obvious with the pendulum, but is also true for pumping. By lifting your legs forward and back, your centre of mass is higher than when your legs are straight down. By raising your centre of mass this way, you give yourself some potential energy (see Activity 1 – The Slide) which isthen converted into kinetic energy. All this makes you swing higher and higher.

On-Site Activities

Playland Unit

Activity 1

Estimation at the Amusement Park

Name: ______________________________

Date: ______________________________

One skill that is important in science is *estimation*. An estimation gives you an approximate answer before you solve a problem. This estimation will tell you if your answer is reasonable. Try the following activities and sharpen your estimation skills. For each question, give your estimation *and the reasoning you used* to obtain that estimation. Remember, an estimation is not just a guess.

1. How tall is the highest hill on the Coaster?

____

____

____

2. What is the average speed of the Coaster for a complete trip?

____

____

____

3. How many swings does the Pirate Ship ride make during its operation?

____

____

____

4. How many hot dogs do all the concession stands combined sell during one day at the PNE?

____

____

____

5. How many people are at Playland today?

____

____

____

Activity 2

Name: ______________________

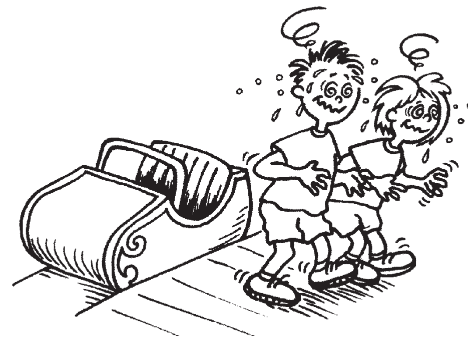
Date: ______________________

Physiology of the Rides

For each of the rides listed below, measure your pulse rate and breathing rate before and after the ride. You can take your pulse by lightly placing your fingertips on the inside of your wrist, near your thumb, or by placing your fingertips behind your ear. Record any symptoms that you experienced by placing numbers of those appropriate symptoms from the list beside the name of the ride.

Symptoms

1. dry mouth
2. dizziness
3. tense muscles
4. unable to move
5. cold hands
6. enlarged eye pupils
7. trembling
8. sweaty hands
9. upset stomach
10. fast breathing
11. stomach butterflies
12. other (explain)



	Pulse Rate		Breathing Rate		Symptoms	
Ride	**Before**	**After**	**Before**	**After**	**Before**	**After**
Coaster						
Kettle Creek Mine						
Flume						
Merry-Go-Round						
Scrambler						
Atmosfear						

Ride	Pulse Rate Before	Pulse Rate After	Breathing Rate Before	Breathing Rate After	Symptoms Before	Symptoms After
Skybender						
Break Dance						
Gladiator						
Pirate Ship						
The Beast						
Hellevator						
Hell's Gate						
Rock-N-Cars						

How can you explain any differences in heart rate, breathing rate or other symptoms before and after the ride? If there were no differences, how can you explain that?

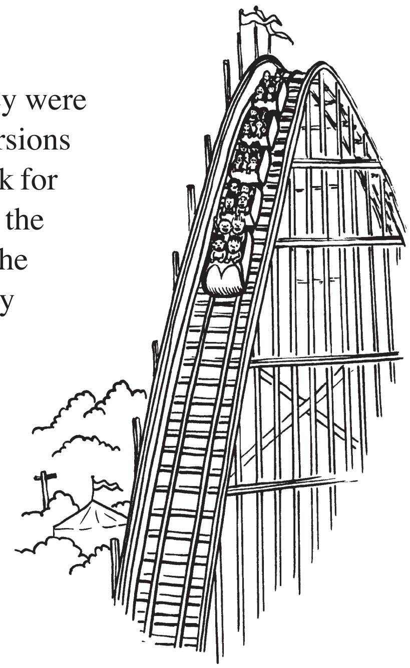
Extension Have the teacher arrange a visit from the school nurse or a doctor to explain the physiological reasons for these symptoms.

Activity 3

Name: ______________________

Date: ______________________

COASTER



The roller coaster was one of the first amusement park rides invented. They were originally made of wood and the coaster cars rode on steel wheels. Later versions followed paths of steels and rolled on air-filled tires. Basically, they all work for the same reasons. They operate because of *gravity*. The park charges for the energy it uses to take you to the top of the first hill and gravity gives you the rest of the ride for free. Of course, the park also ensures that you get safely back to the starting point.

Procedure 1 and Questions

As you ride the Coaster, try to experience the ride as you would any other science experiment. You are the experiment. Note when you feel increased and decreased forces. They may push you into your seat or lift you off it. They may push you left or right. After you have finished the ride, try to answer the following questions.

1. What happens to the size of the hills during the ride? Why?

____

____

____

____

2. Are you moving faster or slower when you are at the top of a hill? Why?

____

____

____

____

3. Are you moving faster or slower when you are at the bottom of a hill? Why?

____

____

____

4. As you go up a hill, do you gain or lose speed? Why?

____

____

____

5. As you go down a hill, do you gain or lose speed? Why?

6. As you go up a hill, do you feel heavier, lighter or the same as you usually do? Why?

7. As you go down a hill, do you feel heavier, lighter, or the same as you usually do? Why?

8. When you are in a turn, are you pushed inward or outward? Why?

9. Are the tracks tilted inward, outward or are they flat on curves? Why?

10. What simple machines can you find in the ride?

11. How fast do you think the ride goes?

12. Time the ride for one trip. If the coaster track is about 700 metres long, what is the average speed of the trip. Give the answer in metres per second then convert the answer to kilometres per hour.

Procedure 2 and Questions

Using the diagram below, pick the best place on the ride for each description. Put the number in the space beside the description. You may use the numbers more than once and may place more than one number by each description.

Accelerating (speeding up) ____________

Decelerating (slowing down) ____________

Banked curve ____________

Centripetal force ____________

Weightless zone ____________

Greatest speed ____________

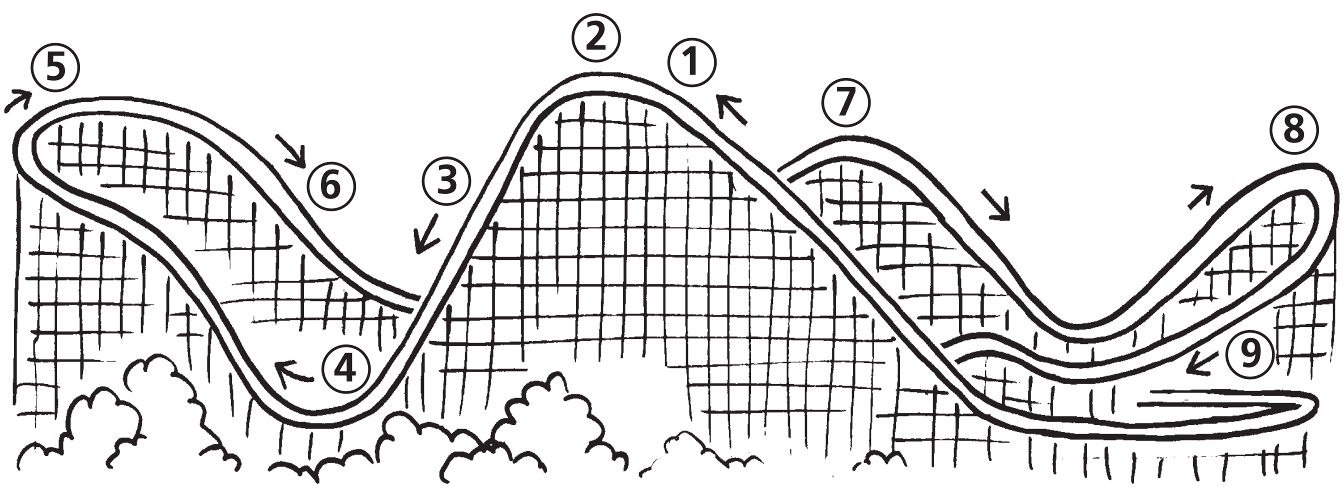
Slowest speed ____________

Most potential (stored) energy ____________

Most kinetic (movement) energy ____________

Backward leaning zone ____________

Forward leaning zone ____________



Activity 4

Name: ______________________

Date: ______________________

Kettle Creek Mine

This ride is a roller coaster. It operates, in part, because of gravity. The potential energy of the first hill is converted into the kinetic energy of motion and you move quickly around the rest of the ride.

Procedure and Questions

1. What happens to the size of the hills during the ride? Why?

2. Where on the ride are you moving the fastest? Why?

3. Where on the ride are you moving the slowest? Why?

4. As you go down a hill, do you speed up or slow down? Can you give an example of another similar situation where you get the same result?

5. As you go up a hill, do you speed up or slow down? Can you give an example of another similar situation where you get the same result?

6. What simple machines do you find on the ride?

7. How fast do you think the ride goes – as fast as you walk, as fast as you ride your bike, or as fast as you parents drive their car? Explain your answer.

Activity 5

FLUME

Name: ______________________________

Date: ______________________________

The Flume is another type of roller coaster. Ride it and answer the following questions.

Procedure and Questions

Pick the best place on the ride for each description word. Put the number in the space beside the description. You may use the numbers more than once and may place more than one number by each description.

Accelerating (speeding up) ____________

Decelerating (slowing down) ____________

Banked curve ____________

Centripetal force ____________

Weightless zone ____________

Greatest speed ____________

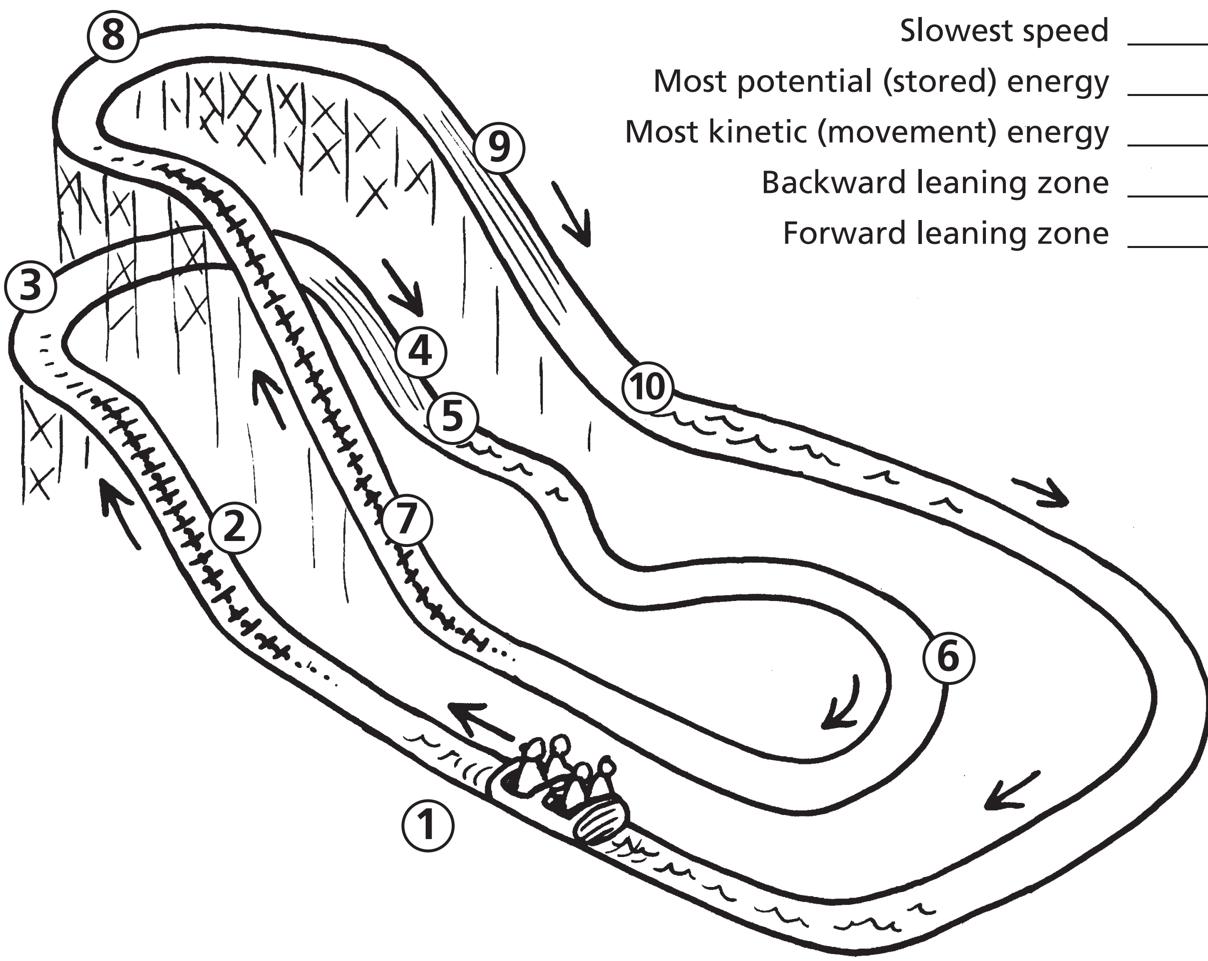
Slowest speed ____________

Most potential (stored) energy ____________

Most kinetic (movement) energy ____________

Backward leaning zone ____________

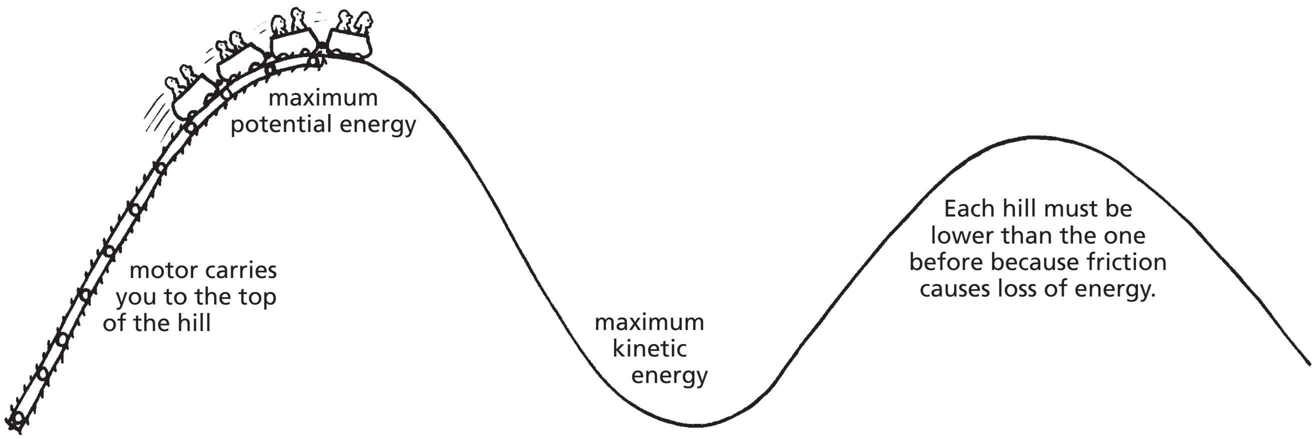
Forward leaning zone ____________



The Explanation

The Coaster, Kettle Creek Mine and Flume all work because of two things. The first, *gravity*, was mentioned earlier. The second is the *Law of Conservation of Energy* which was mentioned in the activity on silides in the playground unit (Pre-Visit Activity 2 – The Slide). A roller coaster is similar to a slide except it's longer and you ride in a train rather than on the seat of your pants. The wheels reduce friction. It's easier to roll something than it is to slide it. Even prehistoric cave people knew that.

Here is a diagram of a roller coaster that has been straightened out.



With a roller coaster, you don't have to climb to the top of the first hill like you do on a slide. A motor does the work. At the top of the hill you have potential energy, stored because gravity wants to pull you down to the ground. That potential energy turns into kinetic energy as gravity pulls you down the first hill. The farther you go down the hill, the more potential energy has changed into kinetic energy. You feel the kinetic energy as speed. At the bottom of the hill you will be going fastest. As you go up the next hill, your kinetic energy will change back into potential energy. The higher you go, the more energy is changed. This conversion of kinetic energy to potential energy will continue as you go up and down hills for the rest of the ride. Your total energy will not increase or decrease, it will just change from one form to another.

Some of the kinetic energy will also be changed into *friction*. Wind resistance, the rolling of the wheels, etc. also use some of the energy. Coaster designers know that friction in the coaster ride uses energy. To make sure that there is enough kinetic energy to reach the starting point for the ride, each successive hill on the ride has to be lower than the first hill.

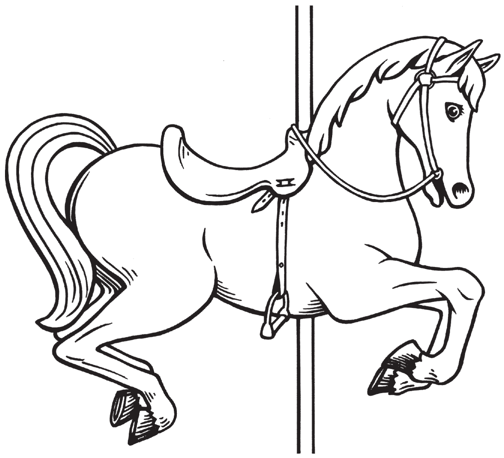
The force that you feel when you make a turn is called *centripetal force*. When you make a turn, it feels like you are being forced to the outside of the car. Coaster designers take this into account when they bank the turns. By tilting the track and thereby the car, you are forced down into your seat rather than being thrown out of the car. You can learn more about centripetal force in the explanation section after the Gladiator ride.

Activity 6

Name: ______________________________

Date: ______________________________

MERRY-GO-ROUND



The Law of Conservation of Energy, as mentioned in the section on the roller coaster, governs and helps explain the operation of many at amusement parks. Another important set of laws are Newton's *Three Laws of Motion*. These Laws are especially important on the centripetal force rides such as the Merry-Go-Round and other rides that go in a circle. Centripetal force causes you to feel like you are being thrown to the side of a ride as it moves in a circle.

As you try the centripetal force rides, again try to experience the ride as if it were a science experiment. Feel the forces acting on your body and your location on the ride where the forces occur.

The Merry-Go-Round

1. As the ride turns, is your body thrown slightly inwards or outwards?

____

____

2. Do all the animals on the ride go up and down at the same time?

____

____

3. Does the ride animal next to you move in the same or opposite direction as you do?

____

____

4. Do you feel slightly lighter or slightly heavier when your horse is moving up? How about when it is moving down?

____

____

5. Do the ride animals on the inside or the outside go faster around the circle?

____

____

____

6. Look at the animals in the ride. What did the artist do to make them appealing to children? Sketch your favorite.

7. What simple machines (i.e. levers, wheels & axis, inclined planes, etc.) are there in this ride?

8. How many g's does this ride create? (Optional: Need to use cell phone accelerometer)

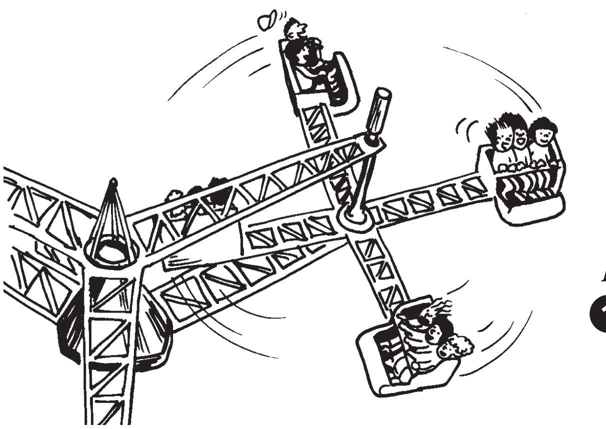
9. How does the ride simulate the galloping motion of a horse?

Activity 7

SCRAMBLER

Name: ____________________

Date: ____________________



This is a more complex ride based on the physics of centripetal force. It involves two rotating axes (plural of axis).

Procedure and Questions

1. Before you get on the ride, watch it for a few minutes. Can you trace the path that the seats take during the ride? What effect does the double rotation have on the path you take?

2. As you ride, are you moving faster when you are nearer or farther from the ride's center? (i.e. in the inside seat or the outside seat?)

3. Does the ride push you inward or outward as you make the turns?

4. Are the forces on the ride always the same? Explain why or why not?

5. Are there times when you feel like the ride is moving in a straight line? Explain how that is possible.

❻ Draw a diagram of the path you take while on the ride.

❼ What g reading do you get on the ride? (Optional: Need to use cell phone accelerometer)

____

____

Extension Activity

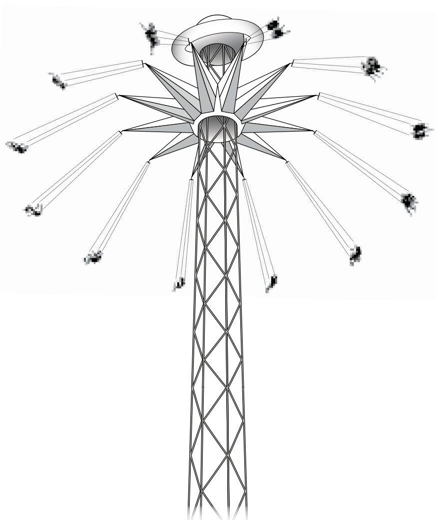
What is the path that you actually take on a ride like the scrambler that has two axes of rotation? To find out, obtain a spirograph®. Find two circles with approximately the same proportions as the amusement ride and draw the figure. What shape do you get?

Activity 8

Name: ____________________

Date: ____________________

ATMOSFEAR



The Atmosfear, similar to the Wave Swinger, offers an extreme ride experience using centrifugal force, only much higher up! Observe it or ride it and answer these questions.

Procedure and Questions

1. Does an empty swing or one with someone in it ride higher? Why?

2. How does it feel as the ride increases speed?

3. What happens to the seats as the ride increases in speed?

4. What forces act on you during the ride?
   Draw a diagram of these forces.

5. What g reading do you get on the ride?
   (Optional: Need to use cell phone accelerometer)

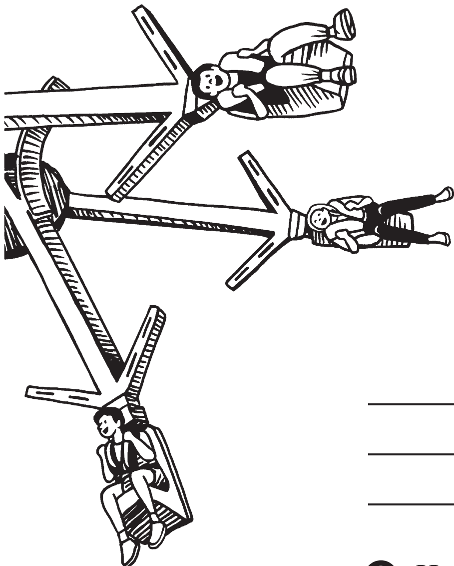
6. How is this ride similar to and different than the Wave Swinger?
   How do the differences affect the thrill of the ride?

Activity 9

SKYBENDER

Name: ____________________

Date: ____________________



Welcome to Playlands newest ride, Skybender! Like previous rides you have experienced, it uses centripetal force, but adds a twist. The arms of Skybender extend out to create a unique sensation when experiencing the ride. Observe Skybender or ride it and answer the following questions.

Questions

1. Describe the sensations that you felt on the ride, including what happened as the ride increased in speed.

2. How did the arms extending out enhance the feeling on the ride?

3. Where do you feel the heaviest and where do you feel the lightest?

4. Do you feel you are moving faster when the arms are extended? Explain.

5. Describe the forces you felt on the ride. Are the forces always the same or do they change during the ride?

Activity 10

Break Dance

Name: ______________________________

Date: ______________________________

This ride uses unusual centripetal force.

Procedure and Questions

Ride the Break Dance and answer the following questions.

1. Does the large wheel at the centre of this ride turn clockwise (move to the left) or counter-clockwise (move to the right)?

____

2. What direction(s) does the small wheel, that holds the ride cars, turn? If it turns different directions, keep track of the direction of the turns for one full ride. For example, record how many times it turns in each direction.

Spins left:________ Doesn't spin:________ Spins right:________

3. Describe the forces you felt while on the ride. Are the forces always the same or do they change during the ride? If the forces change on the ride, where do they change?

____

____

____

____

____

4. How many g's does this ride create? (Optional: Need to use cell phone accelerometer) Are the g's constant or do they change? Explain.

____

____

____

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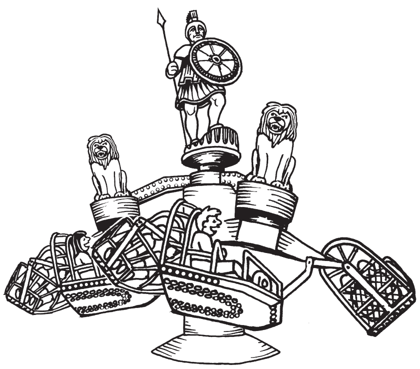
Activity 11

GLADIATOR

Name: ______________________________

Date: ______________________________



This ride uses unusual centripetal force.

Procedure and Questions

Ride the Gladiator and answer the following questions.

1. Does the large wheel at the centre of this ride turn clockwise (move to the left) or counter-clockwise (move to the right)? What other motion does the ride have?

2. Describe the forces you felt while on the ride. Are the forces always the same or do they change during the ride? If the forces change on the ride, where do they change?

3. Concentrate your attention on one rider during the ride and follow this single rider's path for at least one full revolution of the ride. Draw a diagram of the path he took for that single revolution. (Your diagram should be what you would see if you watched the rider's path while looking down on the ride from above.)

4. How many g's does this ride create? (Optional: Need to use cell phone accelerometer) Are the g's constant or do they change? Explain.

The Explanation

Newton's *Three Laws of Motion* play an important part in the operation of many rides at an amusement park, especially those that move in a circle. Simply stated, Newton's Laws are as follows:

1. An object moving at a constant speed in a straight line will stay moving in that straight line unless acted on by an outside force.
2. If an object is moved by a force, it will move in the direction of that force with an acceleration proportional to that force. (Acceleration means the object will change speed or direction).
3. For every action, there is an equal and opposite reaction.

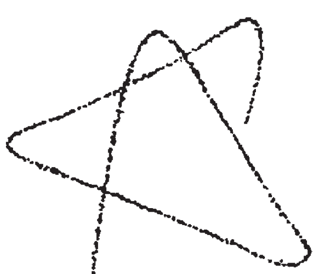
These laws explain why centripetal force is created.

Centripetal Force Rides

One force that a person can feel on certain rides, ranging from the Merry-Go-Round to the Gladiator, is the result of the *centripetal force* the ride creates. Centripetal force is created because the ride moves in a circle.

On rides like the Music Express, the riders move in a simple circle. At any instant on the ride, the rider's body will obey Newton's Three Laws of Motion by trying to move in a straight line (Newton's First Law) even though they are moving in a circle. However, because the ride seats are attached to a central pivot point, the seats exert a force in that direction (Newton's Second Law). That force pushes you toward the centre of the ride, relative to the straight line you wanted to take. You feel as though you are being forced outward in the seat when you are actually pushed toward the center of the ride. Basically, you are trying to move in a straight line and the ride seat curves away from you, toward the centre of the ride. You sense you are being pushed outward on the ride. At the same time, you exert an equal and opposite force on the ride seat (Newton's Third Law).

Rides like the Scrambler, the Break Dance, and the Gladiator move in two circles at the same time. Each ride rotates first around a central pivot point with primary rotation. The ride also has secondary rotation around the pivot point that holds the ride cars. The combination of these two rotations is difficult to follow from the outside of the ride. However, the result of these two rotations cause the rider to speed up in a line, then slow down to change directions, creating a star shaped path as shown below. The exact shape of the star depends on the ride. You can draw a similar shape with a toy called a Spirograph that shows the shapes you can get with two kinds of rotation at the same time.



Activity 12

PIRATE SHIP

Name: ______________________

Date: ______________________

This is another ride that uses centripetal force and conservation of energy.

Procedure and Questions

1. Challenge: Estimate the vertical distance from the top to the bottom of the ride.

____

____

2. How long does it take for this ride to make one complete swing?

____

3. What motion does this ride remind you of?

____

____

4. Identify all the simple machines which make up this ride.

____

____

5. When does the ride seem to be speeding up (accelerating)?

____

6. When does the ride seem to be slowing down (decelerating)?

____

7. Where is the potential (stored) energy the most on this ride?
Where is the potential energy the least?

____

____

____

8. Where is the kinetic (movement) energy the most on this ride?
Where is the kinetic energy the least?

____

____

____

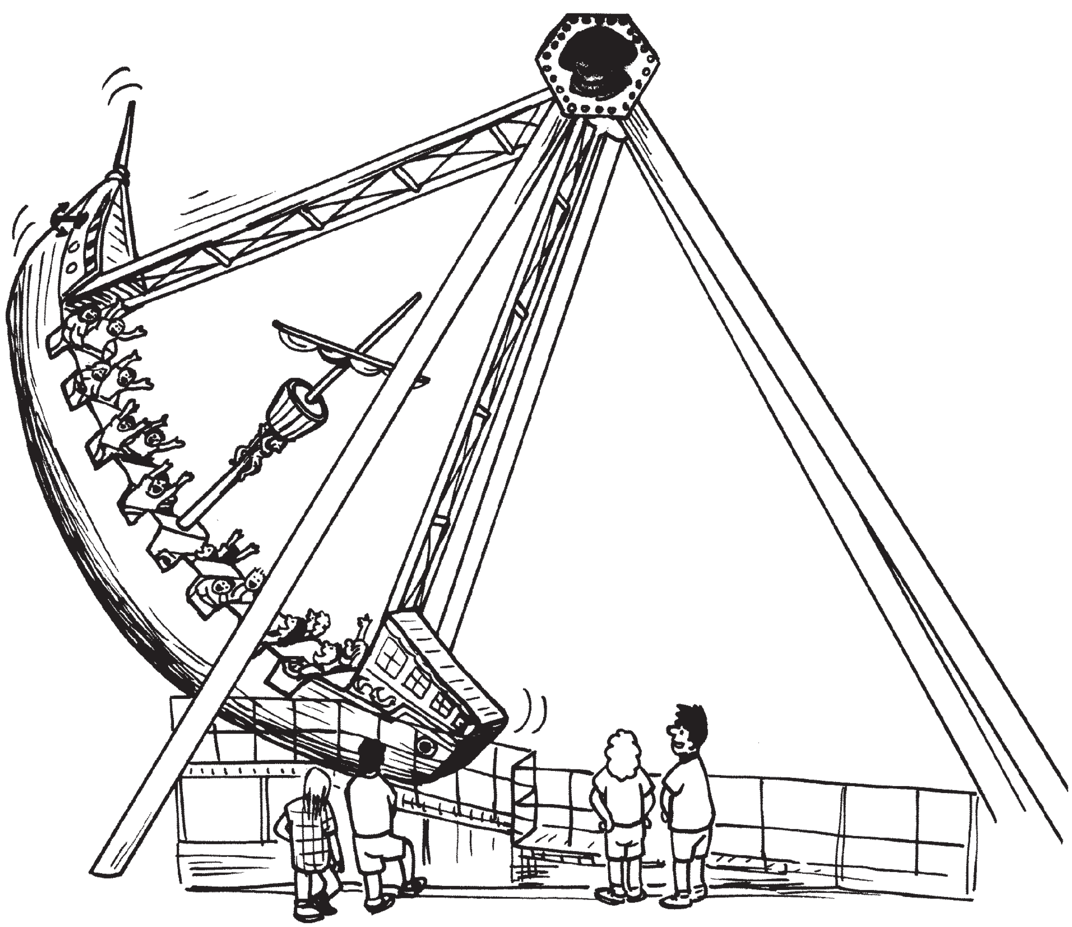
____

9 What forces are acting on you during this ride? Where are the forces greatest? Where are they the least?

10 Compare the forces you feel during the ride while sitting in these seats. How are they the same? How are they different?

a. Sit at either end of the Pirate Ship for one full ride.

b. Sit in the middle of the Pirate Ship for one full ride.

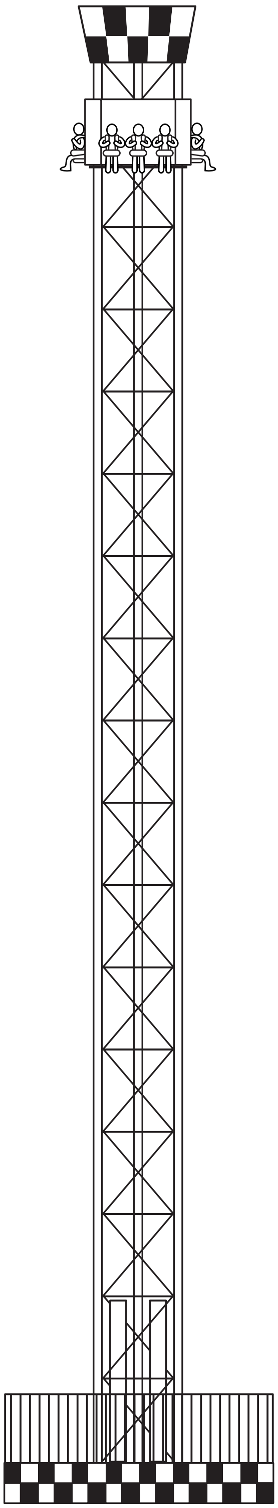


Activity 13

HELLEVATOR

Name: ______________________________

Date: ______________________________



Although you may not know it, the Hellevator is a similar ride to the Coaster. They both use gravity to give riders a thrill. In both, the amusement park charges for the energy it uses to take you to the highest point of the ride and gravity gives you the rest of the ride for free. Of course, the park also ensures that you get safely back to the starting point.

Procedure and Questions

As you ride the Hellevator, try to experience the ride as you would any other science experiment. You are the experiment. Note when you feel increased or decreased forces. They may push you down into your seat or lift you off it. After you have finished the ride, try to answer the following questions.

1. How do you feel as you wait for the ride to start? Can you think of a reason why you might feel this way?

____

____

____

2. How do you feel as you are moving upward on the ride?

____

____

3. How do you feel when you are at the highest point of the ride?

____

____

4. How do you feel as you are moving downward from the highest point of the ride?

____

____

5. Do you travel the fastest at the start of the upward motion or at the end? Can you think of a reason why?

____

____

____

6 As you move upward do you feel heavier or lighter than normal? Why?

7 As you move downward do you feel heavier or lighter than normal? Why?

8 Where on the ride do you have the most kinetic (movement) energy?

9 Where on the ride do you have the most potential (stored) energy?

10 Where does this ride simulate the forces an astronaut would feel during a space flight? What effect would these forces have on the human body during take off and a long weightless space flight?

The Explanation

The Hellevator works because of two things. The first, *gravity*, was mentioned earlier. The second is the *Law of Conservation of Energy* which was mentioned in the activity on Slides in the Unit on Playground Rides. The Hellevator ride gives you a lot of kinetic energy as you are shot up into the air. This kinetic energy is converted into potential energy as you move higher and higher. When you reach the highest point of the ride, all of the kinetic energy has been stored as potential energy. At the highest point you have potential energy, stored because gravity wants to pull you down to the ground. That potential energy turns into kinetic energy as gravity pulls the ride (and you) downward. The further you go down, the more potential energy has changed into kinetic energy. You feel the kinetic energy as speed. At the bottom of the ride some of your kinetic energy will change back into potential energy in the form of compressed air that shoots you up again and the energy conversion repeats itself. This conversion of kinetic energy to potential energy and back again will continue as you go up and down for the rest of the ride. Your total energy will not increase or decrease, it will just change from one form to the other.

Activity 14

Hell's Gate

Name: ____________________

Date: ____________________

The *Law of Conservation of Energy*, as mentioned in the sections on the Coaster and the Hellevator, governs and helps explain the operation of many amusement park rides. Another important set of laws are Newton's Three Laws of Motion. These laws are especially important on the centripetal force rides such as the Merry-Go-Round, the Scrambler, the Gladiator, and other rides that go in a circle. Centripetal force causes you to feel forces as you move in a circle.

As you try the centripetal force rides, again try to experience the ride as if it were a science experiment. Feel the forces acting on your body and notice which parts of the ride where the forces occur.

Procedure and Questions

1. As the ride first starts, describe the forces you feel.

2. Do you feel any different when you travel upward compared to when you travel downward? Explain.

3. Where on the ride do you feel the most forces? Explain why you think the forces are the greatest at that time.

4. Where on the ride do you feel the least forces? Explain why you think the forces are the least at that time.

5. Does it make any difference if you sit at the front or the back of the ride? Why?

6. How many g's does the ride create? Are they always the same during the ride? (Optional: Need to use cell phone accelerometer)

7. Where are the g's the greatest? Where are they the least? Why?

8. What simple machines can you find on this ride?

Activity 15

ROCK-N-CARS

Name: ______________________________

Date: ______________________________

The Rock-N-Cars are a fun place to learn how *not* to drive. Some people try to avoid being hit, while others want to be crashed into. Some drive around sedately, while others run into everything. In this activity we will study the crashes!

Procedure and Questions

As you are on the ride, try to answer the following questions.

1. Before you get on the ride, look at the cars. How are they different than a normal car? Why do you think they are different?

____

____

____

2. When you first start up your car, which way are you pushed?

____

3. When your car stops, which way are you thrown?

____

4. If you are in a head-on crash, which way are you thrown? Why?

____

____

____

5. When you are hit from behind by another car, which way are you thrown? Why?

____

____

____

6. What happens when you are hit from the side?

____

____

____

7. When you run into someone else's car, when do you feel the greatest force?

   _____ when you are moving and they are stopped

   _____ when you are moving and they are moving away from you

   _____ when you are moving and they are moving towards you

   Why?

8. What form of energy do the cars use to make them go? How do you know?

9. Use your discoveries to explain why it is important to wear a shoulder harness when you are riding in a car.

The Explanation

The bumper cars obey Newton's *Three Laws of Motion*. According to his first law, objects like people in bumper cars, want to keep traveling in the direction that they are going. This means that when you are riding in your car and your car hits someone else's car and your car stops, your body obeys Newton's first law and keep going forward. Similarly, when you are stopped and someone else hits your car from behind, moving it forward, your body tries to remain stopped and it feels like you are being thrown backwards.

The second principle involved in bumper cars is *impulse and momentum*. This relates to Newton's second Law and it simply means that when you crash into another car that is stopped, some of your momentum will be transferred to the other car from yours. That's why the other car moves. For safety reasons, it is important to transfer the energy from your car to the other one slowly. Rubber bumpers that surround the cars help do this. They cause the collision between the two cars to take more time and this makes the transfer of energy go more slowly. Collisions are less likely to hurt anyone, including the cars.

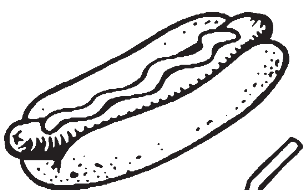
Activity 16

Nutrition/ Consumer Page

Name: ______________________________

Date: ______________________________

Observe the food stalls and their contents closely and answer the following questions (you may even want to purchase some "edibles" for further study).



1. How many millilitres of fluid are in a regular-sized drink? ______________________________
2. How much does this size drink cost? ______________________________
3. How would this price compare to a store-bought drink? Is it a good buy?
4. Is the flavour of a drink at Playland different than a similar canned drink bought in a store?
5. Estimate the number of popcorn kernels in a bag of popcorn. How did you arrive at your estimate?
6. What would you buy at Playland if you were:
   a. on a restricted calorie diet?
   b. on a low-salt diet?
   c. diabetic?
   d. on a low-fat diet?
7. If you could open a *nutritious* food stand at Playland, list several food items that you would sell.
8. If you had an opportunity to make one suggestion to the food sellers at Playland, what would it be?

Post-Visit Activities

Classroom Unit

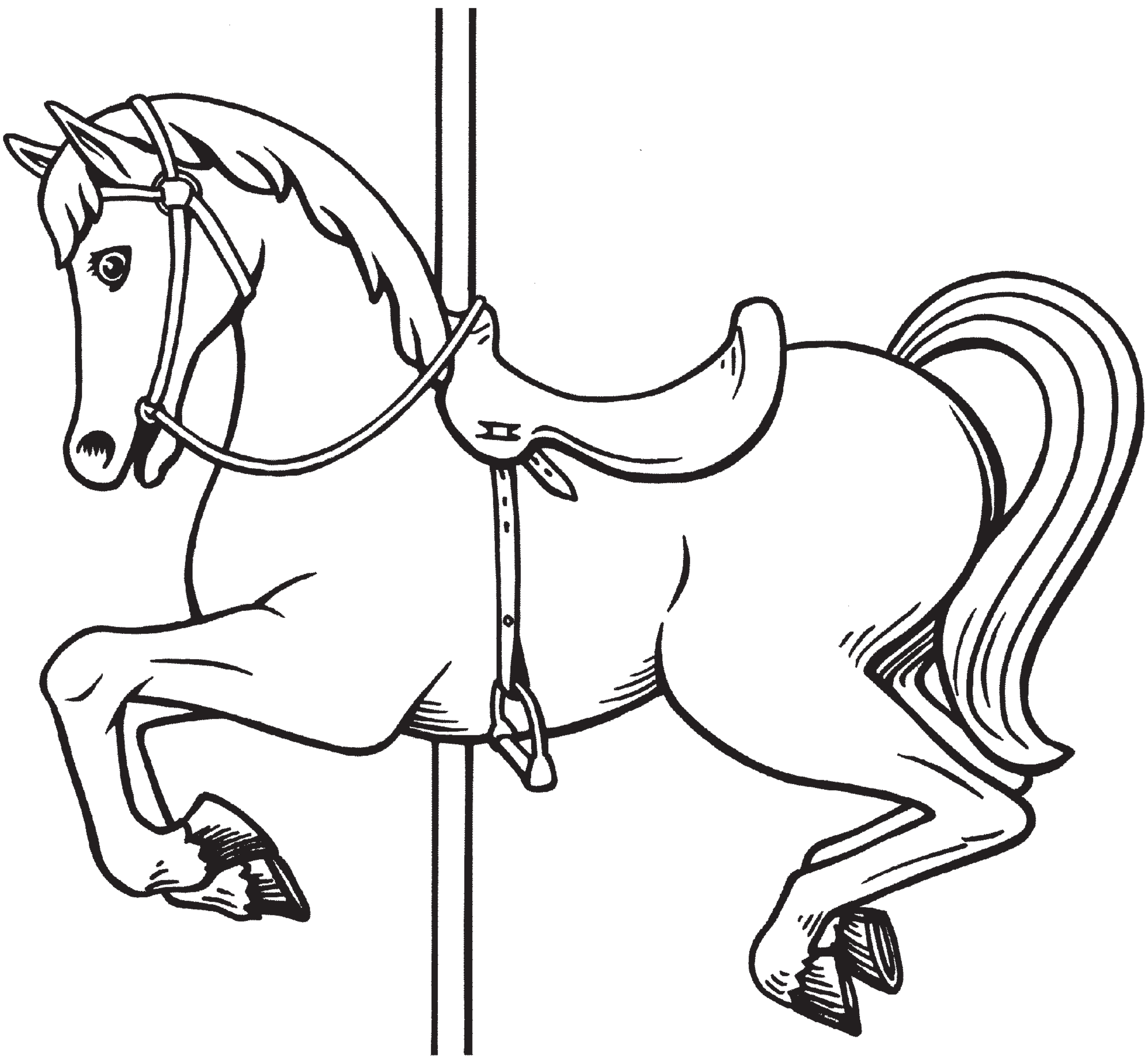
Activity 1

Merry-Go-Round Horses

Name: ____

Date: ____

The horses and other animals that are on the Merry-Go-Round were originally designed by the best artists of the day. They used beautiful colours to paint the animals and jewels to decorate them. Use your imagination to decorate the Merry-Go-Round horse below, or create your own animal that you would put on the Merry-Go-Round.



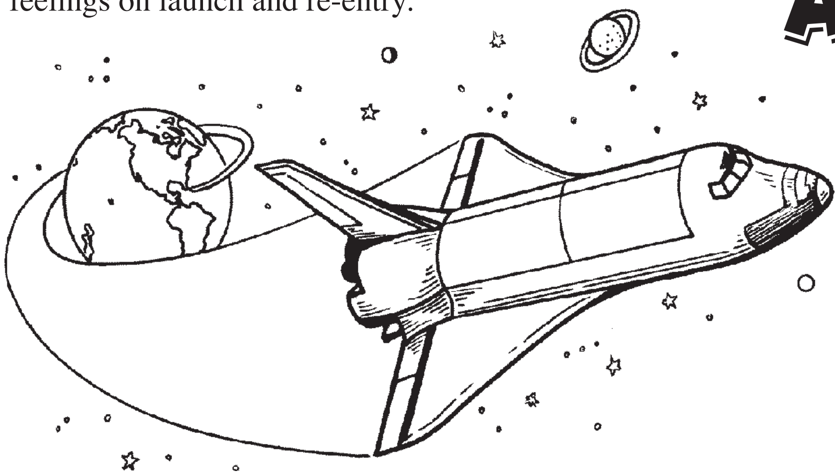
Name: ________________________________

Date: ________________________________

Activity 2

Amusement Park Rides and Space Travel

In your visit to Playland, you have experienced many of the forces that are present in a space shuttle flight. Write a diary from the point of view of a shuttle astronaut describing your feelings on launch and re-entry.



Name: ________________________________

Date: ________________________________

Activity 3

Design-a-Ride

Now that you have experienced many amusement park rides, see if you can improve on the park by designing your own ride.

1. Amusement park rides are designed to give the illusion of danger and speed. Which rides seem to give the greatest illusion of danger and speed? Use the *Physiology of the Rides* sheet (On-Site Activity 2) to see which ride effected you most.

2. Based on your observations at the amusement park, design a new ride for the park. It should give the illusion of danger and speed. Draw a diagram of your design on a separate sheet of paper. You may build a model if you wish. Give your ride an exciting name. Be prepared to present it to the class in a way which will make us want to ride on it!

Activity 4

EVALUATION

Name: ______________________________

Date: ______________________________

List at least three (3) surprising (unexpected) things that you discovered during your visit to the amusement park.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

My most favourite activity was ______________________________ because

____

My least favourite activity was______________________________because

____

Give yourself three (3) compliments about the way you participated in the field trip to Playland.

1. ______________________________
2. ______________________________
3. ______________________________

Think of three (3) questions that you would like to answer on your next trip to Playland.

1. ______________________________

   ____
2. ______________________________

   ____
3. ______________________________

   ____

Name: ______________________________ **_Activity 5_**

Date: ______________________________

First Nations Science

We are taught and learn a Euro-centric view of science. That makes sense because in North America we were settled mainly by Europeans. But there are other points of view that are often overlooked. In this activity you will be given a chance to explore other points of view and contributions to science by other cultures.To make it easier we will divide it into sections: ***transportation***, ***housing***, ***food and agriculture***, and others like ***astronomy***, ***medicine***, ***fishing***, ***sustainability***, and ***environment***.

So, here we go...

Transportation

There are many surfaces we have to travel over: rivers, oceans, lakes, land, mountains, etc. Start with water. Two ways to travel on water are rowboat and canoe. Compare them. Research their use and development. Which is better for Canadian rivers, lakes, rapids, northern waters and oceans? Be prepared to present your findings to your class.

Next look at land travel. What are ways to move over land, including both flat land and mountains? Again be prepared to present your findings to your class.

Food and Agriculture

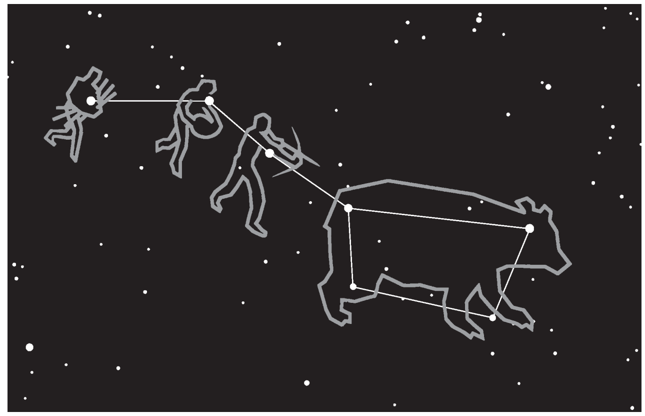
The origin of the foods we eat come from many places. Select a food and research it. Focus on its origin and importance to our diet. Which foods have a First Nations origin and which came from other countries?

Astronomy

When humans developed into a farming society, it became important to know the yearly cycle and the seasons. There are examples of this around the world, from Stonehenge in England to structures in Mexico like Tulum and Chichen Itza. There are also several First

Nations examples. For this topic, research one example of how we measure a year. Look at both past examples and modern ones.

Another thing people have done is look at the stars. They notice shapes of images that some stars seem to make, called constellations. Research one constellation. Draw a picture of the image made by the stars and write about the legend or story that goes with it. Do the First Nations people have a different name and story? Is the name or story different in another country? Finally, draw your own constellation of 3 to 5 stars. Draw the image they make and write a story about the image. Be prepared to tell the class what you learned.

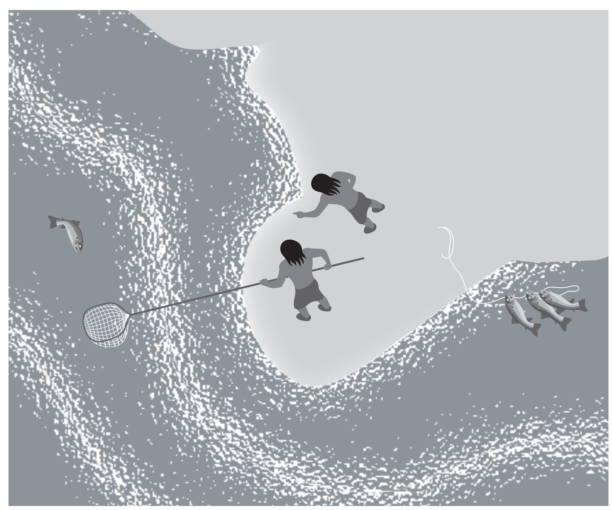


Medicine

Medicines and health remedies come from many places. For this topic, research the history of one medicine. Be prepared to present your findings to the class. Which medicines have a First Nations origin?

Fishing

Besides plants, fish have long been a part of the human diet. Research one kind of food fish. Where does it live and how is it caught? Are these methods sustainable? Finally, has the fish been important for First Nations?



Summary

Write three things you have learned in this activity that you didn't know before. What is one question you still have about First Nations science? How could you answer your question? Be prepared to share this with the class.