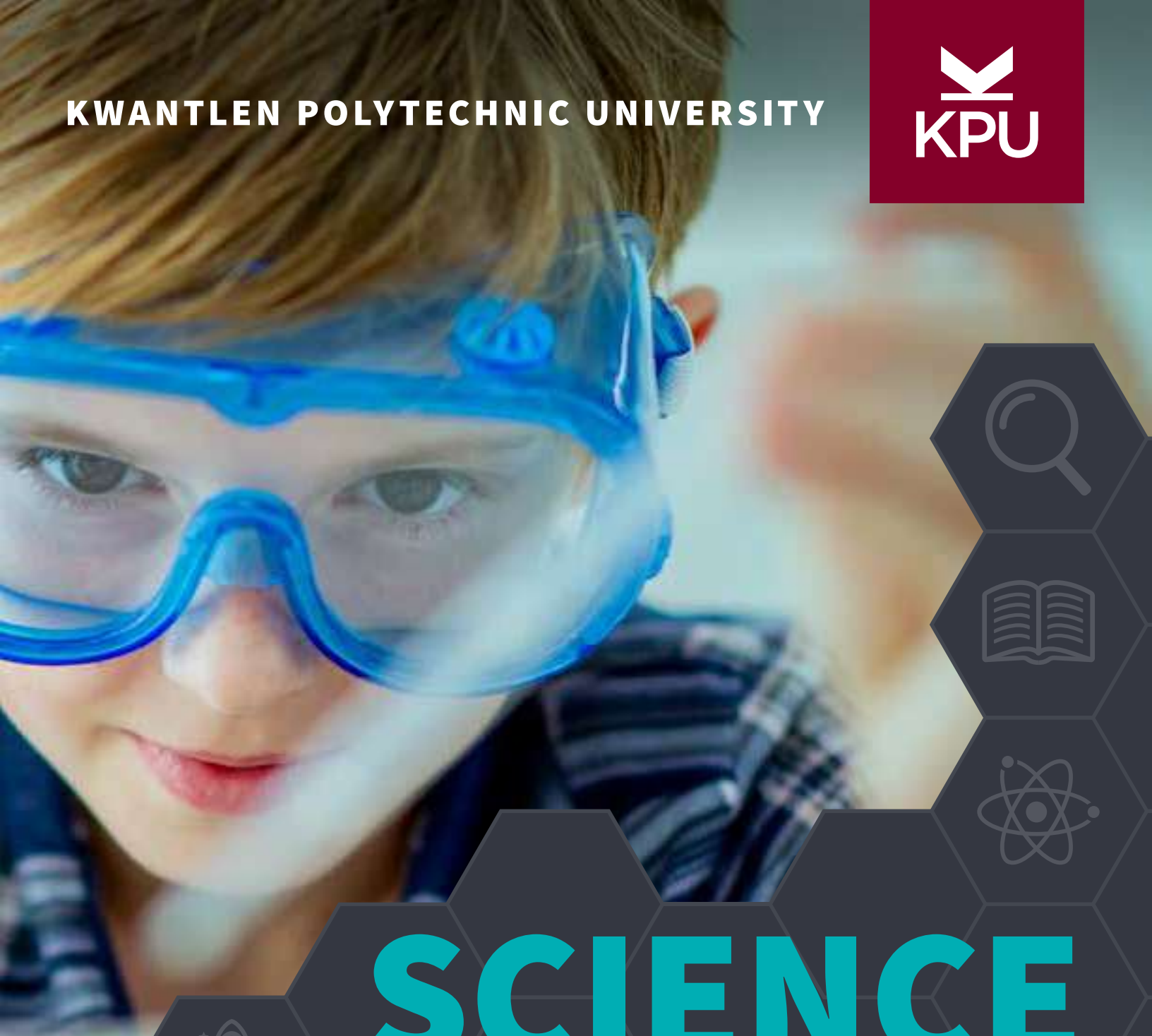
KWANTLEN POLYTECHNIC UNIVERSITY

KPU



SCIENCE RENDEZVOUS

ACTIVITY BOOKLET

Explore Science, Technology, Engineering, Art and Math (STEAM) at home!

This book is produced by
KPU Faculty of Science and Horticulture

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HELLO TO ALL YOU CURIOSITY SEEKERS!

We started hosting our annual KPU Science Rendezvous back in 2013 and we have had an amazing response from the community each year. Kids of all ages have come to our Langley campus annually for interactive activities in our science labs, explosions in our courtyard, catapult launching by our labyrinth, dancing flame shows and so much more!

We also thought we'd send the science home with you to experiment, learn and spark some curiosity in your home! We asked all of the departments in our faculty to come up with some fun-filled activities for you to try. We hope you like it!

BEFORE YOU GET STARTED

- You will need to have some materials on hand — have a look through the activities to see what you need prior to starting.
- Involve your family!
- If you need help or the adults in your house have questions, write to us at **fsh.events@kpu.ca**

JOIN THE ADVENTURE!

Join us online at **kpu.ca/SR** for some virtual fun science activities, lab tours and more! Also, be sure to check out Science Odyssey at **sciod.ca** for Canada's biggest festival of science and technology with over 1000 activities for explorers of all ages!

WE'D LOVE YOUR FEEDBACK!

Let us know how you did with your activity book! Visit **kpu.ca/SR** and click on the feedback survey to share your thoughts!

FLOWER DISSECTION

Spring has sprung and the scents and beautiful colours of flowers are here! Have you ever stopped to think about what flowers DO? Why do plants have flowers in the first place? Let's look at a flower in more detail to find out. *Adult supervision and assistance are required to conduct this dissection.*

1 FIND A FLOWER TO DISSECT!

You'll want to choose a flower with clearly defined parts. Most of the larger flowers that you see blooming will be fun to look at up close.

2 OBSERVE THE FLOWER

» What colour is your flower?

» How many petals does it have?

» When you look at the centre of the flower what do you see?*

**Most flowers will have male and female parts in the centre of the flower. Male parts are made up of the anthers and filament (together these are called the stamen). While the female parts are made up of the stigma, style, and ovary (together these are called the pistil).*

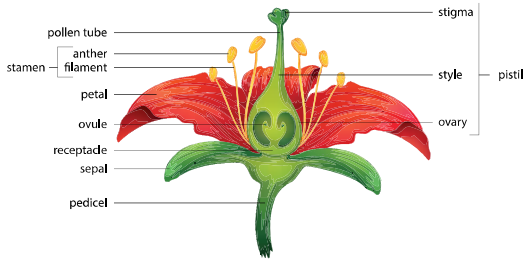
» Gently wipe the anther with a tissue or paper towel. Can you see the pollen?

3 THINK ABOUT WHAT YOU OBSERVED

Why do you think your flower is colourful?
Flowers are colourful so that pollinators, like insects, are attracted to them. Pollinators do the job of moving pollen between different flowers. Your flower may also have a nice smell, this is part of the plants efforts to be as attractive to pollinators as possible.

What happens after a flower is pollinated?
After flowers are pollinated they will turn into fruits withseeds inside. Fruits are eaten by many different animals including birds, squirrels, and bears. Fruits feed the populations of fruit-eating animals, and in return those animals move seeds away from the parent plants so that young plants can grow in new areas.

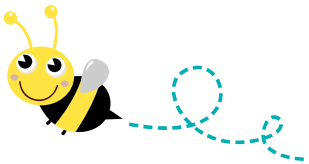
The anatomy of a flower



Red Trillium *(Trillium erectum)*

» Can you see the pistil and stamens on this beautiful flower?

The relationships between flowering plants, pollinators, and fruit eating animals are critical for the health of our wild spaces. Now you know what flowers are for and how important they are!



STRAWBERRY DNA EXTRACTION

DNA | DEOXYRIBONUCLEIC ACID

You've probably heard about DNA, but have you seen what it looks like? DNA is the genetic material that is passed from parent to offspring and is stored inside cells. In this activity you will break open the cell walls of strawberry cells and isolate the DNA inside.

MATERIALS

- 2 - 3 strawberries (fresh or frozen)
- 1 Ziploc® plastic storage bag
- 2 tsp. extracting solution (1 cup water, 2 tsp. liquid dishwashing detergent, 1/8 tsp. salt)
- 1 small glass (egg cup, shot glass, etc.)
- 1 funnel
- 1 metal colander or 1 piece 10x20 cm double-ply cheesecloth
- 3/4 tsp. fresh pineapple or papaya juice
- 1 wood stick (coffee stir stick, toothpick)
- 1 tbsp. ice-cold rubbing alcohol (isopropyl alcohol)

1 PREPARE THE DNA EXTRACTION SOLUTION.

A. Fill a large glass or bowl with 1 cup of water.

B. Add 2 tsp. dishwashing detergent.

C. Add 1/8 tsp. salt.

D. Swirl the flask until all the soap and salt are dissolved trying not to create bubbles.

2 CARRY-OUT THE DNA EXTRACTION.

A. Place 2-3 strawberries in the plastic bag.

B. Remove the air from the bag, seal it, and thoroughly mash the strawberries with your hands.

C. Add 2 tsp. of the DNA extracting solution (part 1) to the bag.

D. Remove the air from the bag again, seal it, and mix the contents thoroughly.

E. Put the cheesecloth (folded in half) or metal colander over the funnel and set up the funnel in the small glass.

F. Pour the strawberry mixture into the colander or cheesecloth, letting the mixture run into the funnel until the glass is about 1/3 full.

G. Remove the funnel and colander or cheesecloth.

H. Add 3/4 tsp. of fresh pineapple or papaya juice to the small glass and mix well using the wooden stick, wait 1-2 minutes.

I. Slowly add 1 tbsp. of chilled isopropyl alcohol. As you add the alcohol, keep the glass tilted at a 45 degree angle and slowly dribble the alcohol down the side so that it floats on the top of the strawberry mixture.

J. Wait just a few minutes and watch cloudiness form where the two layers meet. This cloudiness is the DNA.

K. Use the wooden stick to collect the DNA. The basic trick is to rotate the stick between your fingers to wrap the DNA around it.

What you see here are clumps of tangled DNA molecules! You've actually been able to separate DNA from the strawberry cells!

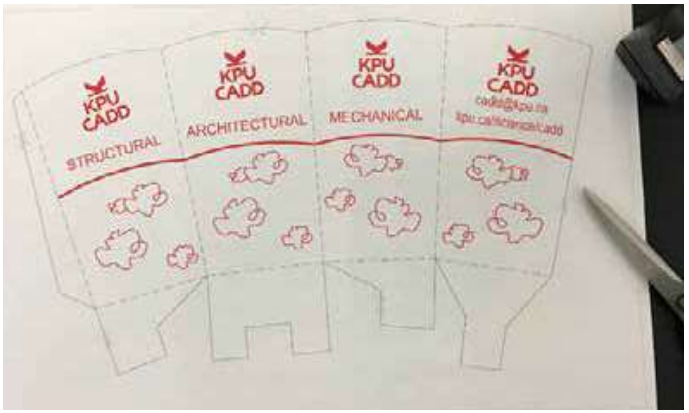
MAKE YOUR OWN POPCORN BOX

Hollow objects made from cardboard, paper and sheet metal are often first designed as a flat pattern. The flat pattern is known as a Development (pattern drawing). It is highly used in design and drafting applications for objects such as aircraft, sheet metal duct work and boxes. We hope this activity provides some fun and understanding of developments while also creating something useful! ***Adult supervision may be required.***

MATERIALS

- Scissors
- Scotch tape
- Popcorn box pattern *(see additional attachment)*

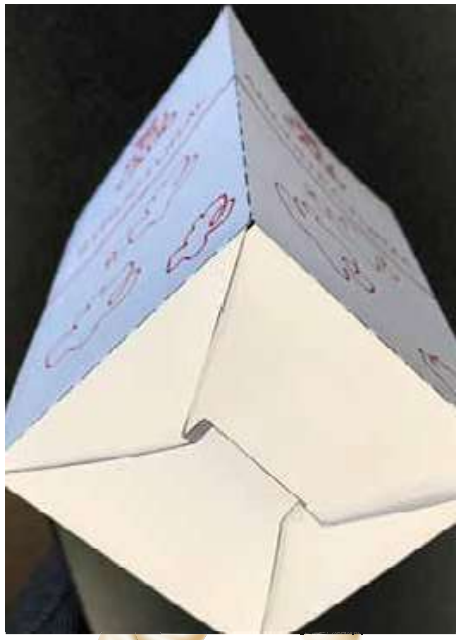
1 CUT AROUND THE EDGES OF THE PATTERN



2 FOLD ALONG ALL DOTTED LINES

3 TAPE ALONG EDGE TO CLOSE SIDES

4 CLOSE THE BOTTOM



TEST YOUR HOUSEHOLD SUBSTANCES

Chemicals can be acidic, basic, or neutral. Acidic chemicals have a pH value less than 7, while basic chemicals have a pH value higher than 7. Neutral chemicals have a pH of exactly 7. Chemists can use pH paper to measure pH. You can purchase pH strips at a local pharmacy or make your own – see instructions below. In this activity, you'll also make your own indicator solution which will change colour depending on whether the substance it's mixed with is acidic or basic. Then, you'll use it to test the acidity/basicity level of some common household substances.

We've given you two possible methods: use red cabbage, or use blueberries, or try them both if you like!
Adult supervision may be required.

MATERIALS

- Small glass jars or clear plastic cups
- Substances to test, for example:
  - Vinegar
  - Baking soda
  - Soap/shampoo
  - Lemon juice
  - Orange juice
  - Antacid tablet
  - Toothpaste
  - Ketchup
  - Mustard

Red Cabbage Indicator

- Red cabbage, 3 or 4 leaves
- Knife and cutting board
- Water
- Funnel or strainer
- Coffee filter
- Container to collect indicator

Blueberry Indicator

- Blueberries, 1 cup
- Fork or spoon
- Water, 1/2 cup
- Pot
- Funnel or strainer
- Coffee filter
- Container to collect indicator

CABBAGE INDICATOR METHOD

A. Using a knife and cutting board, cut up three or four red cabbage leaves into small pieces.

B. Add enough water to just cover the leaves in the pot, and then bring the water to a boil. Boil for 3 or 4 minutes.

C. Take the pot off the heat and let it cool down.

D. Strain the cabbage leaves through the coffee filter and strainer into your collection container. Use a spoon to press on the cabbage and squeeze out as much liquid as possible.

BLUEBERRY INDICATOR METHOD

A. Mash the blueberries in a bowl or a pot to release the blueberry juice.

B. Add the mashed blueberries, including any juice, and half a cup of water to a pot.

C. Bring to a boil, and then let the blueberries simmer for 5 - 10 minutes.

D. Take the pot off the heat and let the mixture cool.

E. Strain the blueberries through the coffee filter and strainer into your collection container. Use a spoon to squeeze out all the liquid.

USING THE INDICATOR

A. Add a tablespoon of each substance you'd like to test into each cup.

B. Add a tablespoon of indicator to each cup.

C. Write down notes about any colour changes you observe.

USING THE PH STRIPS

A. Each strip can be torn in half to test twice as many substances.

B. **For liquids:** Pour them into a small cup, and then use a clean toothpick or cotton swab to place one drop of the liquid on the strip.

C. **For solids:** Dissolve them in some water, and then use a clean toothpick or cotton swab to place one drop of the liquid on the strip.

D. Write down notes about the colour changes you observe on the pH paper. Can you match the colour to a pH level on this chart?

WHAT'S HAPPENING?

Many plants (including red cabbage and blueberries) contain chemicals called anthocyanins, which change colour depending on the pH level. However, not all indicators are identical! They can show different changes, and some even have multiple colour changes depending on the pH.

- What do the acidic chemicals have in common?
- What do the basic chemicals have in common?

Try making your own pH strips by soaking strips cut from coffee filter paper in your indicator solution, and then letting them dry.

AIR POLLUTION EXPERIMENT

Plants and animals (including humans) on Earth get the oxygen we need by breathing air. Besides gases, such as oxygen and nitrogen, air can contain chemicals and particles that we can breathe in. Some particles we breathe in are naturally found in the air: dust, pollen, smoke from fires and sea salt. Air pollution produced from human activities consists of chemicals or particles in the air that can harm the health of humans, animals, and plants. Air pollution is a problem that affects life all over the world.

Earth is surrounded by an atmosphere, a layer of gases stretching from the surface of the planet up to as far as 10,000 kilometers (6,214 miles) above. This experiment can help us understand that there is more in the atmosphere than just air. Maybe you will see some particles from the air.

MATERIALS

- A flat piece of clear plastic (such as a piece of a plastic container lid from your recycling bin)
- Petroleum jelly (like Vaseline jelly)
- A small rock
- A sheet of white paper

1 DETERMINE A SAFE PLACE OUTDOORS TO PLACE THE DEVICE FOR COLLECTION.

2 SPREAD AN EVEN LAYER OF PETROLEUM JELLY ON THE CLEAR PLASTIC SURFACE.

This is now your device. Lay it on your white sheet of paper and take a "before" photograph.

3 TAKE YOUR DEVICE OUTSIDE TO THE SAFE PLACE.

4 USE A ROCK OR OTHER HEAVY OBJECT TO WEIGH IT DOWN.

5 LEAVE THE DEVICE OUTSIDE FOR TWENTY-FOUR HOURS.

6 AFTER A DAY, PLACE YOUR DEVICE ON TOP OF THE WHITE PIECE OF PAPER.

This makes it easier to see the particles collected in the petroleum jelly. You can take another picture for "after".

What difference do you see between the before picture and the after device? What do you think it might be from? Discuss your results with a friend!

HOW MUCH DID IT RAIN?

MAKING A RAIN GAUGE

Ever wonder how hard it rained or whether your outdoor plants need more rainwater? You can find out easily by building your own rain gauge.

MATERIALS

- A tin can, such as an empty tuna can
- A tall glass jar with straight sides works best but an empty two litre pop bottle can work, too. As long as the bottle is in a location that is not windy. Otherwise it may blow over!
- A flat place away from any trees or walls on which you can place the glass jar/pop bottle to collect the rain.
- A pair of scissors
- A ruler
- A felt pen or marker

ASSEMBLY INSTRUCTIONS

A. Carefully pour 2cm of water into the tin can.

B. Pour the water from the tin can into your tall glass jar or 2L pop bottle that has had the narrow part at the top of the bottle cut off.

C. Mark the outside of the jar/bottle at the top of the water level you just added. This is now your reference mark for 2cm of rain.

D. Now using the ruler, measure the distance from the bottom of the jar to the top of your marked water level.

E. Add this distance to the top of your existing mark on the glass jar/bottle.

F. Repeat the previous step until you reach the top of the glass jar/bottle.

G. Every line that you have made is now 2cm of rain!

HOW TO USE YOUR RAIN GAUGE

A. Place your marked glass jar/2 L pop bottle in the location that you selected previously.

B. Make sure that its empty to start!

C. After the next rain fall you can go and check to see how much rain it collected. Did you get as much as the weather report stated?

D. You can leave the water in it to check over a couple of hours or even days. It's completely up to you. Keep in mind that if it's in a sunny location and not raining your collected water will evaporate and effect your next reading.

E. Create a logbook and track your readings. Which day was the wettest? At the end of the season you should have a pretty accurate history of the rainfall in your area.

Now you know how much it actually rains!

WHAT TO DO WITH YOUR FINISHED RAIN GAUGE

- Decorate it
- Show it off
- Track your readings
- Know how much rainwater your plants are getting

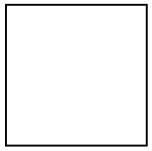
The wettest day last week was:

_____

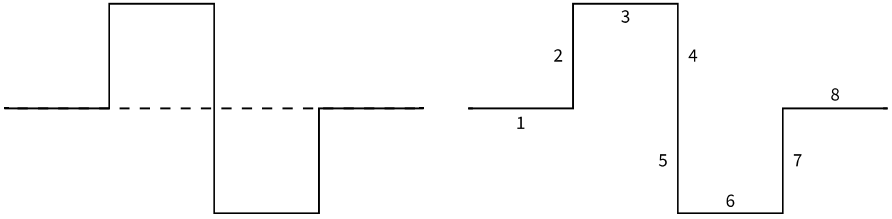
DRAWING A FRACTAL PINWHEEL

There are many different ways a pattern can repeat. Hexagons repeat in rows in a bee's honeycomb. The pattern of petals in a daisy repeats in a circle. Sometimes a pattern repeats inside itself, like the spiral in a snail's shell; if you zoom in closer, the spiral is still a spiral. When a pattern keeps repeating inside itself like that, it is called a fractal.

1 START WITH A BASIC SQUARE

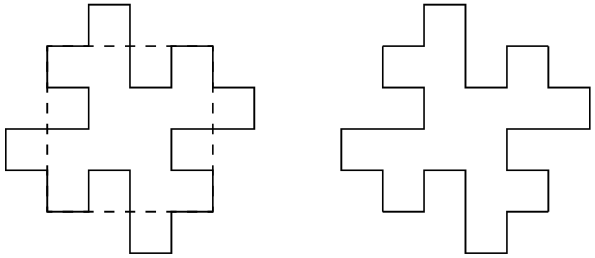


- If the length of the side of the square is 1, then we have Area = 1 square unit, Perimeter = 4 units length. *The perimeter is the measurement of the length around the edge.*
- Now consider each side of the square as a segment, and think of dividing it into 4 parts. The first part stays put, the second part bumps out from the square, the third part bumps into the square, and the fourth part doesn't move.
- Note that if the length of the side of the square was four, it is now twice as long, as there are now eight segments.



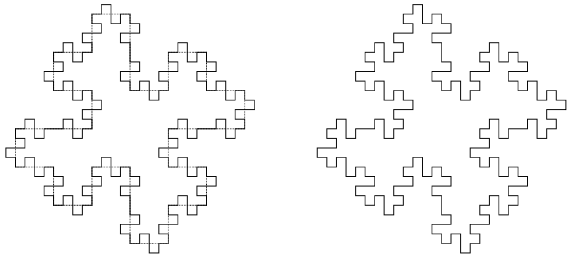
2 REPEAT FOR ALL FOUR SIDES OF THE SQUARE

- The dotted line was the original square.
- We're starting to see a pinwheel effect! Since we alternated bumping out and bumping in, the area of our pinwheel is the same as the area of the original square.
- Area = 1 square unit, Perimeter = 8 units length



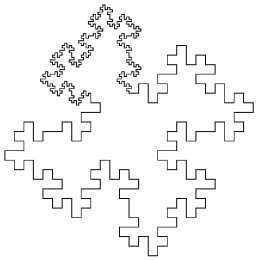
3 REPEAT THIS, DOING THE SAME FOR EACH SEGMENT THAT IS A QUARTER THE LENGTH OF THE ORIGINAL SIDE OF THE SQUARE

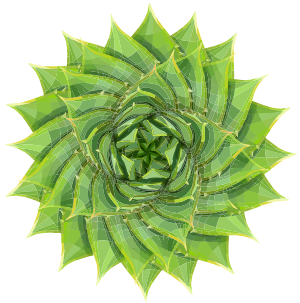
- The dotted line represents the previous stage.
- Area = 1 square unit, Perimeter = 16 units length



4 HERE, WE'VE CONTINUED TO SUBDIVIDE EACH SEGMENT

- The first quarter of the pinwheel is shown in the fourth step.
- In each step, the subdivisions get smaller, so it becomes difficult to see that it is made up of straight lines anymore. And at each step, the area stays the same, but the length around the edge doubles!
- Area = 1 square unit, Perimeter = 32 units length





When we repeat a pattern like this, getting smaller at each stage, we get a fractal pattern. Fractal patterns can be found in nature as well.

If you want to learn more about fractals, go to **mathigon.org/course/fractals**

MAKE A BALLOON ROCKET

MATERIALS

- 1 balloon (round ones will work, but the longer "airship" balloons work best)
- 1 long piece of kite string (about 10 - 15 feet long)
- 1 plastic straw
- Tape

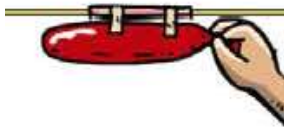
INSTRUCTIONS

A. Tie one end of the string to a chair, door knob, or other support.

B. Put the other end of the string through the straw.

C. Pull the string tight and tie it to another support in the room.

D. Blow up the balloon (but don't tie it). Pinch the end of the balloon and tape the balloon to the straw as shown to the right. You're ready for launch.



E. Let go and watch the rocket fly!

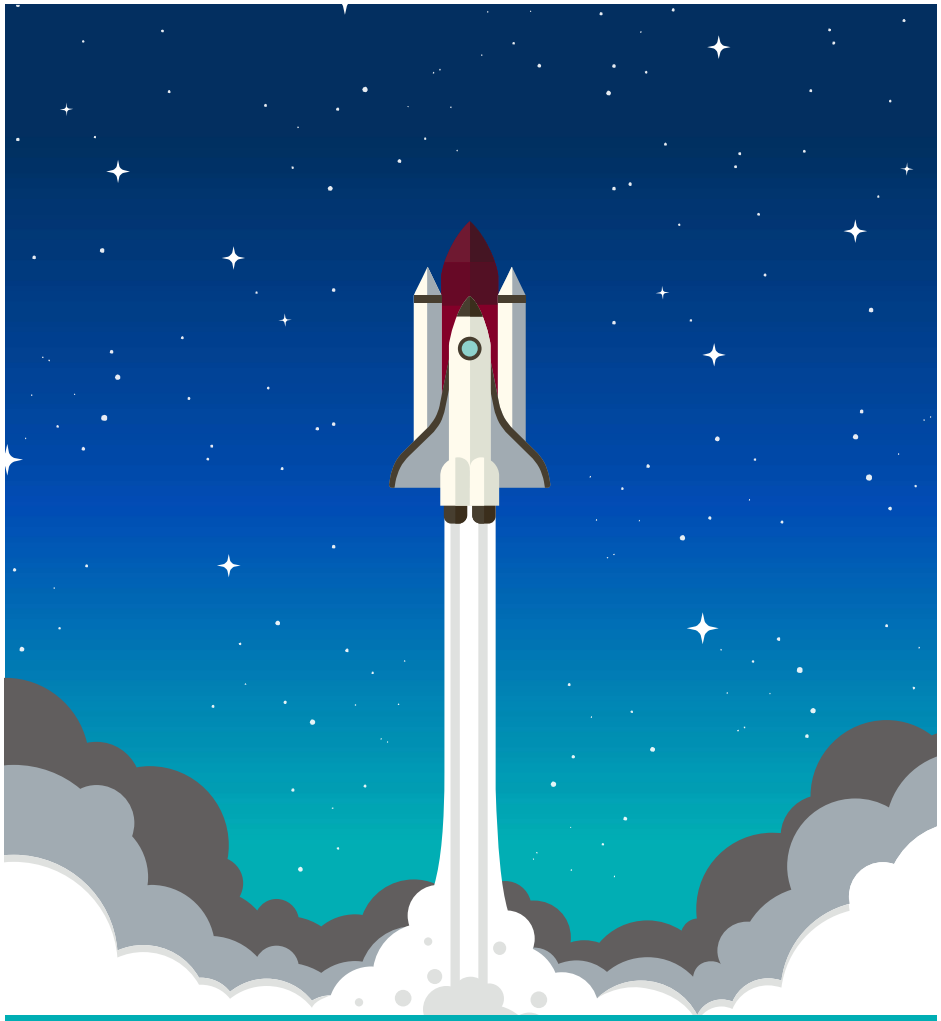
HOW DOES IT WORK?

So how does it work? It's all about the air…and thrust. As the air rushes out of the balloon, it creates a forward motion called THRUST. Thrust is a pushing force created by energy. In the balloon experiment, our thrust comes from the energy of the balloon forcing the air out. Different sizes and shapes of balloons will create more or less thrust. In a real rocket, thrust is created by the force of burning rocket fuel as it blasts from the rockets engine – as the engines blast down, the rocket goes up!

MAKE IT AN EXPERIMENT

The project above is a demonstration. To make it a true experiment, you can try to answer these questions:

- Does the shape of the balloon affect how far (or fast) the rocket travels?
- Does the length of the straw affect how far (or fast) the rocket travels?
- Does the type of string affect how far (or fast) the rocket travels? (try fishing line, nylon string, cotton string, etc.)
- Does the angle of the string affect how far (or fast) the rocket travels?



ONE PARENT OR TWO?

Many fruits and vegetables grow from seeds. Each seed contains the genetic code for a new plant. That code can be a mixture of information from two parent plants, but sometimes it comes from a single parent.

Peas are self-fertile, meaning that a single parent plant can produce seeds that will grow. They don't need bees or wind to bring pollen from another plant to their flowers. Most peas have the same genetic information as their parent. That might be why people say two things that are alike are "like peas in a pod."

Many important fruits and vegetables are not self-fertile. They can only make seeds if they get pollen from another plant. The plants that grow from those seeds may be quite different from each other, and from their parents, because each has a unique mix of genetic information.

Instead of planting seeds, farmers often grow new plants from part of an old plant. Important foods like apples, grapes, potatoes, bananas, strawberries, garlic, and ginger are usually grown from a piece of another plant, not from a seed. New apple trees are usually grown from branches of older trees, potato plants grow from last year's potatoes, bananas from suckers, strawberries from runners, garlic from cloves, ginger from rhizomes…

A plant that isn't grown from a seed is a clone of its parent. That means it's genetically identical to its parent. When farmers grow plants without seeds they know exactly what type of plant they will get.

In this activity, you will grow peas and potatoes. Peas are usually grown from seed but potatoes are not. Both peas and potatoes usually come from a single parent, and contain the same genetic information as their parent.

MATERIALS

- 1 organic potato*
- Green pea seeds
- 4 toothpicks
- 2 jars
- Paper towel or cotton dish towel
- Plate or flat dish
- Filtered water *(if filtered water is unavailable, leave an open container of water on the counter overnight to allow any chlorine to evaporate)*

*Most potatoes in the grocery store have been sprayed with a chemical called CIPC to stop them from growing sprouts. CIPC is not allowed on organic potatoes so they usually sprout faster than regular potatoes. Farmers and gardeners who want to grow potatoes use 'seed' potatoes that haven't been treated with CIPC. At the KPU Farm we purchase organic seed potatoes certified to be virus-free. They're called seed potatoes even though they aren't really seeds.

SPROUTING PEA SEEDS

A. Soak your seeds in a jar of filtered water for at least eight hours. The seeds will expand as they absorb water.

B. Pour out the water. Rinse the soaked seeds with fresh water and drain.

C. Place the seeds on a damp paper towel on a dish and cover with another damp towel. Place the dish in a warm spot.

D. Each day sprinkle or lightly pour extra water on the towel to keep it moist. Drain any excess water.

E. Check your peas each day to see if they have sprouted. They usually sprout after three to five days.

SPROUTING A POTATO

A. Look for little round indents on your potato. These potato 'eyes' are where new sprouts will grow. Turn your potato so that a side with lots of eyes is on top.

B. Poke a few toothpicks into the 'bottom' of the potato to make legs that can hold the potato above the bottom of the jar.

C. Place the pierced potato in your jar. The toothpicks should keep the bottom of the potato from touching the bottom of the jar.

D. Add filtered water to the jar until the bottom 1 - 2 cm of the potato is under water.

E. Place the jar in a cool shady area, like a corner of your kitchen or dining room, for one to two weeks. Replace any water that evaporates. Watch for sprouts.

OBSERVATIONS

Look at your pea and potato sprouts.

- Do they all look the same? The pea sprouts probably look different from the potato sprouts because they have different genetic information.
- Do the pea sprouts look different from each other? They all have similar genetic information, but they might look different from each other because of differences in their environment. Perhaps one pea got a little more water than another, or ended up in the fold of your paper towel.
- Do the potato sprouts look different from each other? They all have the same genetic information, but each sprout is in a slightly different environment on different parts of the potato. The ones that start growing first are usually the biggest.
- Each sprout is the start of a new plant. How many sprouts grew from your potato? How many sprouts grew from each pea seed?
- When they first start growing, the sprouts do not need light. They use energy that was stored by their parent. Pea seeds and potato tubers both contain starch, which is a string of sugar molecules. When the sprouts start growing they break the starch down into sugar to get a boost of energy. If they are underground, the stored energy allows them to grow to the surface of the soil to get the sunlight that they need to keep growing. Did the pea seeds and potato tuber shrink as the stored starch was used up by the growing sprouts?

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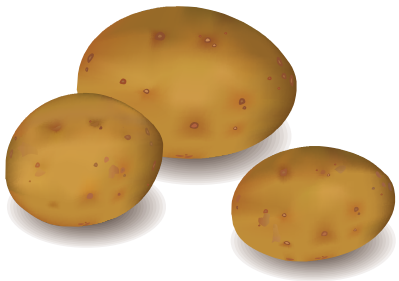
WHAT'S NEXT?

If you don't have a place to plant your pea sprouts you can rinse them off and eat them! They are nutritious and delicious in salads, sandwiches or as a topping on your favourite meals. Don't eat your potato sprouts! Potatoes are tasty healthy food, but the green parts of potato plants can make you sick.

If you have a sunny patch of garden, or even a big bucket of fertile soil, you could plant your pea and potato sprouts and watch them grow. Eventually they could grow new peas and potatoes that you can eat. Here are some hints for growing peas and potatoes together:

- Both peas and potatoes like sunny places that aren't too hot. They grow well if they are started in spring (March-May). Soil should be fertile (add compost), loose, and well-drained. If you are growing in a bucket, it needs holes in the bottom to let water out. Water regularly.
- Pea plants are much skinnier than potato plants. Plant your sprouted pea seeds about 7.5 cm (3") apart from each other, about 2.5 cm (1") below the soil surface. Plant your sprouted potato tuber about 15-30 cm (6" to 1') south of the peas, about 10 cm (4") below the soil surface.
- Peas grow tall quickly and want to climb up to get more light. Plant your peas north of your potatoes and give them stakes or a net to climb. You don't want your fast-growing peas to shade your slower-growing potatoes.
- Peas will start to flower a little more than a month after planting. Because they are self-fertile, the flowers will turn into pea pods without pollen from another plant. Peas will be ready to eat about two months after you plant them. You can also eat some of the pea shoots and flowers! All parts of the pea plant are edible.
- After about two months the pea plants will stop producing new peas and will start to die back. Pull them out to give your growing potato more space. You need to wait three or four months for potatoes to be ready to eat.
- As the potato plant grows you can pile more soil on top of it. Be sure to leave a few green leaves poking out. More potato tubers will grow from the parts of the stem that you bury.
- Around the time that the pea plants start to die back the potato plants will start to flower. Potato flowers that are pollinated may produce little fruits that look like green tomatoes, and contain potato seeds. **Don't eat them.** It is difficult to grow potatoes from their true seeds, and all of the plants would contain a different mix of genetic information, making them quite different from each other and from their parents.
- Potato tubers start to grow below ground around the time that potatoes flower.
- Potato plants die back when the tubers are ready to harvest. Dig them up to collect your new potatoes!



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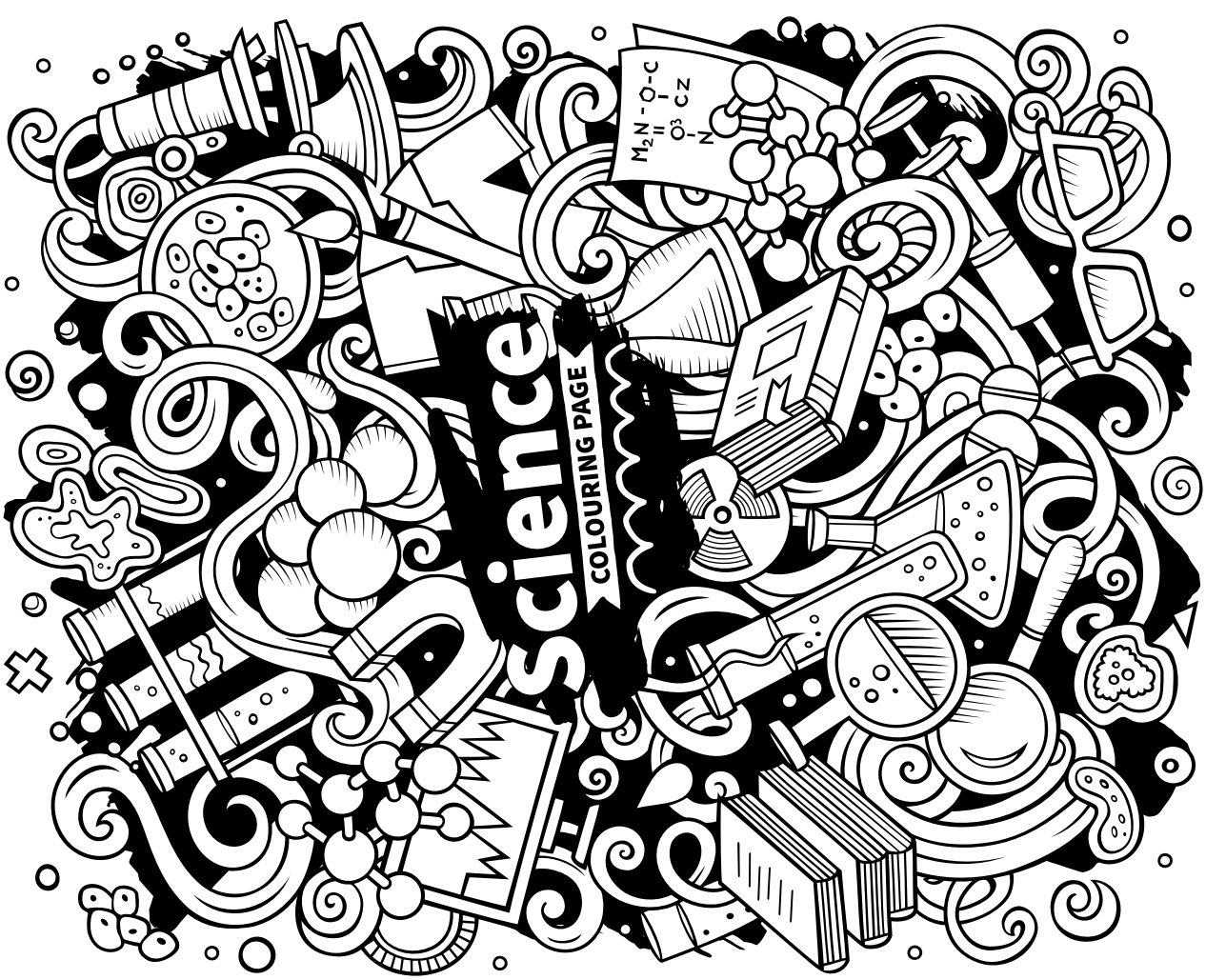
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