SCIENCE CAMPS

Summer Science Activity Book

2020, Edition 1

Grades 4-6

UNIVERSITY OF SASKATCHEWAN
College of Engineering
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Algorithmic Art

Algorithmic art combines computer science and art to create code that helps make works of art. It breaks art creation down into super simple steps like “draw a straight line” or “draw a circle.” It then adds some random elements to it like “draw 5 circles anywhere on the page” to create unique works. These simple steps create something called an **algorithm** (said like *Al-go-rhythm*) which is where this artform gets its name from!

Did You Know? Algorithms are used everywhere, even in your day-to-day life! Examples of algorithms include things like recipes or instructions on how to play games like tag. It can even include things like how to tie a knot or your shoes! They are a simple list of steps telling something (like you or a computer) how to do something. Below is an example of the algorithm for playing normal tag – it only has two steps!

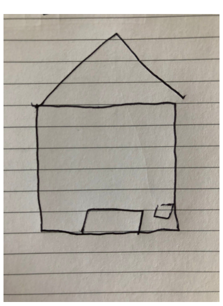
1. If you’re *it*, tag somebody.
2. Or else, if you’re not *it*, run away from the person who is *it*.

The best part about doing algorithmic art is that you **do not** have to use a computer for it. If you were to give an algorithm to another person, they can act as a computer for you and try drawing it! The result might look very different from how you imagined it depending on how specific your instructions are.

Let’s try drawing a house!

Algorithm	Drawing Space!
1. Draw a big square. 2. Draw a triangle on top of your shape from step one! 3. Draw a rectangle inside in the middle of the square, touching the bottom. 4. Draw a small square beside the rectangle, inside the big square.	

Here’s how two of our houses turned out!



Your house probably looked different than ours, and that’s fine! These instructions are specific enough that everybody should end up with the same general shape for their house, but the smaller details might look very different – like the rectangle door or the square window.

You can even make the instructions change depending on certain **conditions**, like changing step one in the house drawing example so it says:

Algorithm	Drawing Space!
1. **If you are wearing a red shirt, draw a big circle. Else, if you are not wearing a red shirt, draw a big oval.** 2. Draw a triangle on top of your shape from step one! 3. Draw a rectangle inside in the middle of the square, touching the bottom. 4. Draw a small square beside the rectangle, inside the big square.	

This makes some changes to the drawing depending on the colour of the shirt you are wearing. You could also use other conditions like "if you're outside" or "if it's morning." A condition is something that you're checking for that can only be **true** or **false**. This is important to remember, as a computer works in ones (true) and zeroes (false). When you check for a condition, you are using **conditional reasoning**. Conditional just means that something "could happen" depending on the result (true or false) you get from checking your condition. So when we check shirt colour in the above example, we're checking what shape we should draw – either a circle or an oval!

Another way to change instructions is to get certain things to **loop** or continue, until a certain condition is met or it's repeated a certain number of times. An example of looping a certain number of times would be this drawing of a caterpillar!

Algorithm	Drawing Space!
1. Draw a circle a. Repeat this five times, with each circle side-by-side 2. Draw a smiley face in the first circle	

You repeat the first instruction five times!

An example of looping while a condition is met:

Algorithm	Drawing Space!
1. Draw a circle a. Repeat while you think the body is too short, with each circle right next to the last one (stop when you think it is long enough!) 2. Draw a smiley face in the first circle you drew	

Here the condition is “you think the body is too short” so you stop when you think the body is long enough! Did you realize you just drew a caterpillar? “😊**OOOOOOO**”

Using these conditions (the “if” statements, and the loops) you can make some pretty unique drawings. You can also make them pretty random. Here’s an example of a random drawing.

Algorithm	Drawing Space!

1. If it’s morning, draw a sun. Else if it’s not morning, draw a moon.
2. If you are left-handed, draw some grass on the ground. Else if you’re right-handed, draw some water for the ground.
3. Draw a bird in the sky
    a. Repeat this two times
4. Draw a cloud in the sky
    a. Repeat this until you think there are enough clouds.	

How Rare Are Your Traits?

What are genes?

Genetics is the study of how genes are passed down from parent to child. Genes are made up of your DNA and come in pairs, one from your mother and one from your father. Think of a gene as instructions on how to make you… you.

Recessive and Dominant Traits

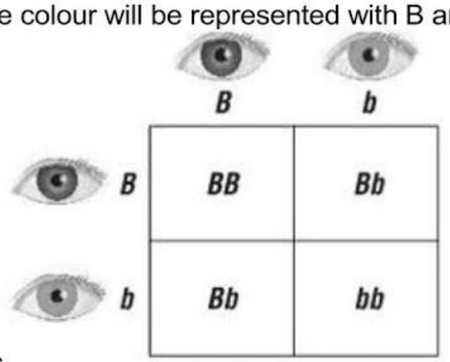
Some genes are more likely to be expressed. These are called *dominant* traits. The ones that are not expressed as much are called *recessive* traits.
Circle the boxes that apply to you:

Freckles	No Freckles
Brown Eyes	Blue/Green Eyes
No Dimples	Dimples
Free earlobe	Attached earlobe
Widow's peak	No Widow's peak
Brown/black hair	Red/blonde hair

The first column is all dominant traits. The second column is all recessive traits.

Can Two Brown-Eyed People Have a Blue-Eyed Child?

Think of dominant traits as a capital letter and recessive as a lower-case letter. These letters can be any of the 26 in the alphabet, but it is helpful to make them something easy to remember.
In this case, eye colour will be represented with B and b.



B = brown eyes
b = blue eyes
Potential offspring can be guessed by using a **Punnett square**.

When **BB** is expressed, the child will have brown eyes because both genes are dominant.
When **Bb** is expressed, the child will have brown eyes because the B gene is dominant over the b gene.
When **bb** is expressed, the child will have blue eyes because both genes are recessive.

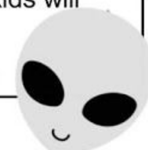
So two brown-eyed people CAN have a child with blue eyes, even if it isn't very probable (about 25% or 1:4)

Your Turn!
Fill in the Punnett squares with each possible offspring outcome!

	p	p
P		
P		

A purple alien and a pink alien fall in love and want to make a baby. What percentage of their potential kids will be pink?

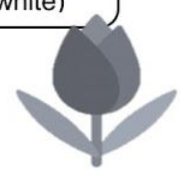
(PP/Pp = purple pp = pink)



	R	r
R		
R		

A gardener is trying to make a pink tulip by breeding a white tulip with a red tulip. What will the outcomes be?

(RR = red Rr = pink rr = white)



	C	c
C		
c		

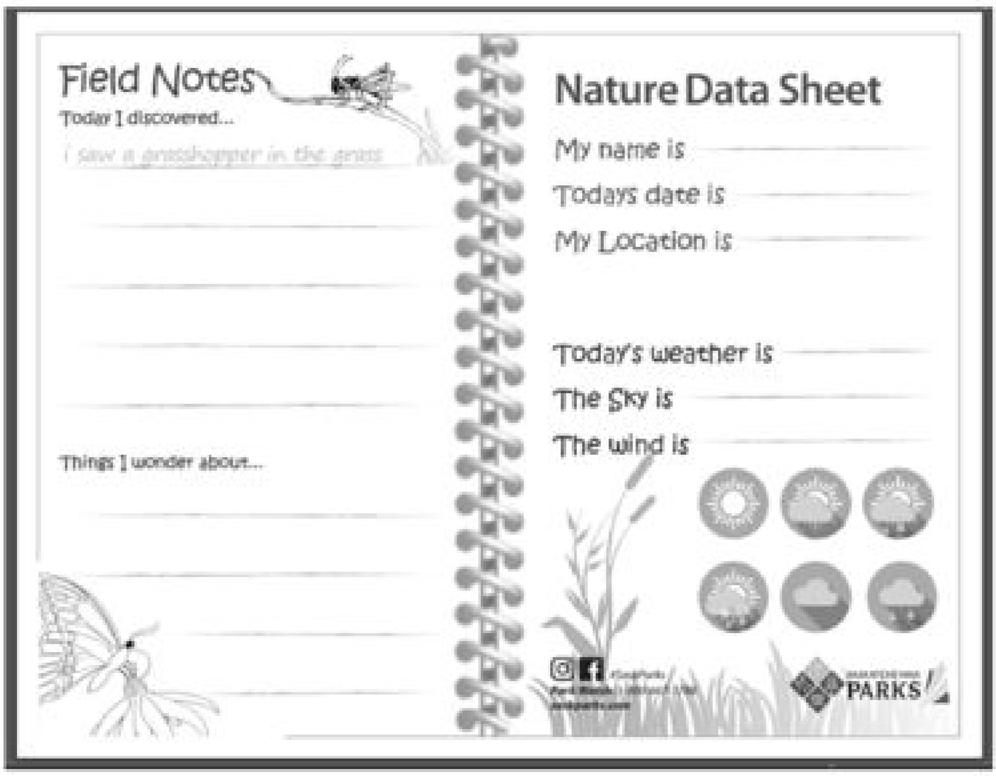
Both of Cookies' parents have dark chocolate bits, but he has milk chocolate. What are the odds of that happening?

Nature Journals

Many biologists, naturalists, botanists and zoologists will use Nature Journals to record their observations when they're out in the wild. A lot of what we know about living things and evolution comes from the nature journals of Charles Darwin. He travelled to the Galapagos Islands 200 years ago and wrote down what he saw in different plants and animals.

You can start your own Nature Journal with just some paper and a pencil! Many biologists now use photography to keep track of what animals or plants look like, but before cameras existed, scientists would have to draw what they saw.

To start your Nature Journal, you can use this template:



Sometimes there is a lot of detail to keep track of, like crazy feather patterns or wacky leaf shapes, so a quick way to get those onto paper is by tracing or doing leaf rubbings.

To do your own leaf rubbings:

1. Take the attached paper (with the grid) and a pencil with you to your backyard or a park near where you live.
2. Write down the different plants you see: trees(birch or evergreen), flowers (dandelions or lilac).
3. Grab one leaf off of a couple different plants. You should notice if it looks veiny or not, how big it is, or if it has different colours on it.

4. Then place the paper over the leaf (try to put the leaf with the more intense pattern or veining facing up) and gently shade over the leaf with your pencil
5. You should be able to see the pattern or the outline of the leaf on your page. You can also do this with grass, or other different textures you find around your house like brick or wood.

Expert tip: sometimes it's easier to take leaf rubbings with a piece of paper underneath the leaf too. Add some colour by using crayons or pastels if you have some!

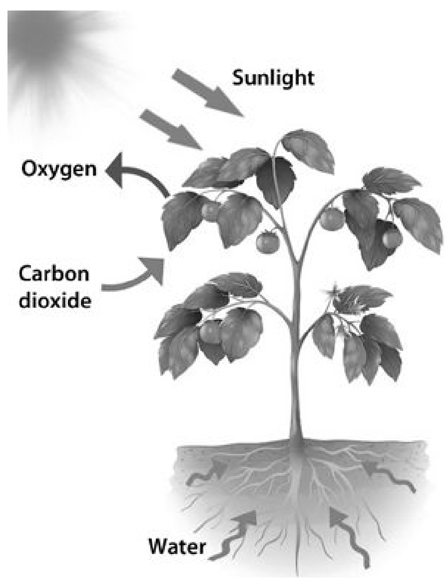
Fill in the boxes below with some leaf rubbings! Or add a drawing of a bird or another wild animal to your budding Nature Journal!

Leaf:	Grass:
Your choice:	Your choice:

Plant Pals - Fill in the Blanks

sun	Carbon dioxide	water	Earth	photosynthesis	cycle	plants	oxygen

When you go outside today, you'll see lots of greenery around including grass, trees, bushes and flowers, all of which are called 1.________. All plants use a process called 2.________________ to get energy from the 3. ______ and make their own foods. You can help plants do this by giving them 4.______ which they soak up from the soil. Leaves are super useful for plants; they provide lots of space for the plant to absorb 5.________________ from the air. When you breathe, you take in 6.________ and breathe out carbon dioxide, but for plants, it's the opposite: they take in carbon dioxide and produce oxygen as a byproduct. This creates an oxygen 7._______ which is maintained by every plant and animal on 8.________.



ANSWERS 1.plants 2.photosynthesis 3.sun 4.water 5.carbon dioxide 6.oxygen 7.cycle 8.Earth

Fun with Falling

Have you ever wondered why insects can fall from great heights and not be harmed but a human can fall from only a few meters and be seriously hurt? This phenomenon is explained by the laws of physics.

Your size plays a very important role in how you experience the world around you. A simple example is the surface tension of water. **Surface tension** is a force that makes water stick to itself, you can think of it as a glue. For humans the force of water holding itself together is basically unnoticed, you can swim in a lake without worrying that the water will hold you in. However, for small animals, water poses a real threat. If an ant was accidentally caught in a water droplet it would be unable to escape. The ant does not have enough strength to overcome the surface tension of the water.

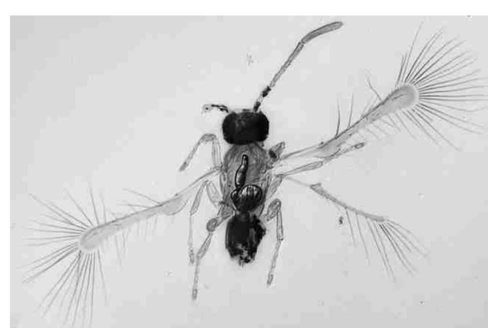
The smallest insect on earth is the *fairyfly*. At a length of only *2 millimetres*, it is almost invisible to the naked eye. For perspective, the fairyfly is nearly **400 times smaller** than the average ant. The fairyfly's perspective of the world is completely different from humans. For example, fairyflies are so small that the air around us is like syrup to them. Instead of normal wings, fairyflies have hairy arms that reach out and grab the air around it, essentially pulling itself through the air. From the fairyfly's perspective, the air is like a giant swimming pool that it can swim through instead of flying.

Now you may be asking what does this have to do with falling. To land safely from a fall the force of the object hitting the ground cannot be very high. Insects are very small so their surface area, the outside of them, is fairly close to their volume, the amount of stuff inside them. When insects fall there is a large amount of surface area compared to volume for the force to distribute so they don't get hurt. You can drop an ant from a plane and it will land unharmed!

Activity:

- Investigate the concepts you have just learned.
- Find objects around your house or backyard to drop from different heights.
- Observe how quickly these objects land and how hard they hit the ground (be careful not to break anything or damage your floors!!).

fairyfly



Using the space on the next page write down your observations for each object.

Did it bounce? Did it float? How fast did it fall? How hard did it hit the ground?

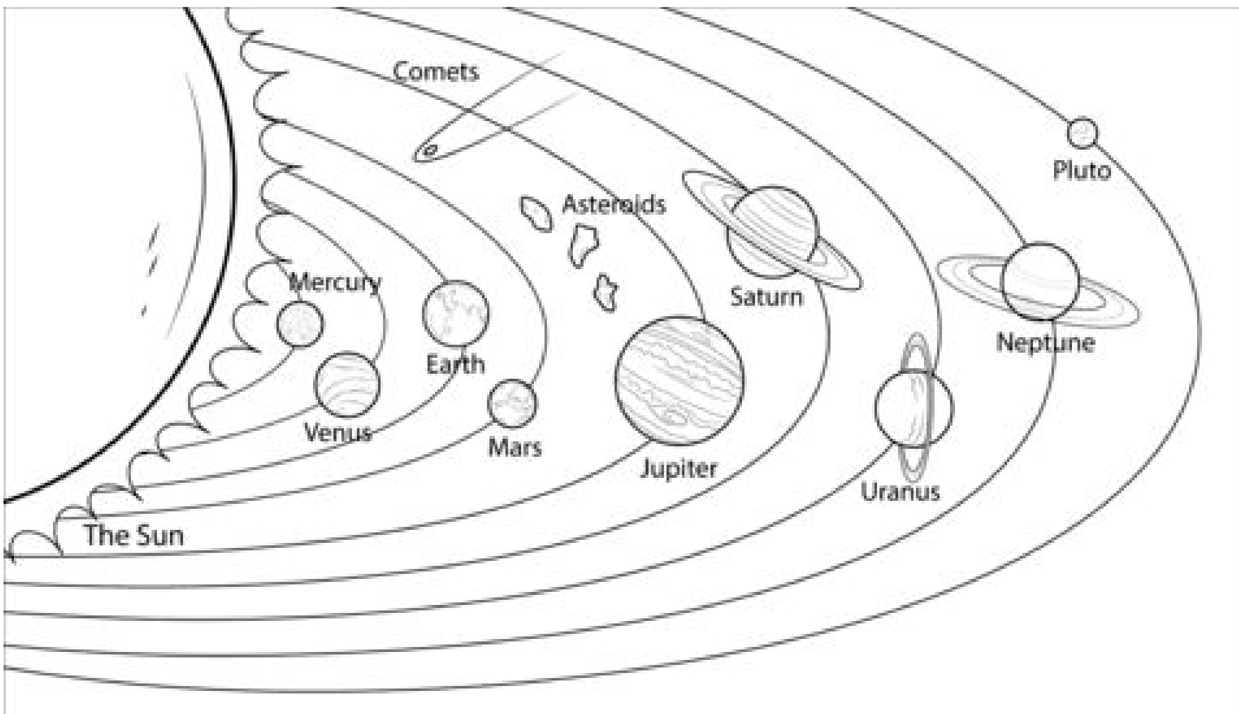
Object:	**Observations:**
Pencil	
Book	
Plastic cup	
Leaf	
Rock	
Choose your own	
Choose your own	
Choose your own	

You should notice that smaller objects drop slower, and objects like leaves that have more surface area than volume float slowly to the ground. Larger objects drop faster and harder.

How Old Are You REALLY?

We measure our age in years. We know that if you were born in 2010, you're about 10 years old. We also know that each year is about 365 days long. But what exactly is a year? Why does it last that long?

A **day** is how long it takes for our planet to rotate in a complete circle. Between lunch yesterday and lunch today, we've all spun completely around and back again. A **year** is how long it takes for our planet to fully revolve around the sun. Between your last birthday and your next birthday, our planet will have moved almost 150 *million* kilometres and ended up in pretty much the exact same place. That's a huge distance - our entire province is only 1,200 kilometres from bottom to top. That means you would need to go up and down Saskatchewan 125,000 times a year, or 342 times a *day*, to go as far as the earth travels each year.



This is our solar system. We're the third planet from the sun. If we take 365 days to rotate around the sun, what about all the other planets that are a whole lot further away? Well, just like you'd expect, those planets take a whole lot longer. On Uranus, the second-last planet pictured, it takes an entire human lifetime to rotate the sun – about 84 years. That means if you're 84 years old on earth, you're still just one year old on Uranus.

Now, let's find out how old you really are on all of the planets in our solar system!

For this activity, you'll need a calculator (or a calculator app, or google "calculator")

First, calculate your age in days.

We will start by getting exactly how old you are in days, months, and years. Just count how many months since your last birthday, and how many days since the start of the month.

For example: if you are 10 years old, your birthday is January 1st, and today is July 5th, then you are 10 years, 7 months, and 5 days old.

My age	*in days*		
Years	___________	**x 365**	=
Months	___________	**x 30**	=
Days	___________	**x 1**	=
		Total	**= _________**

Multiply each number by the multiplier and add them all together.

For example, if I am 10 years, 7 months, and 5 days old, I am:

10 x 365 = 3650

7 x 30 = 210

5 x 1 = 5

*3650 + 210 + 5 = **3865** days old*

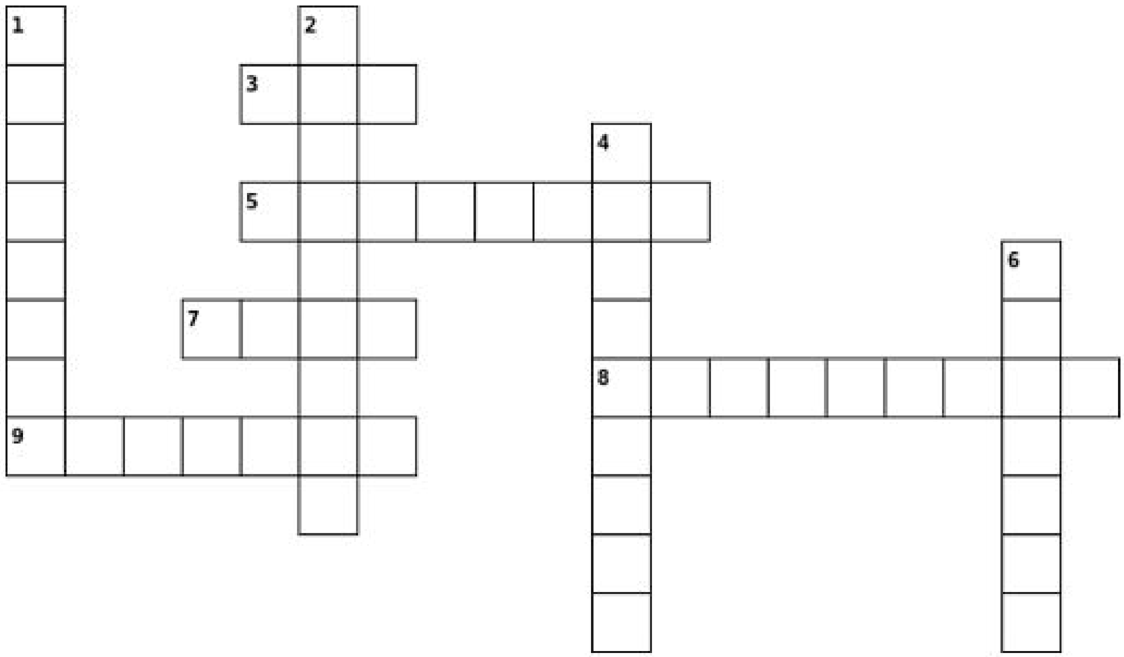
Now that you've figured that out, you can see how old you are on every planet in our solar system! We're going to do that by **dividing** your age in days by the amount of time it takes for a year to pass on that planet. When the calculation asks for your age, **use your age in days!**

For example, if I am 3865 days old, I can calculate 3865 / 365 to see how old I am on earth. I am about 10.6 years old. We already knew that – let's try some we don't know!

Planet	Time to orbit sun	Calculation	I am this old:
Mercury	*88 days*	*age / 88*	=
Venus	*225 days*	*age / 225*	=
Earth	*365 days*	*age / 365*	=
Mars	*687 days*	*age / 687*	=
Jupiter	*11.8 years*	*age / (11.8 x 365)*	=
Saturn	*29.4 years*	*age / (29.4 x 365)*	=
Uranus	*84 years*	*age / (84 x 365)*	=
Neptune	*164 years*	*age / (164 x 365)*	=
Pluto	*248 years*	*age / (248 x 365)*	=

Note: for the calculations with brackets, make sure to put the brackets into the calculator just like it is shown. If your calculator does not have brackets, you can do the calculation in two steps: calculate inside of the brackets first, then divide your age by that value. For example, if my age is 3865 and I want to know how old I am on Pluto, I find that (248 x 365) = 90,520, and then I find what 3865 / 90,520 is. Hint: It should be very small!!

Let's Test Your Knowledge



Across

3. it is the length of the time our planet takes to rotate in a complete circle

5. The smallest insect on earth is __________

7. the length of the time our planet takes to fully revolve around the sun

8. When you check for a condition, you are using conditional _________

9. A force that makes water stick to itself is Surface __________

Down

1. Genes that are more likely to be expressed are called _______ traits

2. The name of the island that Charles Darwin went to 200 years ago

4. A simple list of steps telling something (like you or a computer) how to do something

6. Potential offspring can be guessed by using a _______ square

ANSWERS:
Across: 3 – day, 5 – fairyfly, 7 – year, 8 – reasoning, 9 – tension
Down: 1 – dominant, 2 – Galapagos, 4 – algorithm, 6 - Punnett

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