Amusement Park
PHYSICS

Playland
At the PNE
Vancouver

PHYSICS and SCIENCE DAY 2019

Chemistry 11/12

These educational materials were created by *Science Plus*.
Illustrations, typesetting and layout by
Robert Browne Graphics.

For more information on Amusement Park Science
contact Jim Wiese at jim.wiese@shaw.ca

Vancouver, B.C., Canada
April 2019

Amusement Park Physics

and the new Secondary School Curriculum

Over the past few 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. In addition, students are asked to analyse not only the data they collect, but also the process that was used to collect the data.

The curriculum for Science has changed. Although forces are not directly in the curriculum, inquiry and investigation are at the forefront. ***Amusement Park Physics*** can now be applied to any number of classes as they all include an inquiry / investigative component. Teachers are able to adapt or enhance the curriculum packages currently supplied by ***Amusement Park Physics*** as they see fit. This gives you, as an educator, tremendous flexibility in terms of how you and your class spend your time at Playland. You could focus on one ride and do an in-depth study or perhaps investigate similar rides and compare them.

In addition, classes could choose to investigate / discuss Newton's three (3) laws and then attend ***Amusement Park Physics*** to apply them. This initial investigation could be done as a class or individually as a project.

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 ***Amusement Park Physics***.

Science 8: "Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest"

"Collaboratively plan a range of investigation types, including field work and experiments, to answer their questions or solve problems they have identified"

'Observe, measure and record data (qualitative and quantitative), using equipment, including digital technologies, with accuracy and precision"

Science 9: "Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)"

"Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data"

Amusement Park Physics is designed to get 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.

Amusement Park Physics

It's hard to believe that *Amusement Park Physics* at Playland is in its ***32nd*** year. The project was started in 1988 with our senior Physics students and was expanded in 1990 with the addition of the Grade 9 program. Later we added an elementary school version *The Science of Fun*. In 2008 we added a French Version for elementary schools called *La Science du Plaisir* and a curriculum for Grade 8 Science and Grade 10 Science. In 2011 we added a version for Biology 12, and in 2012 we added a version for students in Chemistry 11 and 12. A special thanks goes to Steve Simms and Mike Eckert at Clayton Heights Secondary for helping with the Chemistry module. In 2016 we added activity sheets for the Beast and the Haunted House. Rather than have them for specific grades, we have questions at the Bronze level, Silver level, and the Gold level. Teachers can choose the level they want their students to do.

The purpose of *Amusement Park Physics* is to provide students with practice in applying to real situations some of the concepts learned in the classroom study of mechanics. It has been an enjoyable conclusion to that aspect of the curriculum and can assist in preparation for final examinations. With the involvement of students from other schools and other districts, the project serves to bring together teachers and students to share their common interest in science. We welcome your participation in either or both events.

Due to the success of *Amusement Park Physics*, we have spread the events to five days in the spring and one day in the fall. You may choose any of these days but we will be limiting numbers to 2500 students per day. These will be filled on a first come basis. This should help eliminate any lineup at the rides to let students make measurements multiple times on each ride.

There is a curriculum package for each grade level – Science 8, Science 10, Physics 11/12, Chemistry 11/12 and Biology 12. You need to only download and print the version that you need. Please feel free to adapt any materials to better suit your students.

I'd like to thank all those involved in *Amusement Park Physics 2019*: Michelle Pattison, Steven Simms, Jennifer Campbell, Peter Male and the staff of the Pacific National Exhibition and Playland for their support. The work and dedication of all these people make *Amusement Park Physics 2019* possible.

Jim Wiese

Table of Contents

**Note: Activities marked with an asterisk will start at Playland but will be completed in your school's science laboratory due to the need for more specialized equipment and chemicals.*

Introduction

The accompanying materials have been divided into several sections: one with information concerning collecting data and making measurements at the amusement park and one with worksheets for Chemistry 11/12. The worksheets are general in nature and can be used with either Chemistry 11 or Chemistry 12 students. They are designed as laboratory investigations in which some can be completed at the amusement park and others where the investigation is started at the park and completed in the school science laboratory.

We try to have consistency between schools' implementation by asking each teacher to remind their students that this is an educational event. A rule of thumb is to have each student or group of students study 3 or 4 of the activities. That is a reasonable expectation for them and keeps them on task during the day. Schools that are wishing to use this event as a reward for "hard work" through the year and that do not intend to have their students working on these materials are asked to make arrangements to visit Playland at another time.

This year's curriculum reflects the different demands that are placed on students in Chemistry 11/12. We have sought to align the worksheets with the Provincial Ministry Chemistry 11/12 guidelines and their prescribed learning outcomes, as well as the Chemistry 12 Provincial Examination.

Students *must* be using the following materials throughout the day:

1. Packet of activities
2. Pencil
3. Timing devices (digital watches with stopwatch mode are helpful)
4. Plastic bags (zip-lock bags are best)
5. Calculator
6. Chemicals as indicated (optional – laboratory activities can be completed in the school laboratory as well)

Critical Safety Note

Any instrument or devices carried on rides by students should be made of plastic and provided with some kind of wrist tether made of heavy string, so that if dropped, the instrument will not break or fall off the ride and cause injury or damage.

Sample Timetable

Please adapt to fit your circumstances

Time Schedule

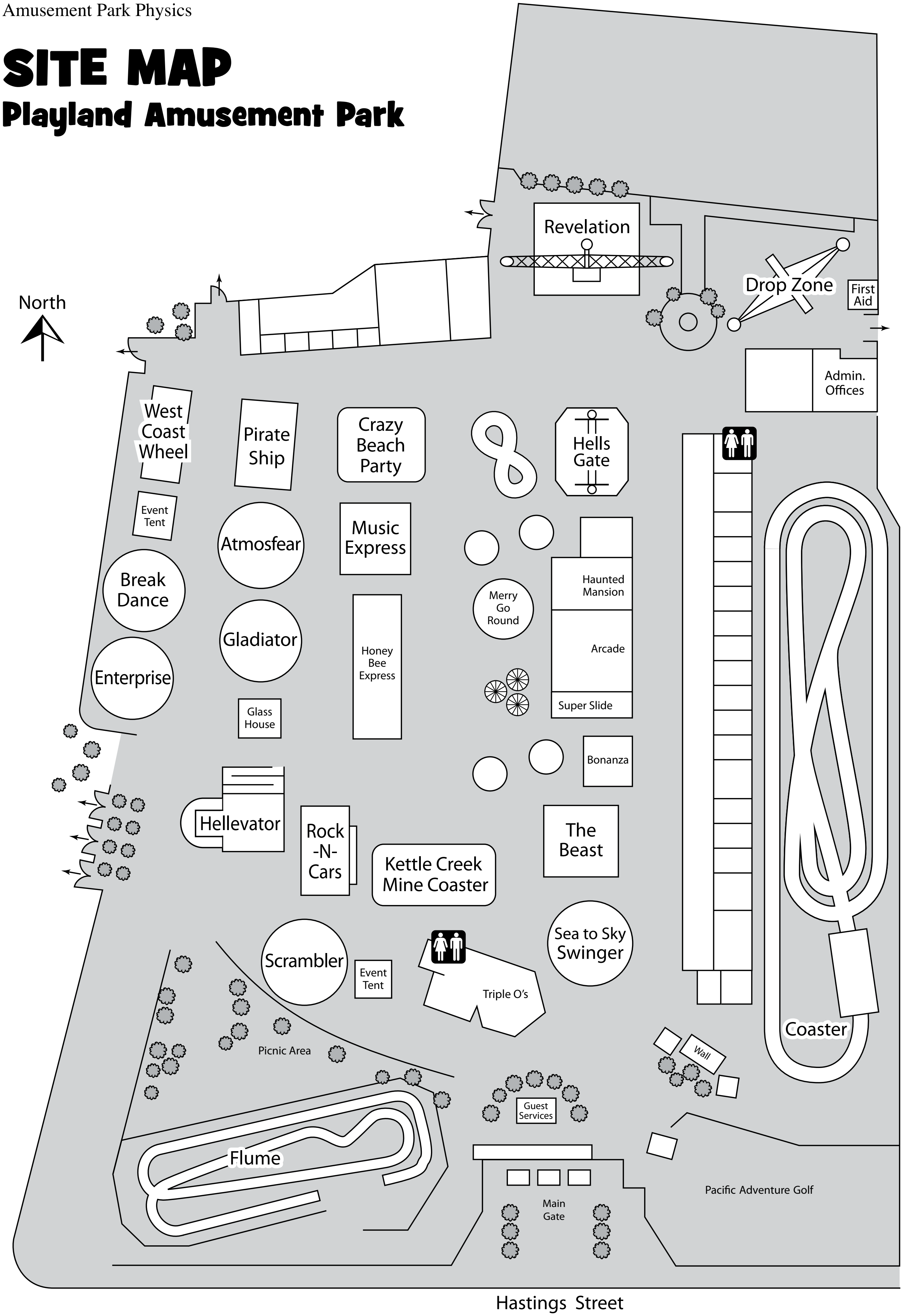
8:30	Buses leave school
9:15	Arrive at Playland
9:30	Enter Playland Amphitheatre for opening session
9:45 – 10:00	Opening Presentation at Playland Amphitheatre
10:00	Gates to Playland open to admit students
10:00 – 2:00	Carry out pre-planned activities involving observations and measurements of selected aspects of the rides. Arrange a meeting time with your teacher for problems that arise or questions you have.
2:00	Playland closes and event ends
2:15	Board buses for return to school
3:00	Buses arrive back at school

Things to Bring:

- ❏ BRING A LUNCH (You will <u>NOT</u> be allowed to leave the park for lunch)
- ❏ BRING A PENCIL
- ❏ Bring a calculator if you wish
- ❏ Don't forget to bring this assignment package!
- ❏ Try to bring a watch with a second hand or digital seconds to record times on the rides. A digital watch with a stopwatch mode works very well.
- ❏ Try to return all equipment (dropper bottles, chemicals, etc.) to your teacher when you are not using them during the day. You'll be sharing them with other students and we need to make sure everyone gets a chance to use them.

SITE MAP

Playland Amusement Park



Section A
Collecting Data and Making Measurements

Mass

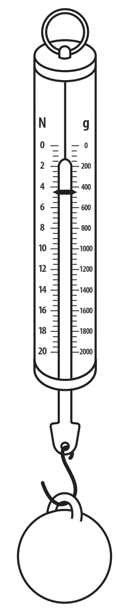
Mass is a quality of all matter. Matter is defined as anything that has mass and takes up space. The units for measuring mass in chemistry are usually grams (g) or kilograms (kg). There are several ways to determine the mass of an object. In a laboratory setting you usually use either a balance scale or an electronic scale. Both are accurate. However, they both have limitations when working in the field. When working away from the laboratory, you can use a spring scale to measure mass. While not always as accurate, they can give a good approximation and will allow you to carry out chemical tests.

Using a spring scale

A spring scale actually measures the force of gravity on an object and gives its weight. But since weight and mass are proportional most scientific spring scales have measurements for both grams (the unit for mass) and Newtons (the unit for force). Each spring scale is designed to work for a specific range of weights.

A spring scale is easy to use. You just hang or clip the unknown mass to the end of the spring scale and read the weight, mass or force.

spring scale



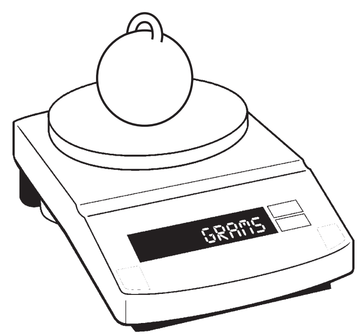
Calibrating a spring scale

You can test the accuracy of a spring scale by comparing its readings to a known mass.

Procedure

1. Collect several spring scales with difference measuring ranges.
   Get either a balance scale or an electronic scale.
2. Obtain a set of known masses.
3. Measure several known masses on both the spring scale and the balance scale or electronic scale by hanging the known mass from the spring scale and reading the results.
4. Compare the results. What did you discover?

electronic scale

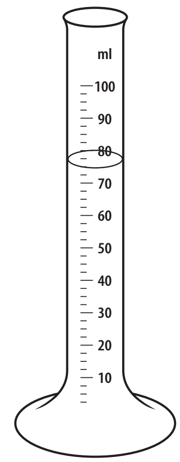


	Known Mass Value (g)	Spring Scale Value (g)	Balance Scale or Electronic Scale Value (g)
Mass 1			
Mass 2			
Mass 3			

Volume

The second part of the definition of matter involves taking up space. The amount of space matter takes up is its volume. The units for measuring volume in chemistry are liters (l) or milliliters (ml). An easy way to measure the volume of a liquid is with a graduate cylinder, made of either Pyrex glass or polypropylene plastic. To measure the volume of a liquid, place it in a graduated cylinder and read the value off the known measurement markings on the side of the cylinder.

graduated cylinder

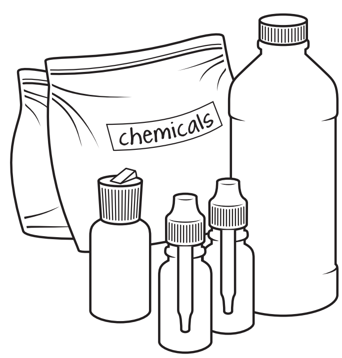


Portable Chemistry Kit

You will need to create a portable chemistry kit to complete some of the activities in this curriculum package. The list of items necessary to complete the activity will be given in the materials section. For some of the activities where more specific laboratory equipment (such as Bunsen burners, etc.) are needed, we will suggest students start the activity at Playland and complete it when you're back at school.

Plastic Containers

Since you will be doing much of your material collection and chemical analysis in the field, it's important that you use materials that don't break. For that reason, we suggest you only use plastic containers and plastic or other non-breakable materials while doing the activities. If you want more accurate readings, you can collect the samples while at Playland in plastic containers and return them to your school laboratory for further analysis.



One way to perform some of the experiments in the activities is to do them in zip-lock plastic bags. These are good containers for qualitative analysis where you are looking for a colour change to indicate the presence of a specific chemical. Other simple containers include plastic bottles with lids and polypropylene dropper bottles.

Chemicals

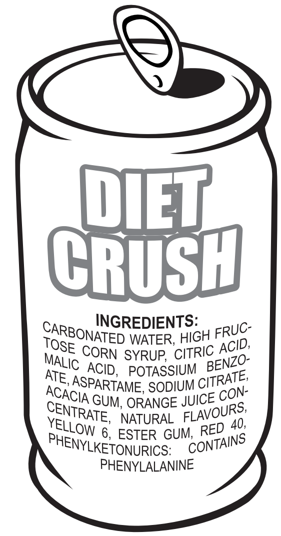
There may be specific chemicals that you will have to bring from your school in order to perform some of the experiments. We suggest that you only bring enough of the chemicals as necessary and carry them in small plastic containers or dropper bottles.

Section B
Chemistry 11/12 Worksheets

**Note: Activities marked with an asterisk will start at Playland but will be completed in your school's science laboratory due to the need for more specialized equipment and chemicals.*

Food Chemistry

A chef thinks of cooking in terms of the art of putting ingredients together to form a new recipe. But there is more to it than that. There is also the chemistry involved when you mix the ingredients together and increase their temperature by cooking them either on the top of the stove or in the oven. The food reactants undergo changes to form new food products. The rules of chemistry don't change just because you're not in a laboratory setting.

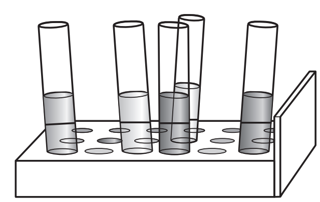


Our food is made up of chemicals. Proteins, carbohydrates and fats are particular types of molecules and amino acids that combine in predictable ways to make up a food. Taste, texture and appearance can be altered by the addition of substitute of chemical food components, like salt, artificial flavours and colours, added sugar, etc. Just check out the ingredient labels of some of the food you eat and you see a cocktail of chemicals that most people are unaware of.

The discipline of food chemistry is concerned with the chemical and microbiological processes of food. There are many different areas of specializations, including food processing, packaging, distribution and storage.

Components of Food

There are three main components studied in food chemistry – ***carbohydrates***, which include simple ones like sugar and complex ones like starch and fiber; ***lipids***, including fats, oils and cholesterol, and ***proteins***, made up of simpler amino acids and an essential part of our diets.

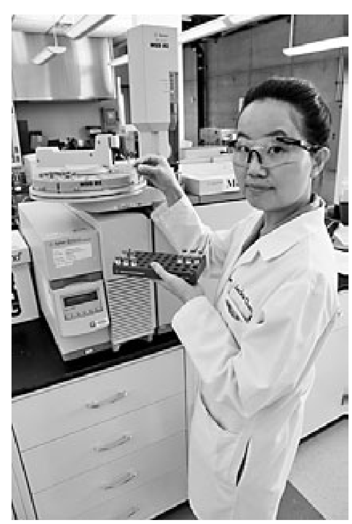


Other components that can be studied include vitamins, minerals, enzymes and water content, as well as food colour, flavour and additives.

Food chemists study how foods change with certain processing techniques and may seek to enhance desirable changes, like increasing sugar content to sweetness, or may seek to prevent undesirable effects, like adding chemicals to slow microbial action.

Other Factors in Food

Besides the actual chemicals in food, there are other factors that make it desirable to eat. Food chemistry also includes testing for aroma, flavour, texture, temperature and calories.



Food chemists analyze the aroma of food using a gas chromatograph. The gas chromatography is used in analytic chemistry for separating and analyzing compounds that can be vaporized without decomposition. Gas chromatography is similar to other forms of chromatography in that different compounds move differently depending on their mass and charge. In food chemistry, the gas chromatograph produces a chart, called a chromatogram, which displays the olfactory properties of food. Some food chemistry properties detected include the minimum concentration of food particles necessary for a human to smell them and the amount of food particles normally produced by an item. Chemicals can be added to enhance or change the odor a food gives off.

For example, a key part of the flavour of a McDonald's french fry comes from its smell. The taste of a McDonald's french fry is largely determined by the cooking oil which is used. For decades McDonald's cooked its french fries in a mixture of about seven percent cottonseed oil and 93 percent beef tallow. The mixture gave the fries their unique flavor and smell — and gave more saturated beef fat per ounce than a McDonald's hamburger. In 1990, amid a barrage of criticism over the amount of cholesterol in its fries, McDonald's switched to pure vegetable oil. This presented the company with a challenge: how to make fries that subtly taste like beef without cooking them in beef tallow. A look at the ingredients in McDonald's french fries suggests how the problem was solved. Toward the end of the list is a seemingly innocuous yet oddly mysterious phrase: "natural flavor." That ingredient helps to explain not only why the fries taste so good but also why most fast food—indeed, most of the food North Americans eat today—tastes the way it does. And the odor of this oil only lasts for a short time. French fries won't taste as good if they are reheated because all of the odor molecules have already left and there isn't anything left of smell.

Flavour chemists study the taste of food. Flavour chemistry includes both the smell of the food mentioned above and the actual taste. It's a combination of what happens on the tongue and what happens in the nose that creates what we call flavour. Try eating your favorite food while holding your nose and you'll see the importance of smell in the whole flavour equation. The taste of a food once it is in the mouth depends on the stimulation of taste buds on the tongue. There are four basic taste senses: sweet, salt, sour and bitter. Recently another basic taste has been added, umami. MSG has a strong umami flavour. One thing food chemists do is work with both food manufacturers and farmers to ensure that processed food retains its taste. It's better to have natural flavours than to add artificial flavours later.

Food chemists also study the texture of food. Mouthfeel is a food product's physical and chemical interaction with the mouth. Food is studied from first bite through complete chewing, swallowing and aftertaste. Some of the texture qualities that are perceived are density (the compactness of the food when bitten completely through), dryness (degree to which a food feels dry in the mouth), moisture release (amount of water/juiciness that is released) and gumminess (energy required to disintegrate a food so that it's ready to swallow)

Another factor in food chemistry is temperature. A food chemist studies the compounds in the food to determine which temperature best produces the desired chemical reactions. For example, the chemist finds which temperature breaks apart a sugar molecule and causes it to react with proteins in the food to create a "carmelization effect."

Finally, food chemists study the calorie content of food. Food is burned in a calorimeter so chemists know the amount of energy in contains. The calorie content is determined by the mass of various compounds present in the food. The food chemist also tests the digestibility of foods, as some of the materials such as cellulose or dietary fiber, are not digested by humans.

There's a lot more to getting the food to your table and into your mouth than you might first suspect. And a lot of it involves chemistry.

Questions

1. What are the three key ingredients of food that food chemists will test for?

2. What are some other factors included in how a food tastes?

3. What does McDonald's do to give their french fries the taste they have?

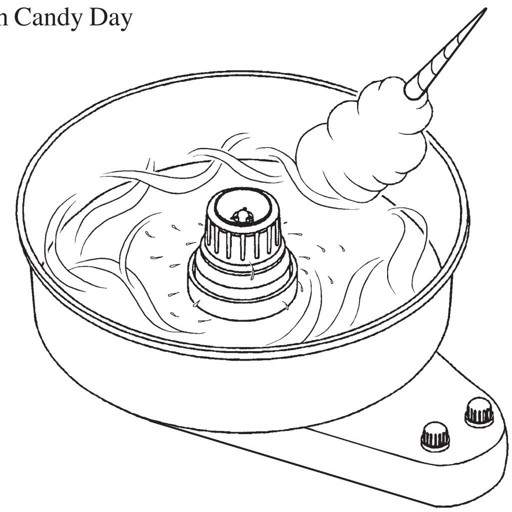
4. Give an example of two foods you like and explain why you like the way they taste. Include a discussion of the taste, smell, texture, temperature, etc.

Extension Activity

Take two foods that you eat at Playland and be a food scientist. Describe the taste, smell, texture and temperature. What could Playland do to improve the foods?

Cotton Candy

Machine-spun cotton candy was invented in 1897, by a dentist, William Morrison, and a candy maker, John Warton. It was first introduced to a wide audience at the 1904 World's Fair in St. Louis, Missouri. It was originally called "Fairy Floss" but was renamed cotton candy in the 1920s. Interestingly, the United States celebrates National Cotton Candy Day on December 7th each year.



Sugar to make cotton candy is specially milled with melting characteristics and a crystal size to match the cotton candy machine. The machine contains a spinning head enclosing a small sugar reserve bowl. The sugar in a central bowl is heated and the head spins forcing the molten sugar out through tiny holes by centripetal force. The molten sugar solidifies in the air and is caught in a larger bowl, which totally surrounds the spinning head. The cotton-like sugar builds up on the inside of the larger bowl. The machine operator then twirls a stick or paper cone around the large catching bowl, gathering the sugar strands into a fluffy ball you can eat.

But how much sugar is in the cotton candy? Try this activity to find out.

Materials

- ☐ Spring Scale
- ☐ Ruler
- ☐ Cotton Candy

Procedure

1. Purchase a plastic bag of cotton candy.
2. Use the spring scale measure the mass of the cotton candy and the paper cone.
3. Use the ruler to measure the length, width and height of the cotton candy. This will be an approximation due to the uneven surface of the cotton candy.
4. Remove the paper cone from the center of the cotton candy and measure the mass of the paper cone.

Data

Mass of cotton candy plus paper cone: ________________ g

Dimensions of cotton candy:

Length ____________ m

Width ____________ m

Height ____________ m

Mass of paper cone: ________________ g

Calculations

1. Calculate the mass of cotton candy.

   __________ g

2. Calculate the volume of the cotton candy.

   __________ m^3

3. Determine the density of the cotton candy.

   __________ g/m^3

4. Calculate the number of moles of sugar in the cotton candy.

   __________ moles

5. If you use an average of 4 Cal/g, how many Calories are in a bag of cotton candy?

   __________ Cal

Questions

1. What is the chemical formula for sugar (sucrose)?

2. How many carbon atoms are there in the amount of cotton candy you tested?

3. How many hydrogen atoms are there in the cotton candy?

4. Write the chemical equation for what happens when you eat the cotton candy.
   Assume it's a simple respiration reaction – sugar plus oxygen give carbon dioxide and water.
   Complete the equation by adding the enthalpy change ($\Delta H = -5640.9$ kJ/mol).
   Is the reaction exothermic or endothermic?

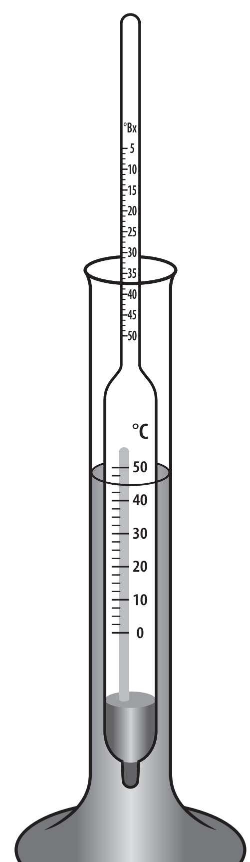
Soda

Coca Cola has been around for a long time. The first prototype Coca Cola recipe was formulated by John Pemberton in a drugstore in Columbus, Georgia, originally as a carbonated medicine in the late 1800s. At the time, it was believed that carbonated water was good for the health. When originally sold, Coca Cola's two key ingredients were cocaine (benaoylmethyl ecgonine) and caffeine. The cocaine was derived from the coca leaf and the caffeine from the kola nut, leading to the name Coca Cola (the K in Kola was replace with a C for marketing purposes). In 1903 the cocaine was removed from the drink recipe and replaced with "spent leaves" of the coca plant, the leftovers of the cocaine extraction process. Coca Cola still uses a cocaine-free coca leaf extract for flavour. The exact formula for Coca Cola's natural flavourings is a trade secret with the original copy of the formula held in a bank vault in Atlanta, Georgia. Only two executives at the Coca Cola company headquarters have access to the formula.

One of the other key ingredients for Coca Cola is sugar. But how much? In this activity, you'll calculate the amount of sugar found in an average Coca Cola drink at Playland.

Materials

- ☐ 100 ml Graduated cylinder
- ☐ Brix hydrometer
- ☐ Coca Cola



Procedure

1. Purchase a regular Coca Cola drink at the refreshment stand. Ask for it with no ice.
2. Set the drink aside for 15 minutes to decrease the amount of carbon dioxide.
3. After 15 minutes, measure the temperature of the cola.
4. Measure the amount of liquid in the Coca Cola drink using the graduated cylinder. If you have more than one cylinder of liquid, use another container to hold the extra liquid.
5. Pour about 75 ml of Coca Cola into the graduated cylinder. Place the Brix hydrometer in the liquid and record the reading.

Data

Volume of Coca Cola in drink	__________	ml
Temperature of the Coca Cola	__________	° C
Brix hydrometer reading	__________	°Bx

Note: One degree Brix (1 °Bx) is 1 gram of sucrose in 100 grams of solution. This represents the strength of the solution as a percentage by weight. Thus 22.5 °Bx = 22.5% sugar. If you don't have a Brix hydrometer, use an average Brix value of 10.8 °Bx for Coca Cola.

Calculations

1. What is the percentage of sugar in the drink? (Remember that 1° Bx = 1 % sugar)

__________ %

2. How many total grams of sugar are in the drink.

__________ g

3. How many sugar molecules are in the drink.

__________ molecules

4. If you use an average of 4 Cal/g, how many Calories are in the Coca Cola you purchased?

_________ Cal

Questions

1. An approximation for the Brix scale can be calculated from the formula °Bx = 261.3 x (1 – 1/S) where S is the specific gravity of the liquid. If the specific gravity of a liquid is 1.056, what is its Brix scale value?

__________ ° Bx

2. They think they made a mistake when they set up the Coca Cola machine. They measured the specific gravity of their soda and found it was 1.092. What is the Brix scale value and how much sugar would be in 100 mL of the new drink?

__________ ° Bx

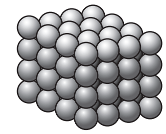
__________ g

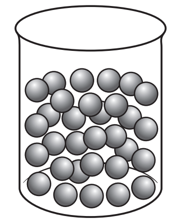
3. If you drink one Coca Cola from Playland each day for a year, how many Calories will you have taken in? If there are 3500 Calories/pound of weight, how much weight will you gain in a year from the drink?

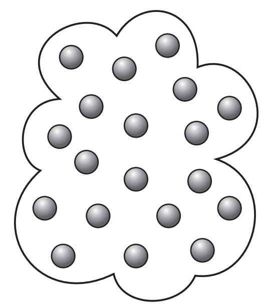
__________ Calories/year

__________ pounds/year

Observing Matter


solid


liquid


gas

The states of matter are the distinct forms that different phases of matter can take on. The most common states of matter on Earth are solid, liquid and gas. Solid is the state in which matter maintains a fixed volume and shape; liquid is the state in which matter maintains a fixed volume but changes shape depending on the contain that holds it; and gas is the state of matter in which matter expands to occupy whatever volume is available. The states of matter can change depending on the temperature and pressure of the matter.

When observing matter you can record either its ***qualitative*** properties (properties that are observed and don't involve a numerical measurement) or ***quantitative*** properties (properties that are observed and do involve a numerical measurement).

In a ***physical change*** matter undergo a change that doesn't change their chemical nature. In a ***chemical change*** matter does change their chemical nature.

Equipment

- ☐ Spring Scale
- ☐ Graduated Cylinder
- ☐ Ruler
- ☐ Various Food Items

Procedure

1. For each item in Table 1 in the data section, record both qualitative and quantitative properties.
2. For each item in Table 2 in the data section, record the beginning and end phase, the phase change that occurs.
3. For each item in Table 3 in the data section, tell whether the change is a chemical change or a physical change.

Data

Table 1 – Qualitative and Quantitative Properties

Object	Qualitative Properties	Quantitative Properties
Snow Cone		
Popcorn		
Mini Donuts		
Cotton Candy		
Corn Dog		
Hellevator Cup filled with Coca Cola		

Table Two – Phase Change

Change	Beginning Phase	End Phase	Phase Change
Snow Cone melts.			
Moisture forms on the outside of the Hellevator cup.			
Water in a puddle disappears.			

Table Three – Chemical and Physical Change

Action	Physical or Chemical Change
You eat a bag of popcorn.	
Snow cone melts.	
Playland cooks a hamburger.	
Sugar and cream is added to a cup of coffee.	
You drop a mini donut into a glass of water.	

Questions

1. State whether the following would be a physical or chemical change.

   Melting ice cream ____________________

   Ripping a ticket ____________________

   Popping popcorn ____________________

   Making a mini donut ____________________

   Your face turns red after a ride ____________________

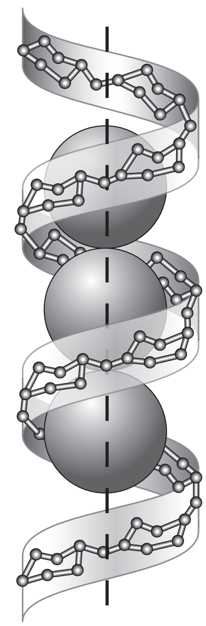
2. List three other physical changes and three other chemical changes you see at Playland.

Looking for Starch

Starch is the main polysaccharide used by plants to store glucose for later use as energy. Plants often store starch in seeds or other specialized areas of the plant cells.

A simple chemical test for starch is with ***Lugol's iodine***. Lugol's iodine is naturally a brown colour but will change to a blue colour in the presence of starch. The colour change occurs when starch is mixed with iodine in water to form a starch/iodine complex. Many of the details of the exact reaction are unknown but it seems that the iodine molecule gets stuck inside the coils of the starch molecule. The starch forces the iodine atoms into a linear arrangement and there appears to be some transfer of change. The spacing of the electrons in their energy levels of the iodine molecule are just right for absorbing visible light of a specific frequency, which gives the complex its intense blue colour.

With that in mind, you're going to look for starch in some of the foods commonly eaten at Playland.



iodine atoms in a linear pattern within the coils of a starch molecule

Materials

- ☐ Lugol's iodine in a plastic dropper bottle
- ☐ Paper towel
- ☐ Food samples

Procedure

1. Gather the food samples that are to be tested.
2. Place a small sample of each food on the paper towel and label each.
3. Add a drop of Lugol's iodine to each food sample and record the result.

Data

Food Sample	Colour of Iodine	Starch Present? (Yes or No)
Mini donut		
Hamburger patty		
Cotton Candy		
Popcorn		
Bun or Bread		
Food of your choice: ____________________		

Questions

1. Did any item you tested surprise you? If so, why?

2. Chew a mini donut for a minute without swallowing it. Spit the dough on the paper towel and test it again. What are the results this time? Explain what happened.

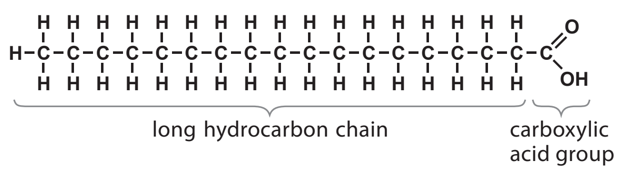
Fats in Food

Chemically, fats are triesters of glycerol and fatty acids and are generally insoluble in water. Fats may be either solid or liquid at room temperature, depending on their structure and composition. Although the words oils, fats and lipids are all used to describe fats, oils are more often used to describe fats that are liquids at room temperature while fats refer to fats that are solids at room temperature. Lipid is used to refer to both liquid and solid fats and relates more to their chemical structure and physical properties of the fats.

There are many different kinds of fats, but each is a variation of the same chemical structure. All fats consist of three fatty acids (chains of carbon and hydrogen atoms, with a carboxylic acid group at one end) bonded to a backbone structure, usually glycerol (made of carbon, hydrogen and oxygen). Chemically, this is triester of glycerol. An ester is a molecule formed from the reaction of carboxylic acid and an organic alcohol. The properties of each fat molecule depend on the particular fatty acids it contains. In general, the longer the fatty acid, the higher the melting point. Long fatty acid chains also yield more energy per molecule when metabolized by the body.

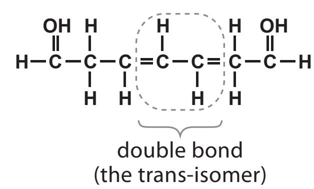
A fat's fatty acids may also differ in the number of hydrogen atoms that are bonded to the chain of carbon atoms. Each carbon atom is typically bonded to two hydrogen atoms. This makes it a saturated fat because it's saturated with hydrogen, bonded to as many hydrogen atoms as possible. In other fats, carbon atoms double bond to the neighboring atom and to only one hydrogen atom creating an unsaturated fat.

Essential features of a fatty acid



There are two ways the carbon-carbon double bond in an unsaturated fat can be arranged: the isomer with both parts of the chain on the same side of the double bond (the cis-isomer) or the isomer with the parts of the chain on opposite sides of the double bond (the trans-isomer). Because of their different chemistry, trans fatty acids metabolize differently in the human body and significantly increase the risk of coronary heart disease.

"Trans" fatty acid



In this activity, you're going to test for fats in some of the food found at Playland.

Materials

- ☐ Plastic Bag or Plastic Container
- ☐ Water
- ☐ Sudan III Stain in Plastic Dropper Bottle
- ☐ Various Sample Foods

Procedure

1. Collect the food that you are going to test.
2. Break the food into small pieces and place a small amount of each food in a different plastic bag or container. Label each bag or container with the food inside.
3. Add water to the bag or container until the food is covered.
4. Mix the food and water together.

5. Add 3 drops of Sudan III stain to each food container. Shake gently to mix.
6. A red-stained oil layer will separate out and float on the water surface if fat is present.

Data

Food Tested	Sudan III Colour	Fat Present? (Yes or No)
Mini donut		
Hamburger patty		
French Fries		
Popcorn		
Bun or Bread		
Food of your choice: ____________		

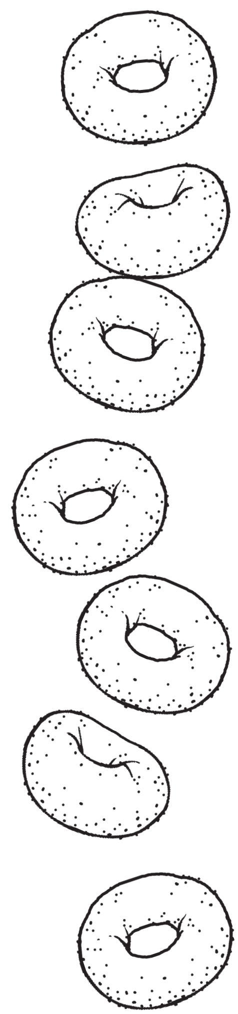
Questions

1. Which foods contained fats? Did any surprise you?

2. Draw a picture of a simple fat molecule.
   Indicate if it is saturated or unsaturated and explain why.

More Sugar*

**Note: This activity will start at Playland but will be completed in your school's science laboratory due to the need for more specialized equipment and chemicals.*



Sugar is the term used for a class of edible crystalline carbohydrate, mainly sucrose, glucose and fructose (including high fructose corn syrup). Chemically, they fall into categories of monosaccharide, disaccharide or polysaccharide, depending on the molecular size and composition. Almost all sugars have the chemical formula of CnH2nOn (where $3 < n < 7$) and end with "-ose". Monosaccharides and disaccharides contain either aldehyde groups or ketone groups. These carbon-oxygen double bonds (C=O) are the reactive centers for the sugars. When several monosaccharides with one ring in their structure react, they will form a disaccharide or polysaccharide, joined by covalent glycosidic bonds with the resultant loss of one water molecule (H_20) per bond. These disaccharide or polysaccharide bonds must be hydrolyzed (broken) by enzymes before they can be metabolized, digested and absorbed by the human body.

A simple test for simple sugars in food, such as glucose, involves ***Benedict's solution***. Benedict's solution is a clear blue solution of sodium and copper salts. In the presence of simple sugars, the blue solution changes colour to green, yellow, and brick-red, depending on the amount of sugar. All simple sugars (monosaccharides) are reducing sugars and have a free reactive carbonyl group. The copper sulfate ($CuSO_4$) present in the Benedict's solution reacts with electrons from the aldehyde or ketone group of the reducing sugar to form cuprous oxide (Cu2O), a red-brown precipitate. The final colour of the solution depends on how much of this precipitate was formed, which indicates how much reducing sugar was present. More complex sugars, like the disaccharide sucrose, are non-reducing sugars and will not react with Benedict' solution.

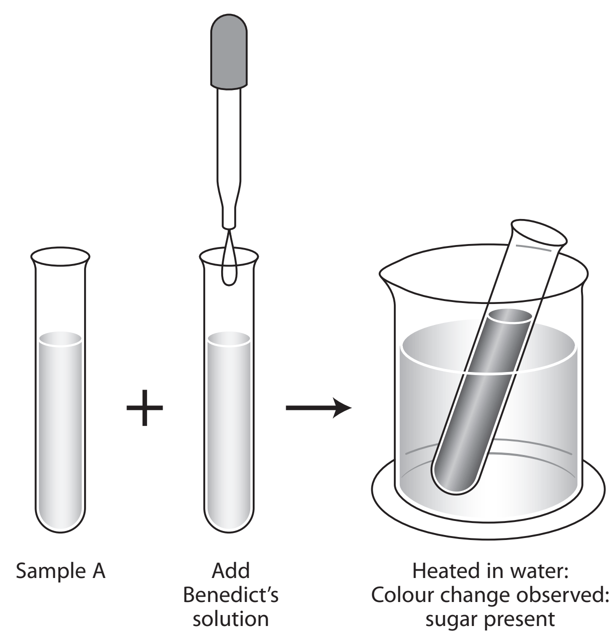
In this activity you will look for simple sugars in the food found at Playland. You will collect test samples at Playland but will perform the chemical test for sugar back in the chemistry laboratory at your school.

Materials – at Playland

- ☐ Plastic bags
- ☐ Various food samples

Materials – in the chemistry laboratory

- ☐ Test tubes
- ☐ Distilled water
- ☐ Beaker
- ☐ Thermometer
- ☐ Hot plate
- ☐ Benedict's solution



Procedure – at Playland

1. Collect the food samples you are going to test.
2. Place each food in a separate plastic bag and label each with the food collected.
3. Set the food sample aside. You will complete the food test back at school.

Procedure – in the chemistry laboratory

1. Create a water bath by placing water in a beaker and placing it on the hot plate. The water should be 40° to 50° C.
2. Break each food sample into small pieces and replace in the plastic bag.
3. Add enough distilled water to each bag to cover the food and mix thoroughly.
4. Transfer a small amount of the liquid from each bag to separate test tubes. Mark each test tube with the food they contain.
5. Add 10 drops of Benedict's solution to each test tube.
6. Carefully heat the test tubes in the water bath for five minutes.
7. Note any colour change. If sugar is present, the solution will turn green, yellow, or brick-red, depending on the sugar concentration.

Data

Food Tested	Colour	Sugar Present? (Yes or No)
Mini donut		
French fries		
Coca Cola		
Popcorn		
Bun or bread		
Food of your choice: ________________		

Questions

1. Which foods contain sugar? Did any of your results surprise you? Why?

___

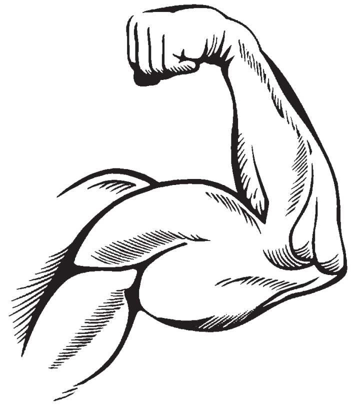
___

___

2. Draw a diagram of a molecule of sucrose.

Protein*

**Note: This activity will start at Playland but will be completed in your school's science laboratory due to the need for more specialized equipment and chemicals.*



Proteins are complex molecules composed of carbon, hydrogen, oxygen and nitrogen. Many proteins also contain sulfur. The building blocks of proteins are ***amino acids***. Amino acids are molecules containing an amine group, a carboxylic acid group and a different side-chain depending on the amino acid. The generic chemical formula for amino acids is $H_2NCHRCOOH$, where R is the side-chain and which vary from a single hydrogen atom (in glycine) to a larger heterocyclic group (in tryptophan). When adjacent amino acids bond together by peptide bonds between the carboxyl and amine groups in a linear chain, they form a primary structure of the protein. Most proteins then fold into 3-dimensional structures due to hydrogen bonding, disulfide bonds, etc.

When eaten, proteins are broken down by digestion into smaller peptide segments and the individual amino acids they are made of. Protein is an important nutrient in humans for growth and repair of muscle and other parts of the body. Many proteins are enzymes that catalyze biochemical reactions and are important in metabolism and regulation.

You can test food for protein with the ***Biuret test***. When you perform the Biuret test for proteins, the Biuret reagent starts a light blue colour but turn pink or purple when mixed with a solution containing protein. Chemically, the colour change comes when the copper ions of the Biuret reagent react with peptide bonds in the proteins' polypeptide chains and a purple colour complex if formed. The reaction is normally done in a basic solution, so NaOH is part of the Biuret reagent as well.

In this activity you will look for protein in the food found at Playland. You will collect test samples at Playland but will perform the chemical test for protein back in the chemistry laboratory at your school.

Materials – at Playland

- ☐ Plastic bags
- ☐ Various food samples

Materials – in the chemistry laboratory

- ☐ Test tubes
- ☐ Distilled water
- ☐ Biuret Reagent

Procedure – at Playland

1. Collect the food samples you are going to test.
2. Place each food in a separate plastic bag and label each with the food collected.
3. Set the food sample aside. You will complete the food test back at school.

Procedure – in the chemistry laboratory

1. Break each food sample into small pieces and replace in the plastic bag.
2. Add enough distilled water to each bag to cover the food and mix thoroughly.
3. Transfer a small amount of the liquid from each bag to separate test tubes.
   Mark each test tube with the food they contain.
4. Add 3 drops of Biuret Reagent to each test tube.
5. Note any colour change. If protein is present, the solution will pink or purple.

Data

Food Tested	Colour	Protein Present? (Yes or No)
Hamburger patty		
French fries		
Hot dog		
Popcorn		
Bun or bread		
Food of your choice: ____________		

Questions

1. Which foods contain protein? Did any of your results surprise you? Why?

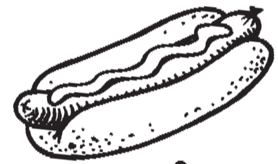
____

____

____

2. Draw a diagram of a molecule of a simple protein that contains at least 4 amino acids.

Nutrition



Instructions

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

1. After ordering a regular-sized drink, estimate how many ml of fluid you actually receive: ____________ ml

2. Measure the amount of liquid in the drink: ____________ ml

   How close was your estimate? ____________________________

3. How much did a regular drink cost? $____________

4. How would this price compare to a store-bought drink?

____

4. What type of drink did you order? Does the flavour differ from the canned, store-bought version? If so, how?

____

____

____

5. Approximately how many kernels of popcorn do you get in a *regular-sized* bag? In a *large* bag? Is real butter used? If not, what substitute is used? What is the ratio of buttered to non-buttered kernels in a *regular* bag? In a *large* bag? (Ask the person in the booth).

____

____

____

6. Estimate the mass of a bag of cotton candy. ____________ g

   Measure the mass of the cotton candy before you eat it and the mass of the paper cone after the cotton candy is gone to calculate the amount of sugar in the cotton candy.

   Mass of cotton candy and paper cone before ____________ g

   Mass of paper cone ____________ g

   Mass of sugar in the cotton candy ____________ g

   How close was your estimate? ____________________________

7. What are the ingredients listed on a bag of cotton candy? What do you think "certified food colours" are? What different colours does cotton candy come in? What other colours would sell well?

____

____

____

8. What foods did you consume at Playland?

9. What would you buy at Playland if:
   (a) you were on a restricted calorie diet?

   (b) you were on a low-salt diet?

   (c) you were diabetic?

10. If you had the opportunity to operate a nutritious food stall at Playland, list several foods that you would sell.

11. If there was one question you could ask the “food” experts at Playland, what would it be?

12. If you had an opportunity to make one suggestion to the “food” experts at Playland, what would it be?

13. How much does a Playland hot dog cost? $ ____________________
    Estimate how much you think the same size hot dog would cost to make at home.

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.

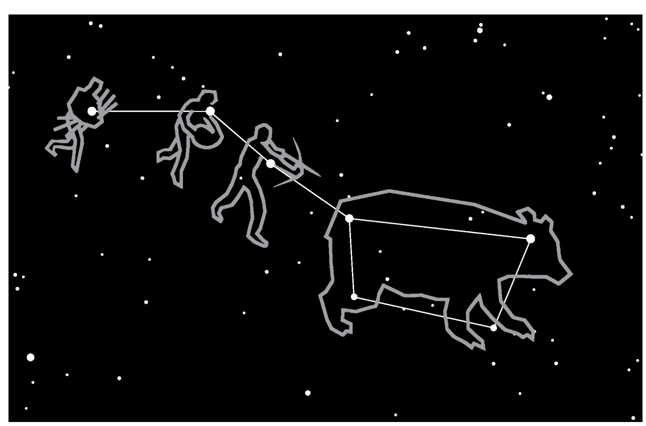
Next look at land travel. What are ways to move over land, including both flat land and mountains? Again be prepared to present your findings to your class.

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.



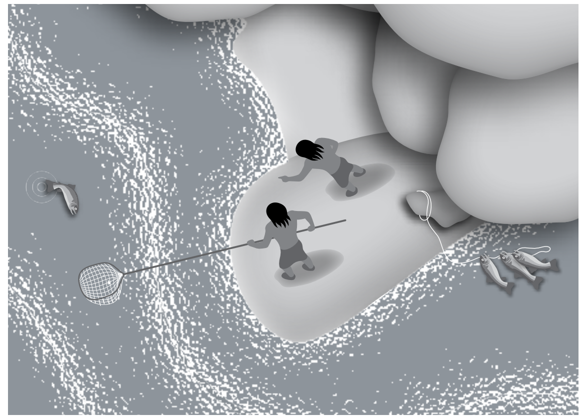
Another thing people have done is look at the stars. They notice shapes of images that some stars seem to make, called constellations. Research one constellation. Draw a picture of the image made by the stars and write about the legend or story that goes with it. Do the First Nations people have a different 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.