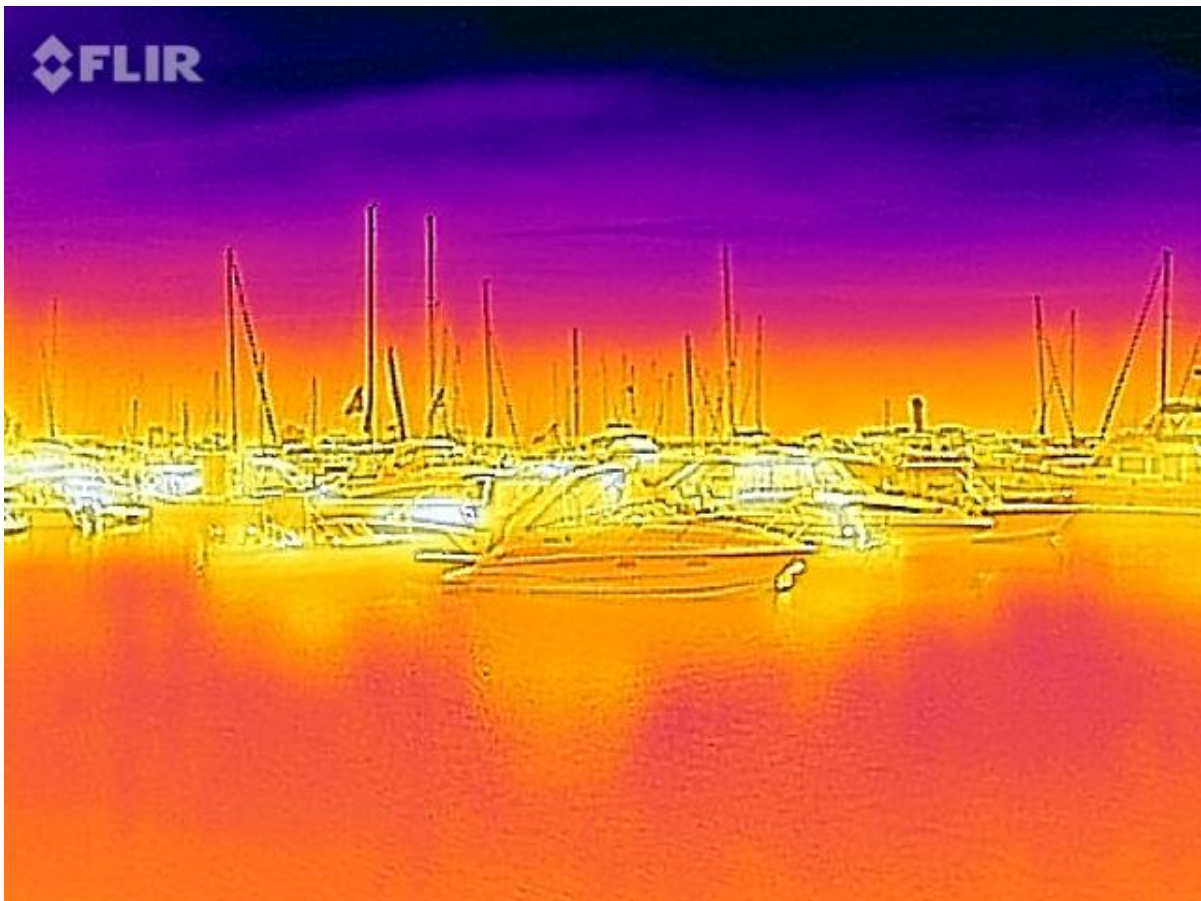


Love STEM with **Hopscotch**

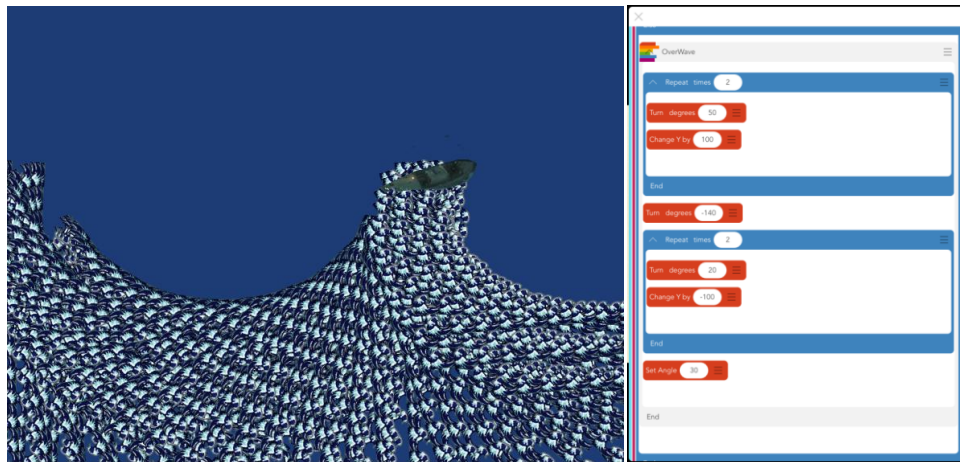


Diane Boulanger

Love STEM with Hopscotch

Based on real events that happened in 1952, the movie *Finest Hours* shows a captivating example of growth mindset. During a colossal storm, two oil tankers broke in half and the Coast Guards of Port Chatham had to rescue the survivors of the SS Fort Mercer and the SS Pendleton. To go to see, the boats must pass over the bar to find the stern of the tanker. Knowing the extreme difficulty of navigating the storm, fishermen discuss with Bernie Webber the impossibility of crossing the bar in such a weather situation. The fishermen show a fixed mindset and recommend to Bernie to try to go out in vain and return empty-handed. However, with his courage and a growth mindset, Bernie says he is not sure of being able of getting there, but that he will try and do his best. Bernie and his crew manage to rescue 32 members of the SS Pendleton.

One wonders what is the relationship between the movie and mathematics? To pilot his boat, Bernie must show mathematical knowledge. He listens to the sound of the waves and must time the interval between the waves in order to be able to cross them. He must also assess the angle of his boat with the angle of approach of the waves in order to face them. Finally, Bernie has to adjust the speed of his boat when passing over the wave. Students can put themselves in the shoes of this great character by creating a Hopscotch game that simulates the outing at sea.



Name of the program: The Bar <https://c.gethopscotch.com/p/y9a42d394>

It is an inspiring film to link the text of the movie with mathematics. Readers write a reading response using Hopscotch. In the Hopscotch simulation, high waves occur regularly and the CG-36500 tries to cross the bar. A sea waves program is already available on Hopscotch. It can be remixed and modified by adding a picture of the CG-

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36500 itself, taken from the Internet, and programming the angles and time required for the boat to cross each wave. The program is interactive and responds to commands easily programmed with Hopscotch. This type of reading and reading response will most likely help students develop a positive attitude toward science, technology, engineering and mathematics, while having fun.

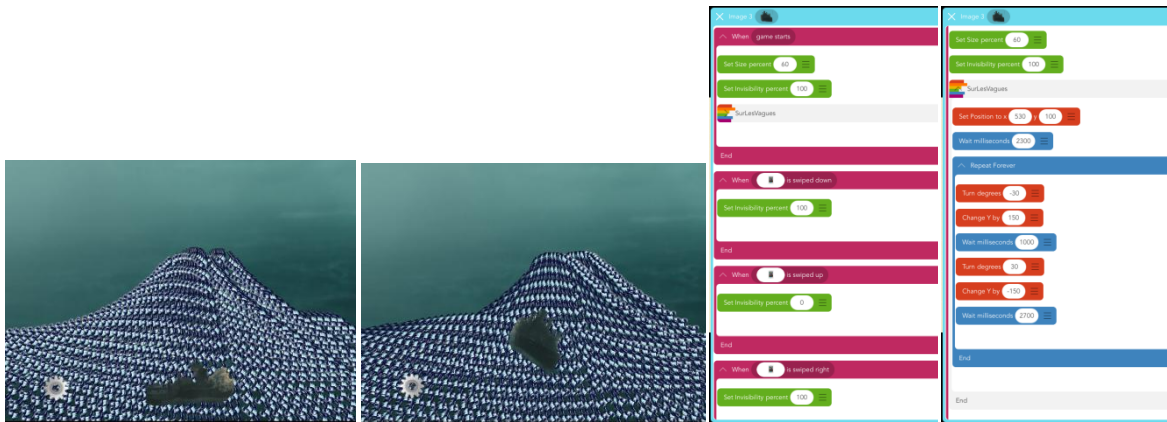
To be successful in Science, Technology, Engineering and Mathematics (STEM), students must have a growth mindset and a positive attitude towards STEM. This example uses the following strategies. We use a visual element that gives artists a way to express themselves. We make a mathematical link that is relevant to students, since they have probably seen the movie on the big screen with their parents. One integrates the real life of a boat captain in the problem to be solved. We use what students like, an excellent Disney movie and technology. A simulation game is programmed that students can play, once completed. We show the value of mathematics by making meaningful connections and how this serves to save human lives. Since there are many ways to write a simulation, you can reduce anxiety about mathematics by allowing the writing of simple or complex simulations. In this example, when you press the iPad, or the iPhone, the boat springs over the wave. The boat changes its angle and rises and descends. By putting yourself in the shoes of a really inspiring character, one can realize that it is possible to change one's intelligence and do math that makes a huge difference.

As important as students' growth mindset towards learning mathematics is adult's mindset towards his students. If a teacher believes that her students are limited, she will have very low expectations of her students and will not give them appropriate challenges. Students become smarter when they have growth mindset and have stimulating mathematical work (Seely, 2016).

In the movie *Finest Hours*, there is another character who has a superb growth mindset. It is Ray Siebert who works in the engine room of the oil tanker SS Pendleton. He observes very closely the hull of the boat and realizes by the sound of the metal that the boat can break with the waves of the storm. The captain with a fixed mindset towards the machinist, do not trust him. Siebert warned his captain, asking him to slow down the ship. The captain does not take any account of his observations and it costs him his life. The SS Pendleton breaks in half, and half the boat sinks. Without any officer

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present, Ray Siebert directs the crew to the highlands in order to immobilize the vessel and give the coast guard the chance to find him.



Nom du programme : Pendleton <https://c.gethopscotch.com/p/yaznrndn68>

Mathematics for Engineers

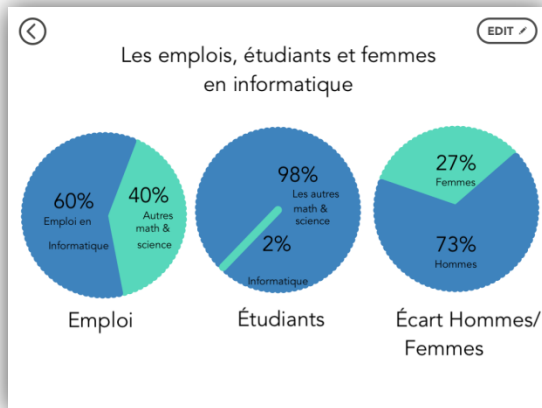
The movie *Finest Hours* also reminds us of what our world looked like before the computer age. We had boats and automobiles with mechanical mechanisms, analog radars, shortwave radio. There were no satellites, no computerized weather monitoring system, no computerized security system, no digital camera, no infrared camera to see in the dark, no computer, no Internet to inform us. It was a world that today's students have never known. Do we want to return to this world without digital technology? What do most people think?

In the current context, with our technological and digital world, I was wondering what kind of mathematics is most needed now and in the future. Is something missing in the current teaching of mathematics? I think mathematics behind technology, mathematics behind science and engineering, are fundamental to continue building our economy. Prime Minister Justin Trudeau wants to ensure that Canada's education system meets the challenges of the future, that Canada can play an important role in the world. He leads the Hour of Code movement in Canada.

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The work opportunities for future engineers, for students who know how to code, are enormous. Here are CODE.org statistics. In the area of mathematics, science and technology, 60% of the jobs available are jobs for people who know how to code. And if you look at the number of graduates in mathematics, science and technology, only 2% have the necessary training to be able to work in this field. Of those qualified, only 27% are women. Also, most parents want their children to learn to code, but only 1 out of 4 school principals offer programming courses at their school. How can we teach mathematics to inspire future engineers?



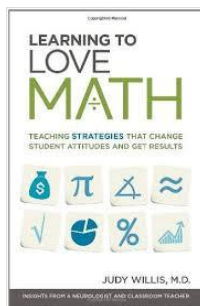
What can we do to give each of our students a better chance to have access to a current field and which benefits are phenomenal? Our youngsters have the chance to use computers and all of their products. They are often more familiar with their usage than us. However, few of them have the opportunity to see the other side of the coin and gain the knowledge to create what they use in their daily lives. One of the best ways to

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include all our students in computer science is to introduce them to computational thinking while very young, before negative attitudes are formed. By starting young, they will have the chance to develop personal ties and interests towards computers, while having fun. We can make connections between computational thinking, our entire curriculum, and the interest of all our students. We can make connections between the math behind computers and the world.

Develop a growth mindset towards math

Many students have a fixed mindset towards math. Math is often taught with worksheets and without making deep connections with the real world. This does not give students the means to develop their real potential. Moreover, popular culture shows that it is acceptable to hate mathematics. Well-known actors like Angelina Jolie and Harrison Ford are an example in some of their films (Hollywood Hates Math). What are the next steps to be followed with such a general fixed mindset in society and with our students? Under these conditions, teachers must redouble their efforts to develop a growth mindset towards math. In her book "Learning to love math", Judy Willis, suggests strategies based on brain research to improve students' attitude toward mathematics.



Conferences with parents

Where can we get help? Since much of the child's brain development takes place at home, it is very important to involve parents and make the connection between mathematical success and the child's growth mindset. Mathematical success is not only demonstrated with good grades on the report card, but also with a positive attitude. It is

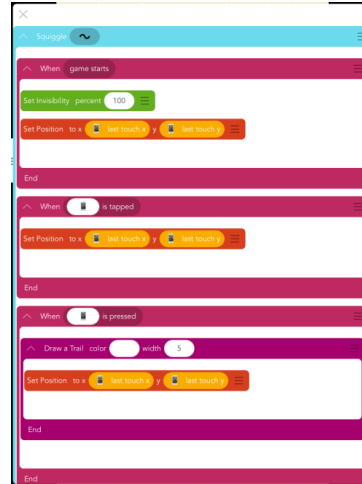
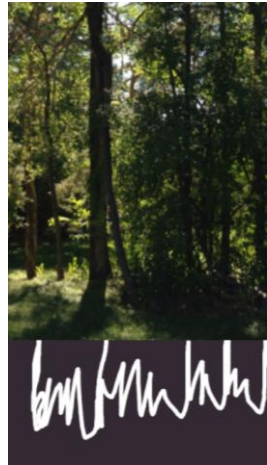
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conceivable that a gifted student with a fixed mindset develops his mathematical skills more slowly than a student with learning difficulties but with a growth mindset. It is also conceivable that a student is very stressed because of the enormous pressure exerted by the parents to demonstrate with tests that his child is gifted. This stress affects the development of the child. Establishing a classroom and home environment where the student can develop a growth mindset becomes paramount.

With parents working collaboratively with the teacher, one can find ways to integrate the student's interest with mathematics. Since students are generally interested in technology, getting an iPad or a home iPhone with the free Hopscotch application will greatly encourage students towards STEM. A subscription to Hopscotch offers more features, including the use of photos. I met parents who at music concerts on Saturday night gave an iPad with Hopscotch to their children to encourage them to code, while they relaxed by listening to the music of the recital. Other parents started coding with Hopscotch with their daughter from the age of 5 because they see and understand the importance of coding and want to give their children all the tools necessary to succeed and accomplish wonders.

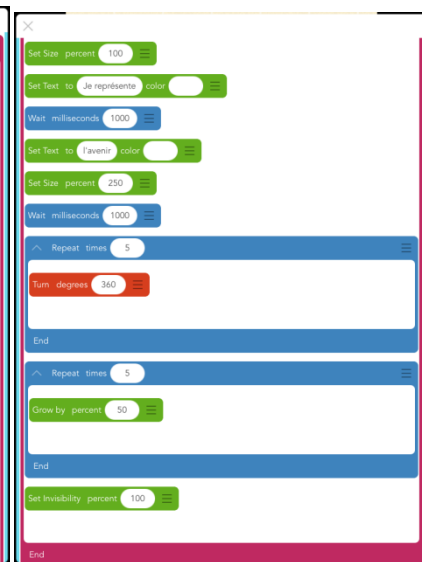
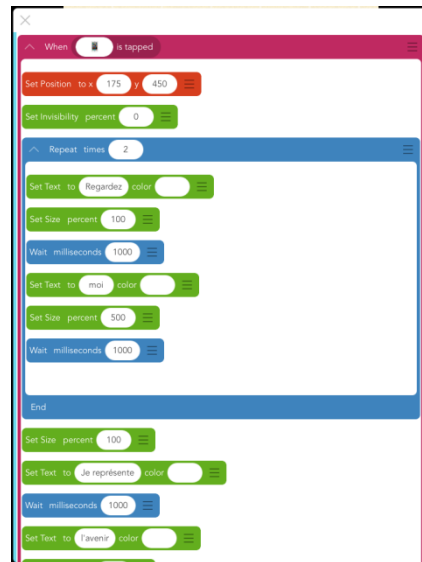
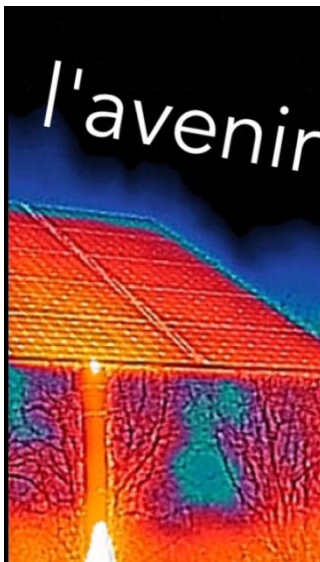
Did you know that trees can talk? This is the result of research by scientist Suzanne Simard (2016) who was inspired by the giant trees of British Columbia since her childhood. By using radioactive isotopes of carbon, birches and fir trees have a different carbon conversation, each season. The two species of trees work together. They also communicate with nitrogen, phosphorus and water. Also, older trees feed younger trees, which should inform us to make a better choice in cutting trees in a forest. In this Hopscotch program, one can see the communication between the trees using the roots. The lines of communication between the more mature trees and the younger trees take shape interactively, by sliding their finger on the iPad or the iPhone.

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Name of the programme : Les arbres parlent <https://c.gethopscotch.com/p/y9bte3tny>

ISTE offers technological standards for the entire international community. The ISTE standards of 2016 added computational thinking to the technological standards. Computational thinking helps develop understanding and find solutions using technology. The technology most certainly includes learning to code with Hopscotch, but also to use other tools like a microscope or even an infrared camera. If used at home, these tools will involve parents in their purchase, use and visiting educational places. Each Hopscotch program written with an image taken from outside requires being approved before being shared with the Hopscotch community.



Name of the program: Media <https://c.gethopscotch.com/p/y9baf92wo>

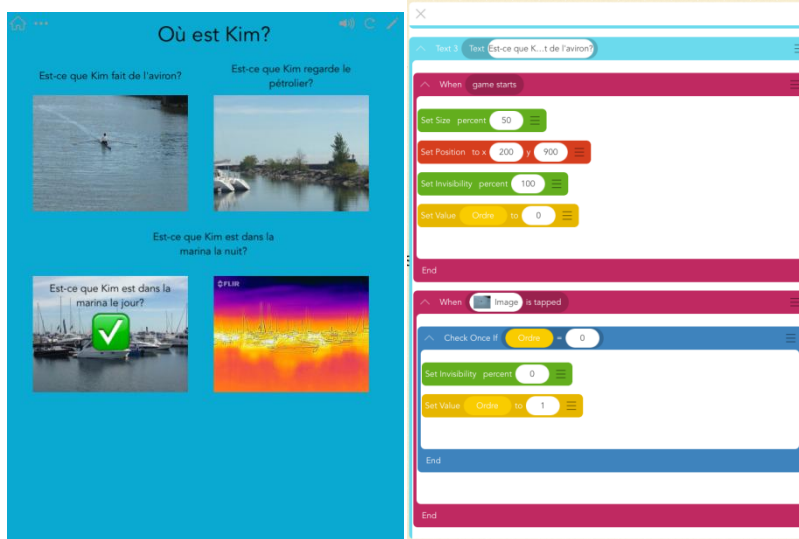
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We see here an infrared photo of a solar panel taken during an field trip to the environmental center Camp Kawartha. The Hopscotch program shows several animated advertising texts with a position on the screen, angle and size of the letters that change. The text even rotates. With such an interactive product, Cartesian points and angles are literally children's games and not a chore.

Redo a test

Children who write a test at school do not always get the best marks because of the stress of the test, the memory gaps and the time limit. Judy Willis recommends repeating a test if the test result is too low. Have we neglected anything? Hopscotch allows for much more evaluation. The teacher can do an assessment for learning before starting any Hopscotch project. This evaluation aims to understand what students think before instruction. Subsequently, the assessment as learning provides regular feedback, and provides the basis we use to develop new opportunities for practice. Whenever you share a program with the Hopscotch community, the Hopscotch application offers an assessment as learning, in a safe environment. If the program shared has inappropriate images, the program will be rejected. Hopscotch also offers other ideas similar to the shared program that improves the student's program design and how it is written. The student learns to revise and improve his programs using the feedback he receives from Hopscotch, that is directly related to the program he just shared. During the assessment as learning, students are also encouraged to reflect on their own work and self-regulate their work. After receiving and incorporating a lot of feedback, the assessment of learning will necessarily be better while using the evaluation criteria discussed with the students.

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Name of the program : Rosetta Stone <https://c.gethopscotch.com/p/y8qsxe7th>

It is the same concept of evaluation as the learning that the Rosetta Stone site offers, which makes it possible to learn another language by making mistakes. Errors are normal and encouraged. The student is not punished for making a mistake, error is an integral part of learning. This Hopscotch program, easy to design, mimics an exercise of Rosetta Stone. A question is asked and two answers are possible. If the wrong answer is selected by pressing the wrong image, the exercise must be repeated, and if the correct answer is chosen, the program indicates its agreement with a sound, a check mark and continues the exercise. By not having bad marks for errors, by being able to correct and improve his understanding, the student can maintain a positive attitude towards his learning.

Demonstrate the value of math

Do you know the difference between holography, augmented reality and virtual reality? Holography as it was known with the Star Wars C3PO robot that gives a 3D message from Princess Leia to Luke Skywalker, is a 3D image that can be seen from several angles. Augmented reality that we have known with the glasses used in *Minority Report* to read the future, inserts synthetic images to real-world images that can be projected on a mobile device or glasses. Virtual reality, which we knew with the film *The Matrix*, is an immersive and complete digital experience that creates another reality detached from the current reality of the user. Each of these technologies can be used for

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educational, scientific, or leisure purposes. They raise many mathematical and ethical questions. The encompassing virtual world completely changes the reality of a person who could become at the mercy of traders, as in the case of illegal drugs. It is up to society and each of us to learn and develop applications that will have a positive effect on society as a whole.



Name of the program : Papillon <https://c.gethopscotch.com/p/y7w5w1rxl>

What mathematical subjects were used in this survey? We can see here a simple model of 2D holography that allows to resuscitate a dead butterfly. Aware of the environment, we take the picture of a dead butterfly, and the photo of a place where it could move. The butterfly is animated and it looks like it flies over the water lilies. We created a virtual zoo in 2D holography to raise interest in protecting an endangered species. Saving our environment is a relevant and current goal where mathematics is at the forefront.

Start the year by showing that you are concerned

At the beginning of the year, students were asked what mathematical strategies they liked and which did not help. The purpose of this exercise is to encourage positive experiences they had related to the school. Some schools do not have enough equipment for all students. This does not prevent the teaching of computational thinking. We can use paper, art, repetitive routines like planting seeds or simply images of the lines of codes in order to introduce computational thinking. We can see an

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example of a positive experience. Can we deduce by reading these lines of code, what algorithm will draw a square, which will draw a circle or an octagon? The angles, the number of repetitions are surely clues.

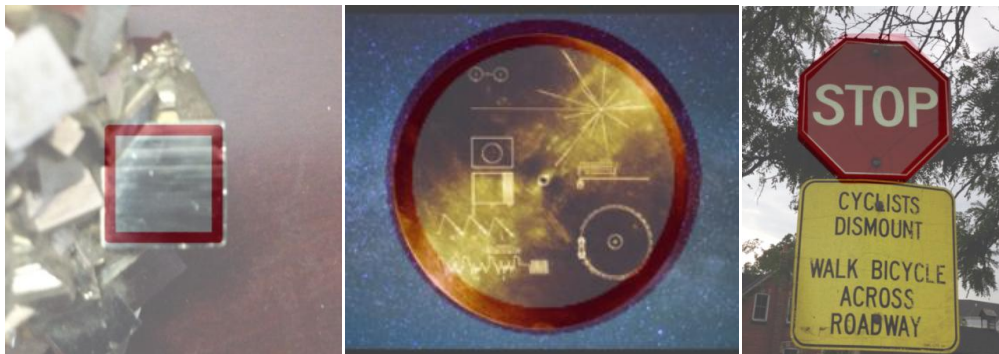


Name of the program : Circle <https://c.gethopscotch.com/p/y96opn250>

Name of the program : Square <https://c.gethopscotch.com/p/y96nf510u>

Name of the program : Octagon <https://c.gethopscotch.com/p/y96pq19n9>

Even if the school does not have enough equipment, some teachers allow students to bring their own equipment to the classroom. Those who have been fortunate enough to have a teacher open to technology, can share their positive experience by showing geometric shapes drawn with the Hopscotch code.

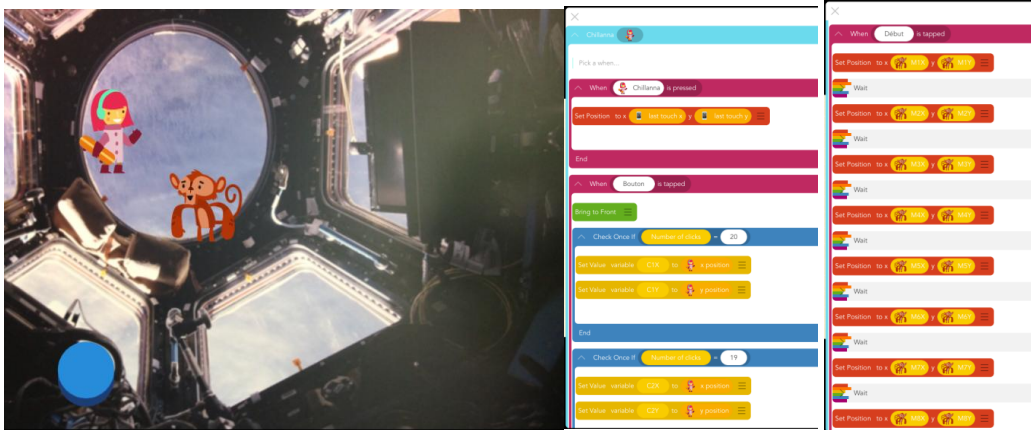


Personally, as a student, the school I attended only had one computer for the entire school. The mathematics teacher therefore established an after-school computer club where students could go and learn how to code. This is how I made my debut, by learning the connection between mathematics and computer science, after school, because it was fascinating.

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Have your students assess you

What would happen if students evaluated our own understanding of mathematics? Report cards and tests are often associated with a very stressful and negative experience. In terms of learning mathematics with Hopscotch, the application offers assessment as learning that allows you to think about how to write a program. With his own device, the student can enjoy coding for long hours at home. Coding with Hopscotch looks more like a game and not solving challenging mathematics problems in an obscure context. Hopscotch keeps a portfolio of all programs published in order to choose its best program for the assessment of the learning. The Hopscotch community offers a large number of examples that can be used to understand computational thinking. We can read a program written by other members of the community to see what is possible to do with Hopscotch and to be inspired by it.



Name of the program : Stop motion ISS <https://c.gethopscotch.com/p/y8zokh8er>

Here we see a program that recreates a stop-motion simulation of astronauts in the international space station. The program is already written and the student only has to play it. Astronauts move in space, and one takes a picture at regular intervals by pressing the blue button. Once completed, the film is replayed and astronauts always move in the same way as it was recorded. By reading the code, we realize that this program uses variables, which record the position of the astronauts on each photo. By recalling the position of astronauts with the variables, the astronauts can be moved to the right place as many times as desired. One can see the possibilities, applications related to real situations in space and see that mathematics with Hopscotch is easily achievable. Hopscotch is an invaluable tool for learning mathematics without negative stress.

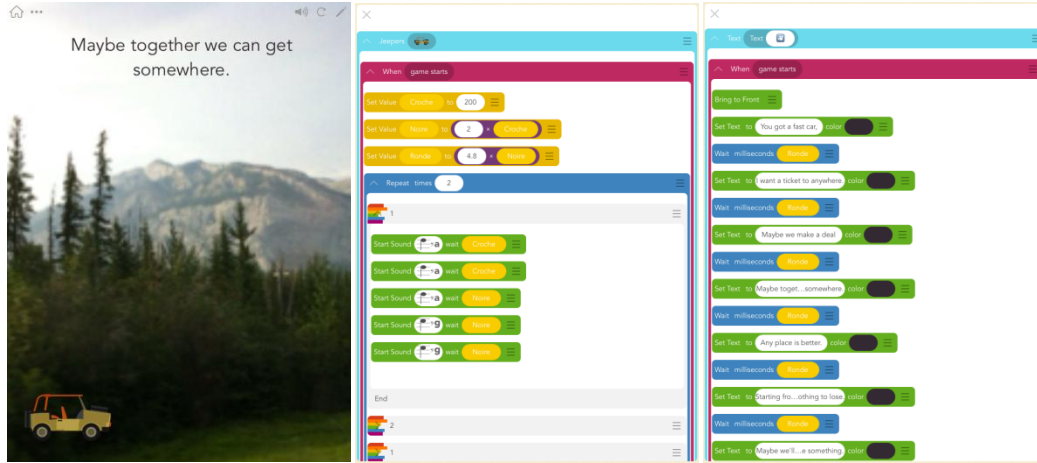
A feasible challenge

How can we begin to think about the problem of the growth mindset with technology? Video game developers are very skilled at creating feasible challenges for their users. These hypnotic challenges encourage users to play for hours and hours to solve the challenges presented. The same is true of programming with Hopscotch. By giving a lot of support, by suggesting somewhat different ideas whenever a program is shared with the community, by suggesting thousands of fascinating ideas, learning mathematics while programming becomes a game, a feasible challenge. Everyone learns little by little, according to their own rhythm, with personally inviting ideas. With Hopscotch, students not only play a game; they go further. Throughout their development, students create innovative programs that allow everyone to see themselves, at an early age, as an innovator. They personify from the very beginning, being developer and engineer.

Use multiple senses

Do students have a strong talent like music? Music awakens pleasant sensations in most people. Music is also filled with a mathematical concept that awakens the senses. Why not use music in mathematics? We can see the relationship between the sounds, the length of each note. One can discover the mathematical relationship between the length of a black note, a white note or an eighth note. We can also add the words of the song and an animation that accompanies the song. It is a quite pleasant way to do mathematics and develop computational thinking for someone who is passionate about music. One can see here the code for the music and the words of the song *Fast Car* of Tracy Chapman.

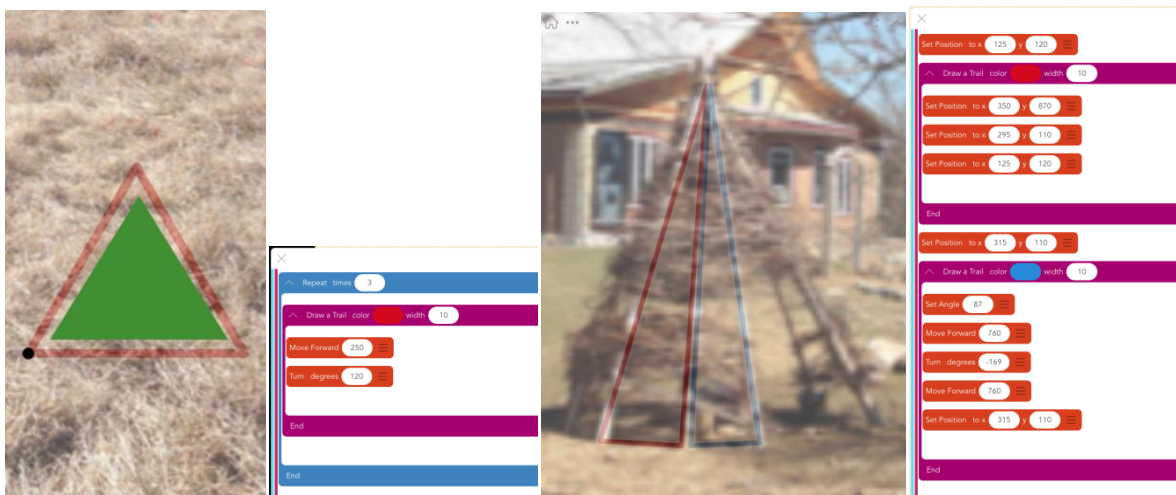
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Name of the program : Fast Car <https://c.gethopscotch.com/p/y8r0h88bh>

Use a flexible grouping

Teachers think it is difficult to have students of several levels in the same class. Do you agree? In a regular classroom, we find students in difficulty who work at a very low level and gifted students who work at a level higher than their grade level. In addition, some teachers have combined classes with two different grade levels. With a flexible grouping, students can work with different groups of students, depending on their skill. Each group is working on a different problem. If the student knows the problem easily, he can change his group and work at a slightly higher level.



Name of the program : DI Triangle <https://c.gethopscotch.com/p/y9feeqvj>

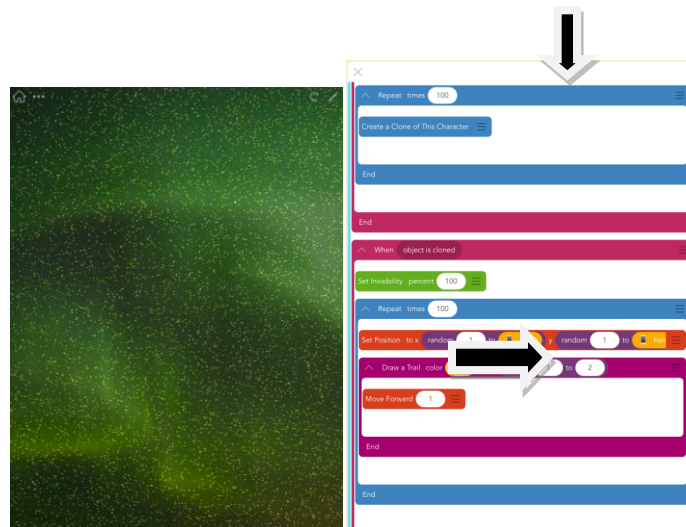
Name of the program : DI Triangles <https://c.gethopscotch.com/p/y9fbp0krp>

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We can see here 3 different algorithms to draw a triangle. The first defines an equilateral triangle, with its three sides of the same length and three identical angles. The other two examples link triangles to first nations life. Tipis are constructed using triangles. Drawing a non-standard triangle requires a different strategy or algorithm. In the second example, the code draws lines between the Cartesian points of each tip of the triangle. In the last example, the code draws the lines of the triangle using Cartesian points and angles. Each project draws a triangle, but using a very different thought. The student who has mastered one type of algorithm can easily switch to another algorithm and push his understanding of the triangles by discussing it with another group in the class.

Support students for a feasible challenge

Students with learning difficulties in mathematics will be more motivated when their results from their work look magnificent and not just problems on paper. Have you ever discussed this with your class?



Name of the program : Nombres d'étoiles <https://c.gethopscotch.com/p/y9e8fumhr>

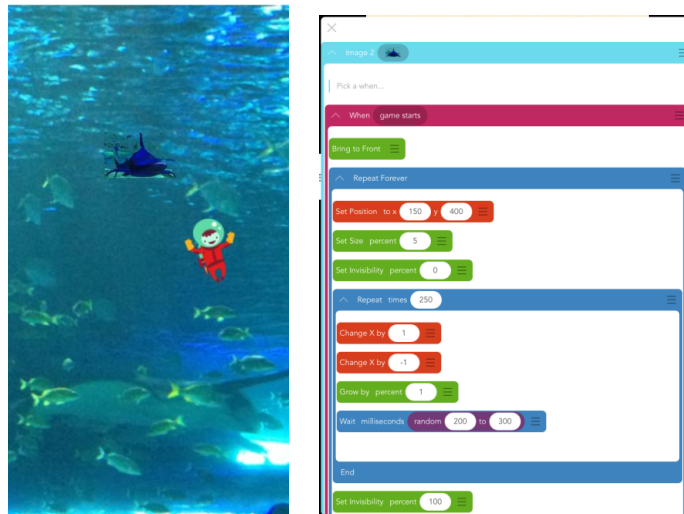
Using the Hopscotch code, one can interactively and visually show the representation of a number and the visual result of a multiplication. The student is supported by showing him how to write the algorithms and how to read them. There are several ways to write an algorithm to have a similar result. In this case, we want to show 1,000 stars in the sky with the aurora borealis. One can draw 1000 points with a single object or we can draw 100 points with 100 objects by cloning our object. Here we see an application of

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multiplication where 100 clones draw 100 different objects. The result is 1,000 stars drawn in the sky. By adding the photo of the aurora borealis at the bottom, we get a quite spectacular picture of nature as a result of multiplication.

Supporting students with reading difficulties

Are there any of our strategies that are not working? Students who have difficulty reading long passages in a language that is unfamiliar or too high for them can use the videos prepared by Hopscotch or those available online to learn computational thinking and deduce the related mathematics. In the radio program *Les Années Lumières* (18.09.2016), francophone teachers from Quebec who had students passionate about technology, mentioned that the English videos of Hopscotch were very easy to follow even for francophone students. Visual element of the video made the understanding obvious. 'Everybody understands'. This makes it possible to have a differentiation of the mathematics according to the interest of the pupils and their level of language.



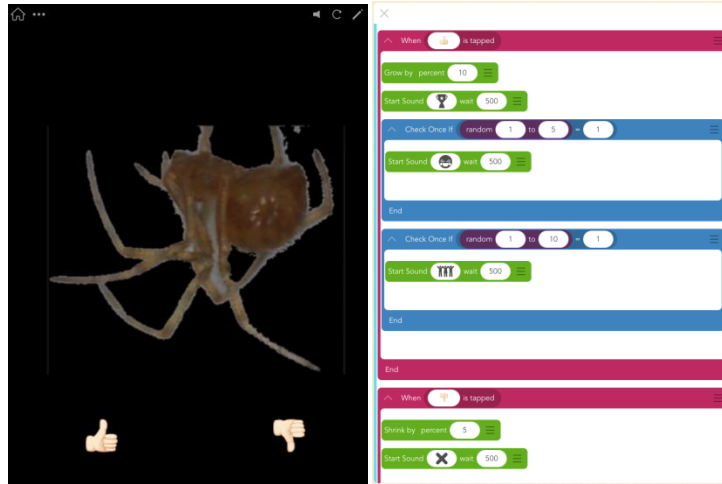
Name of the program : Requin <https://c.gethopscotch.com/p/y7qivrq2b>

One can use videos to learn computational thinking and how to code an idea. Students' interest can be used to code a game or application that interests them. This example discredits a misconception about sharks that are dangerous. The diver is fascinated by the idea of meeting an approaching shark.

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Avoid boring students

The Hopscotch application is filled with ideas at all levels to stimulate student learning. Once the student has mastered a concept, he can very easily switch to another concept, with thousands of examples on Hopscotch. He does not need to wait for the teacher's instructions. He can easily lead his own learning. Moreover, he can use tools of his choice, captivating the imagination of the students.



Name of the program : Spider BIGGAR <https://c.gethopscotch.com/p/y8z5w2ipo>

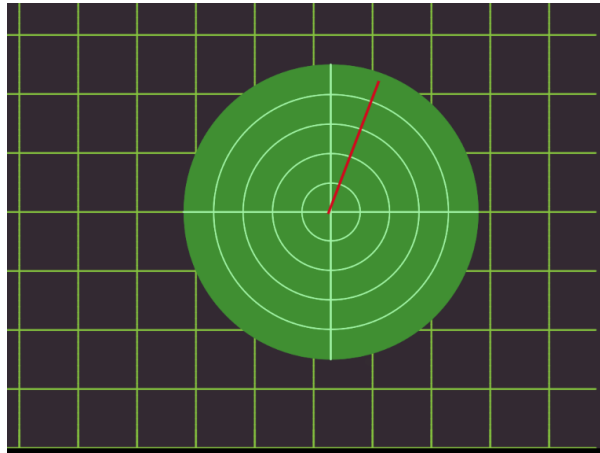
Can we create a model of a microscope? We see here a picture of a spider taken using the ZOOM X microscope whose eyepiece is the iPad or the iPhone. By pressing the buttons, you can enlarge or shrink the image. By adding sounds, the digital microscope becomes a game.

Giving students a mathematical challenge

Gifted students in mathematics can write programs even beyond the teacher's understanding, because the Hopscotch application provides the necessary support. During the Genius Hour, once a week, we can challenge all our students in order to create something they value and that interest them. Is this a reasonable solution, considering your context? This is the same concept that Google uses with their employees. They have the autonomy to work on a fascinating project of their choice if they follow the vision of the corporation. They have a day in a week to build something of their choice that will benefit the business. For example, using this process, an

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employee developed the first prototype of Google glasses in just 90 minutes (Schmidt & Rosenberg, 2014).



Name of the program : Radar <https://c.gethopscotch.com/p/y2vt6dbkp>

Here we see a digital radar developed with Hopscotch. Radars are very important for detecting ships, for air traffic control, in meteorology. They are also used by the military for national defense and even for self-driving cars. The challenges given during Genius Hour will motivate all students, including gifted math students.

Differentiated planning

The differentiated teaching of reading, for example, is a well-known concept. Each student has the opportunity to choose texts at their own level, according to their interest and to give a reading response according to their level and their interest. The differentiated teaching of mathematics, however, is much less widespread and especially new (Small, 2014). Differentiated teaching of mathematics using programming is even rarer in schools. Students in mathematics have the same differences in level and interest as what is observed in language teaching. Differentiated instruction makes it possible to better adapt to the needs of our students by using open-ended questions that can be answered in a number of ways, depending on the level and interest of the students. Using open-ended questions, students learn the same concept, but they respond to the mathematical challenge at different levels.

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Working with Cartesian points and angles

It is possible, for example, to work on the Cartesian points and the angles by drawing microbes in water. How to draw a diagram or a sketch to solve the problem? To draw a line, you must indicate where the line begins (the Cartesian point) and the angle with which the line will be drawn. Here are four different algorithms for drawing microbes.



Name of the program : Microbes <https://c.gethopscotch.com/p/y9bhfuq7z>

Name of the program : Microbes recursion <https://c.gethopscotch.com/p/y9f7xw40y>

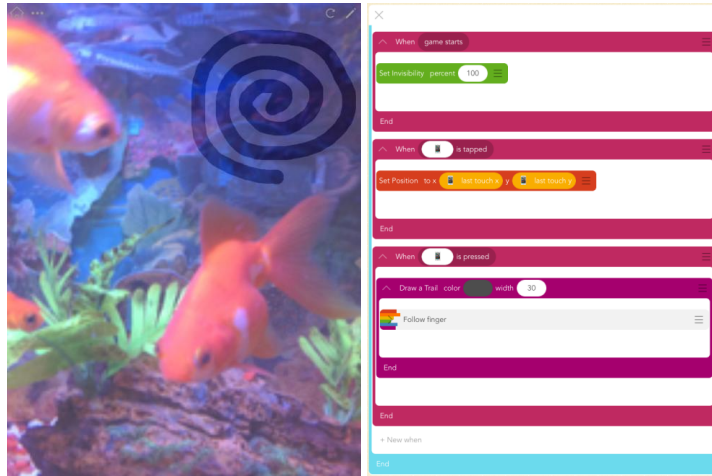
The simplest algorithm is to draw one line at a time using one object for each line. It is also possible to use an object and a loop that allows to draw several lines, one after the other. The student in search of a challenge can use the clones to draw several lines with several objects at the same time. The student in search of a challenge can also use the concept of recursion in order to draw the lines. With recursion, the algorithm draws a line with the Cartesian point and the desired angle and once it is finished, the algorithm recalls itself to draw another line. With an open question, a great idea was taught, but the students responded at their own level, challenging each student.

Working with shapes

The challenge will be in keeping with the students' needs while learning the great mathematical ideas. By observing nature, spirals are observed in several different places. One can notice the shells that have this shape, water that moves in a spiral shape. There is also the tail of a chameleon, different shells and ferns that are formed in spirals with spirals inside the spiral. Draw a spiral with its lines of different sizes and angles show the great idea of the representation of geometric shapes. Each of the following examples

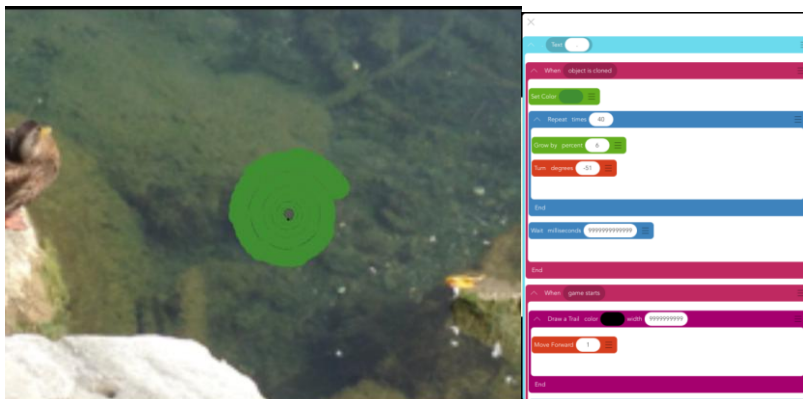
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has a very different level and could be programmed by students of different levels, within a single class; however, each program is an example of the same great idea.



Name of the program : DI spirale <https://c.gethopscotch.com/p/y9f2kbi6>

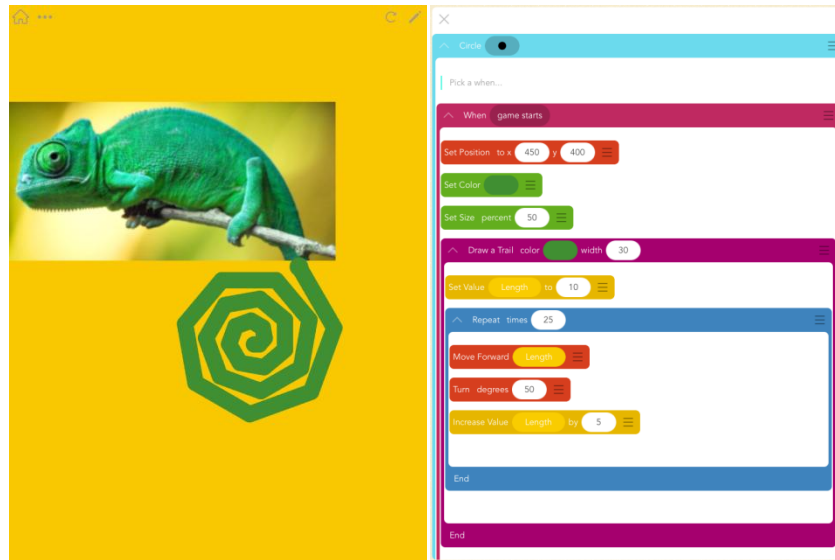
The spiral next to the fish is drawn with the finger by the student. This algorithm is very simple to perform using the 'Follow Finger' function which is already available and written by Hopscotch. Are there alternative solutions?



Name of the program : DI spirale <https://c.gethopscotch.com/p/y9f031mmg>

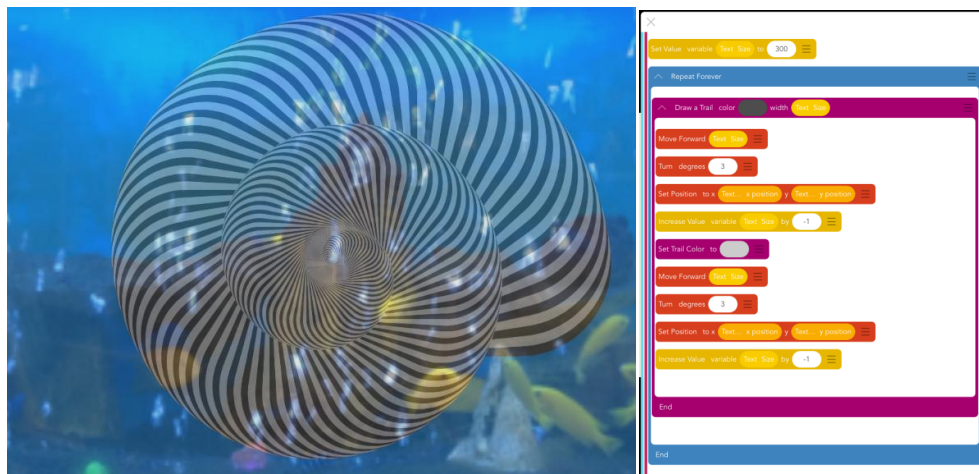
In this example, drawing the spiral requires a more advanced understanding of clones and loops (Repeat). Each point clone will do exactly the same thing and give the effect of the spiral. Each point will increase by 6%, turn 51 degrees and repeat 40 times. What we see is all the clones of a point, but at a different time from their passage in the algorithm. All the points put together give the effect of the spiral.

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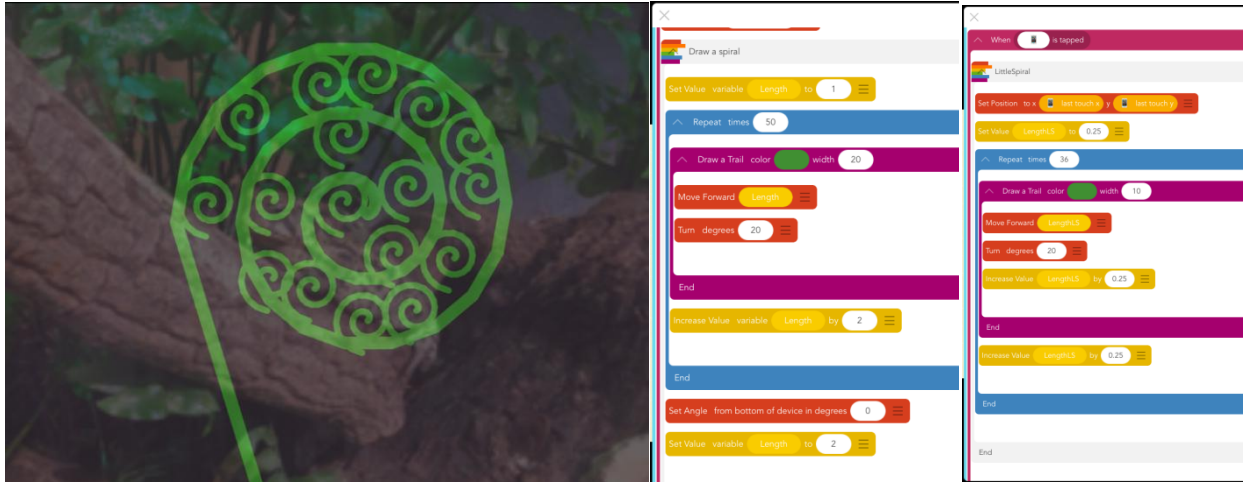
Name of the program : DI spirale <https://c.gethopscotch.com/p/y9f0yrguo>

One might think that the chameleon tail example is simpler than the previous example, but it is actually more complex because it requires the use of a variable. The variable is used to increase the length of each line of the spiral. At first, a small line is drawn, rotated by 5 degrees, the length of the line increased, and repeated 25 times.



Name of the program : DI spirale <https://c.gethopscotch.com/p/y9ezjancz>

The algorithm of the spiral becomes even more complex using two colors, variables created by the programmer for the length of the lines and variables created by Hopscotch which informs us, in this example, on the current position of our pencil tip.



Name of the program : DI spirale <https://c.gethopscotch.com/p/y9f39g337>

Nature also gives us beautiful examples of ferns with spirals inside a large spiral. We have an algorithm for the large spiral and a different algorithm for the small spiral. Each algorithm is placed inside a block created by the programmer so that it can be reused easily. Once the big spiral is drawn, you press the iPad to draw a small spiral where you touched the iPad with your finger.

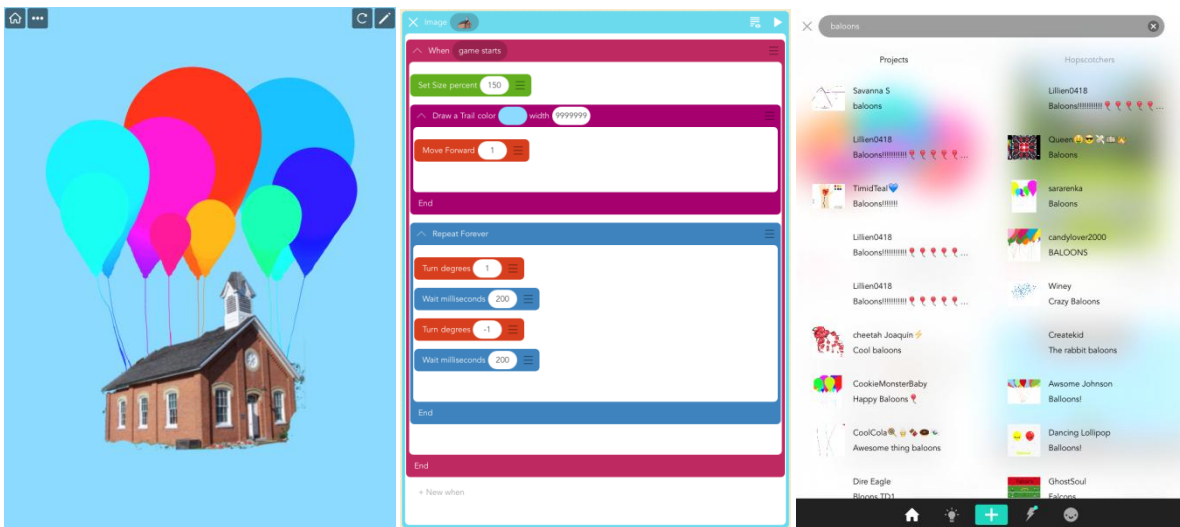
We have an example of differentiated teaching where each student shows his understanding of a great mathematical idea while being engaged and stimulated according to his own level of learning. Everyone feels included and valued since everyone can succeed, whether disadvantaged or gifted. Moreover, this mode of learning is no more difficult for the teacher. It is actually easier because all students succeed with an open question and everyone can share their work with the Hopscotch community. Those who love to code can work at home or in coding clubs and thus develop their thinking, much like athletes, but mathematics athletes.

Growth Mindset

In the movie *Up*, Carl, an elderly man, shows a fixed mindset when a young explorer Russel asks him if he can help. Carl refuses every time. Carl dreamed of traveling, but the circumstances of his life made his dream difficult to achieve. He is surrounded by people

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who want to build new buildings where he lives, but he refuses to sell. He suddenly goes on a journey without leaving his house, using balloons tied to his house. Carl still does not want to talk to Russel who was on the balcony at the time of departure. After many considerations, seeing Russel absolutely terrorized on the balcony which is now at a very high altitude, Carl invites Russel to enter the house and the adventure begins. It took unusual circumstances to change Carl's opinion. What assumptions do we have about mathematics or even computational thinking and programming? It's difficult? Is it for nerds or geeks? It is difficult? Can we ask this question to the students? By reading blogs from other teachers, one can see the perspective of students in other classes. Students present their point of view. Learning to code is fun. This makes it possible to update our dreams. Everyone should learn to code. Programming helps to understand many things. You will have more options at university and in your career (Welcome, 2016). Learning to code is learned little by little. With Hopscotch, all students, from grade 3, can code easily.



Name of the program : Mindset <https://c.gethopscotch.com/p/yaouljnw7>

How to find the information needed to successfully code? The Hopscotch application offers all the necessary support. There are videos explaining how to code our first programs. There are lessons you can buy. There are thousands of programs available that can be read in order to understand the logic. There are also thousands of programs that we can remix and add what we like, even if our programming knowledge is limited.

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What are the steps to follow in developing a project like this? We want to create a house that flies with balloons. Since we do not know much how to code, we will first look for a program of balloons already written and choose something that we like. Using the Magic Eraser application, we will cut out an image of our house, The Old Brittonia School House, and insert it into our Hopscotch program. We will only code the house and use the balloons already programmed by Hopscotch. Third, we draw a blue background for the sky, a point that covers the entire iPad. Fourthly, we make the house vibrate a bit to give the illusion of movement in the sky. We regularly change the angle of the house, waiting a little between each movement. And now, the program is over. To play the game that we just created, we just draw the balloons at the touch of a finger. Would you be encouraged to continue doing mathematics by programming with Hopscotch after writing such a beautiful and interesting program? How do you explain what you learned from the movie *Up*?

In her book *Mathematical Mindsets*, Jo Boaler, refutes our preconceived ideas, that mathematics is only for gifted people in mathematics. In an experiment on the brain, scientists observed the growth of neurons of people who did exercises of 10 minutes every day for three weeks and those who received no training. They noticed that those who did the 10-minute exercises changed their brain structurally. Their brains have resurfaced and developed. This experiment shows that intelligence is not fixed and that it changes with the use of the brain during the exercises. This demonstrates that ALL students can learn mathematics at high levels.



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If students do not believe in themselves, they will not make the effort to solve the problems, believing either that we are gifted in math and we understand right away or that we are not gifted and that we do not understand. According to her studies, 40% of students have a fixed mindset and 40% have a growth mindset towards mathematics. Students with a growth mindset have results that show at least one year ahead of other mathematics students, as assessed by the PISA mathematics tests. It is the kind of encouragement that is given to students that makes a difference.

Mistakes

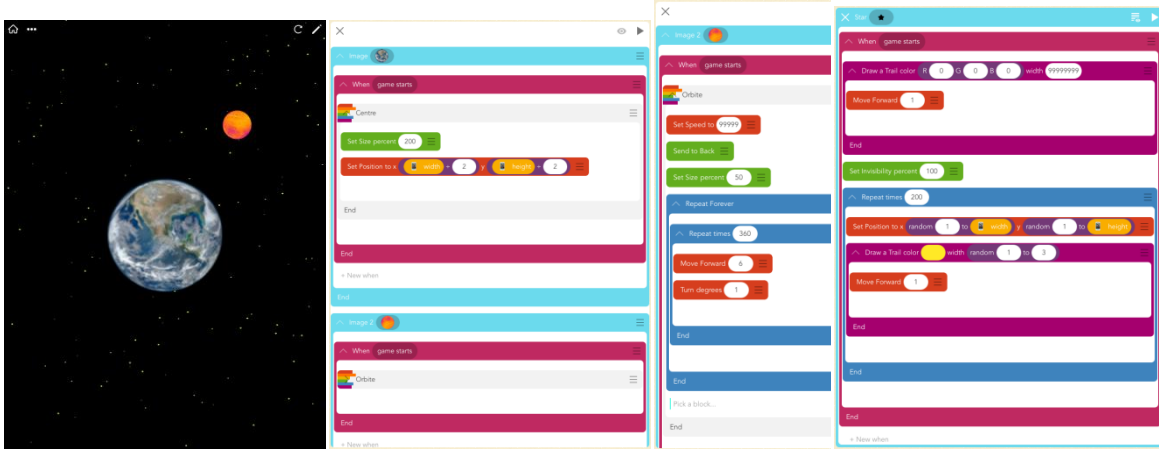
Making mistakes is fundamental to learning. We learn by making mistakes. 'Whenever we make a mistake, our brain develops a new synapse' (Boaler, 2016). The activity of the brain is greater after the analysis of an error. With a positive attitude towards mistakes, learning is done quickly. If mistakes are not appreciated or even, if they are punished, it does not allow students to believe in themselves and keep a growth mindset. This is the nature of learning. It is also the nature of scientific development. Scientists make mistakes and this is normal. This is how scientific knowledge develops.

One can think of the relatively recent decommissioning of Pluto (Radio Canada, 2006). At its discovery, it was thought that Pluto was a planet of the solar system. After further observations, it was discovered that Pluto was not a planet, but rather ancient asteroids of the Kuiper belt, in fact, the brightest and largest object of the Kuiper belt. After many discussions, 2500 astronomers gathered in Prague for an international astronomical conference decided to reduce the number of planets in the solar system to 8 planets. The scientists noticed the error and revised their collective understanding of the astronomy of the solar system. The scientific community has a growth mindset. They have lectures to discuss mistakes. Our understanding of error increases by discussing and bringing more observations about the phenomenon. Scientific knowledge increases with research, observation, problem solving and error correction as our knowledge grows.

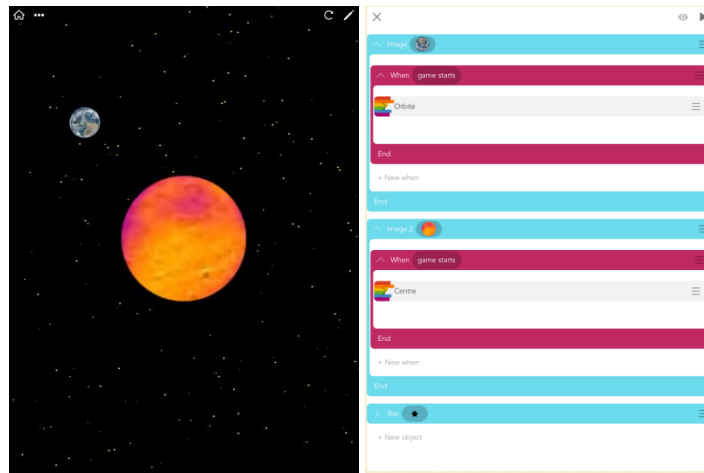
The growth mindset has not always been welcome in the European scientific society. One can think of Galileo. He was professor of mathematics in the Middle Ages, in Italy. His scientific observations have led him to rethink the geocentric model of the solar system towards the heliocentric model. His ideas were not well received by his

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entourage who had a fixed mindset. They refused to consider his observations and conclusions. The clergy asked him, under penalty of death, to withdraw his remarks so as to be able to keep the scientific theory of the time which was erroneous. Here we see an example where the fixed mindset is an established belief and a fundamental belief.



Name of the program : Géocentrisme <https://c.gethopscotch.com/p/yba24upvz>

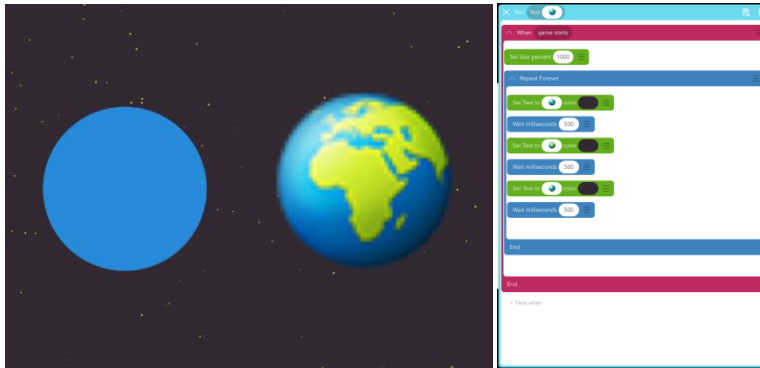


Name of the program : Héliocentrisme <https://c.gethopscotch.com/p/yba2aqs08>

A negative attitude towards being in error is still present today. Most recently, there was a family dispute in Ontario that had to be dealt with by the police because the discussion became very heated (Radio Canada, 2016). One person said forcefully that the Earth was flat and the other that the Earth was round. We see here an example of how a person with a fixed mindset has not learned the concept of round Earth in school, and how he behaves in everyday relationships with his family. How can we interpret

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that there are still people who believe that the Earth is flat and who do not have the growth mindset necessary to realize that the Earth is round?



Name of the program : Modèle de la Terre plate

<https://c.gethopscotch.com/p/yb9zoc457>

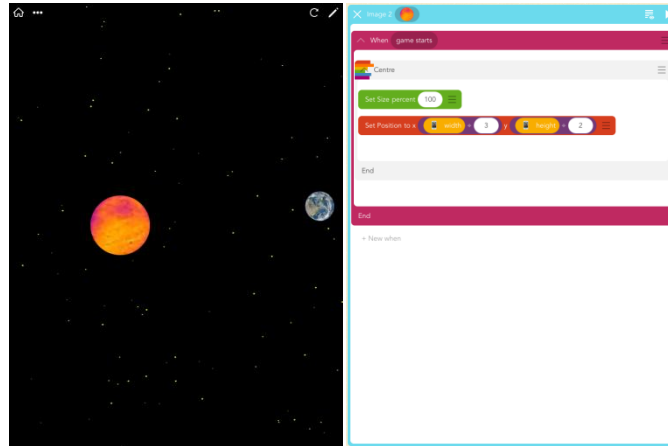
Jo Boaler says that the best thing a parent or educator can do is change the message they give students about mathematical errors, change the message about the importance and value of errors. Students feel much better when they understand that the errors are positive. Have you seen situations where this strategy could be used?

Scientific popular culture shows with the show *'The Magic School Bus'* that you have to take risks and make mistakes to learn. In Ms Frizzle's class, students take risks, make mistakes, make educational trips, experiment, and learn by doing personal projects. The message is that we learn by making mistakes. At the end of each program, students call the producer to correct errors in the program. The *'Magic School Bus'* valorizes the discussion of errors. We show that this is a normal process. This message is not new, but it must also be present in mathematical studies. We must instill in all our students this mentality that allows them to solve difficult problems and to persevere in finding a solution to the mathematical problems.

Jo Boaler suggests sharing our favorite conceptual errors. The teacher can discuss the error with the class and indicate the source of the error and why this is an error. In his book, Micheal Allan (2014) offers many ideas of common errors in science. These errors can also be interpreted as mathematical conceptual errors. For example, many students think that the distance between the sun and the Earth is greater in winter than in summer because the distance between the heat source and the temperature on Earth is proportional. The scientific concept is intimately connected with the mathematical concept. We see here an example of the wrong idea, the planet Earth is further away

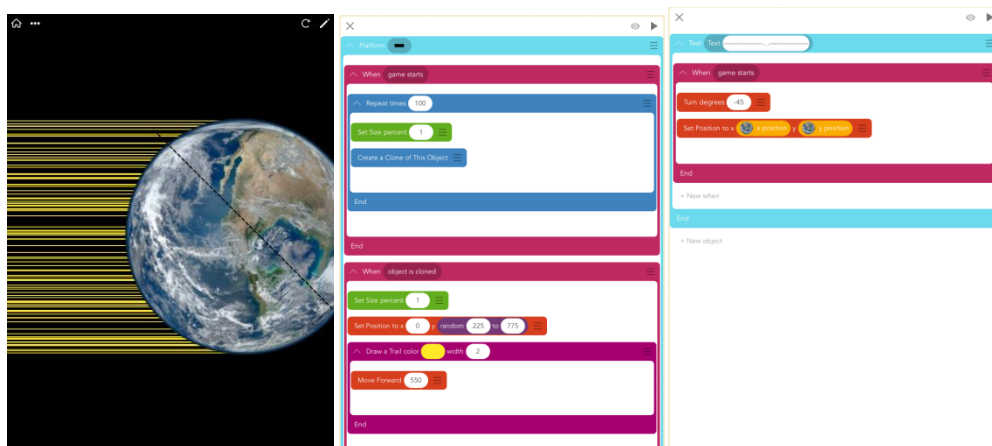
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from the sun during the winter and closer to the sun during the summer. Towards what other problems does this problem lead us?



Name of the program : Hiver – idée fausse <https://c.gethopscotch.com/p/yba70eq35>

In discussing this mathematical interpretation, one may wonder whether our idea works in all cases. Students who have traveled a bit can know that when winter is present in North America, it is summer in Australia, at a different Cartesian point on Earth. One loses some confidence in this explanation since Australia should be as far from the sun in winter as North America. We have to find a new explanation. The distance of the sun is surely an important factor on the temperature of the Earth. The temperature on Mercury is on average 167 degrees Celcius, while on Mars, the average temperature is -63 degrees Celcius. Is there any other way of explaining what is happening? Is there a pattern that can be expressed?



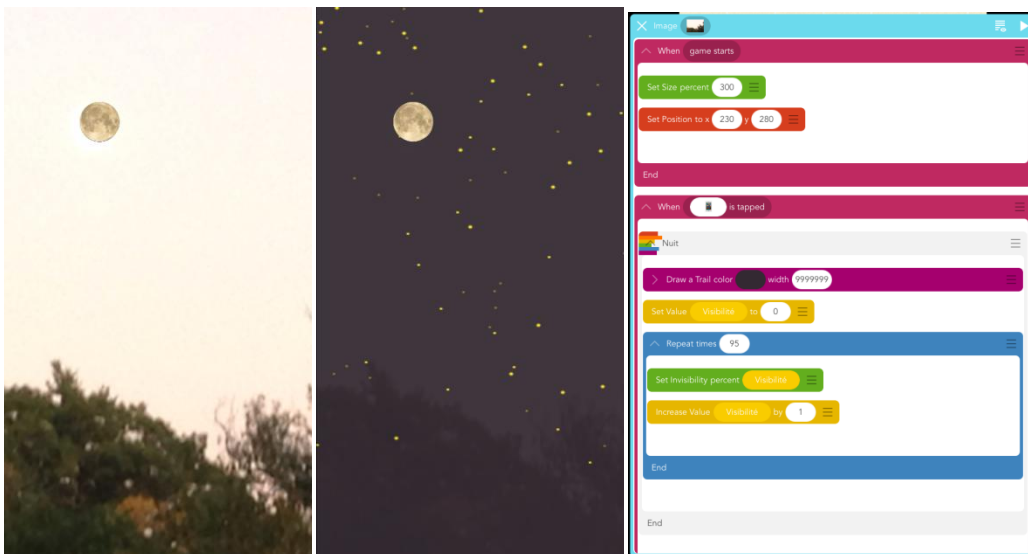
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Name of the program : Lumière du soleil sur la Terre

<https://c.gethopscotch.com/p/yba8r9so0>

The inclination of the Earth must also be taken into consideration. The Earth travels in space with an angle, in relation to the sun. The Earth rotates on itself with an axis of rotation that is not perpendicular to the sun. This axis of rotation is 23 degrees. During the summer, the days are longer and some parts of the Earth receive more radiation from the sun. During winter, the days are shorter, and there is less radiation from the sun. What are the mathematical ideas in this example? We have discussed distance, Cartesian points, angles, axis of rotation. The models we have created also include percentage, addition and subtraction, variables, random numbers and, even more important, all high-level intellectual processes. By creating a model of his understanding, the student has solved a problem. During class discussion and sharing he explains his understanding of the mathematical problem and reflects on the mathematical concepts presented by his classmates. Using a scientific example, there is a link between mathematics and science. The use of Hopscotch shows a judicious choice of technology. The modeling of the Earth around the sun makes it possible to represent a concept mathematically (Ministry of Education of Ontario, 2005).

In the previous example, we discussed mathematical errors. We can also correct scientific errors using mathematical models, using Hopscotch. For example, many believe it is not possible to see the moon during the day. Can we take a picture of the moon during the day and build a mathematical model?



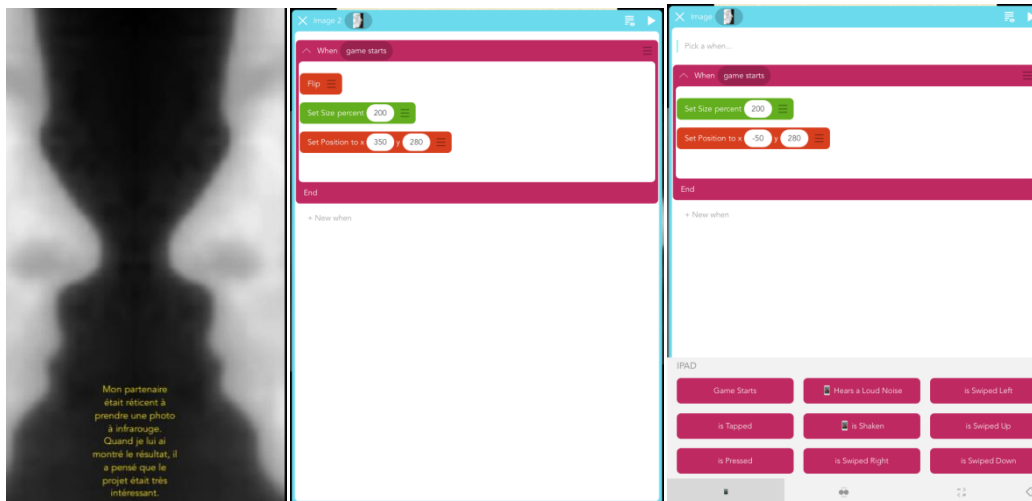
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Name of the program : Lune jour et nuit <https://c.gethopscotch.com/p/yba5yld4i>

Hopscotch allows the inclusion of photos, here, a picture of the moon just before sunset. With this photo, we can build a model of the sunset. At the beginning of the simulation, the photo is present as it was taken by the camera. We gradually reduce the visibility of the photo using variables and computational thinking. At the end, we have the night with the photo which is still a little visible, the moon that remained totally visible and the stars that are beginning to appear. This mathematical model of the moon allows to discuss conceptual errors in science and mathematics.

Beauty in Mathematics

How is beauty related to mathematics? Mathematics is often taught using many tests and quizzes, which is an idea far removed from the nature of mathematics. There is a lot of mathematics around us and making connections between mathematics and the world around us could allow us to ask deeper questions on the subject. Mathematics has a beautiful and magnificent side that is difficult to capture with a test. Mathematics can be found in works of art or nature.

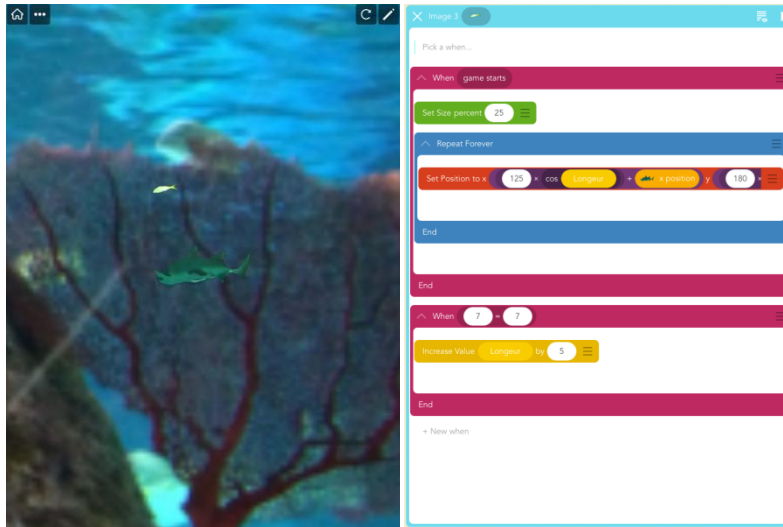


Name of the program : Math Silhouette <https://c.gethopscotch.com/p/yacc71m4n>

Is it a human figure or a vase? The photo of a face was taken in infrared so as not to identify the person. Using the FLIP command of Hopscotch, you keep an image as it is

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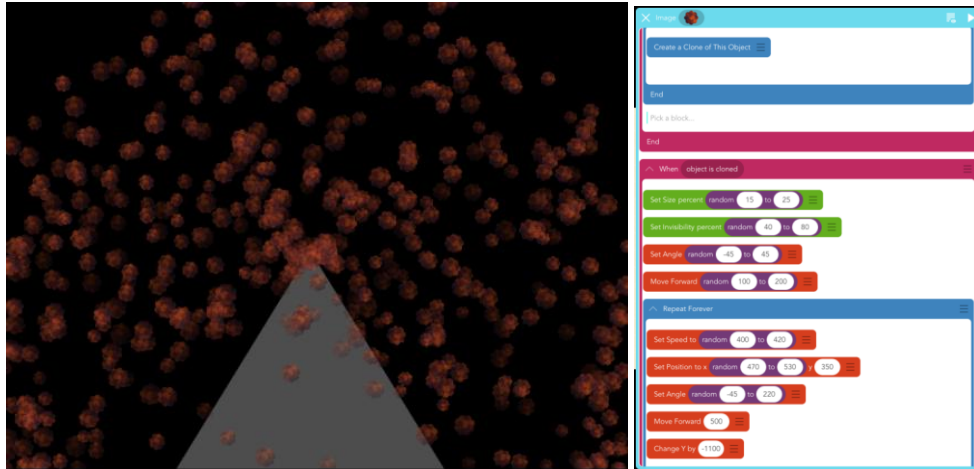
and reverse a copy of the image. Then place the images side by side. We can see two different interpretations of the image. Either they are two human figures, a vertical reflection of each other along the line of the mirror. Either it is a vase. The mathematical concept is beautiful and the resulting image is aesthetically pleasing.



Name of the program : Math des poissons <https://c.gethopscotch.com/p/yaxovx4g8>

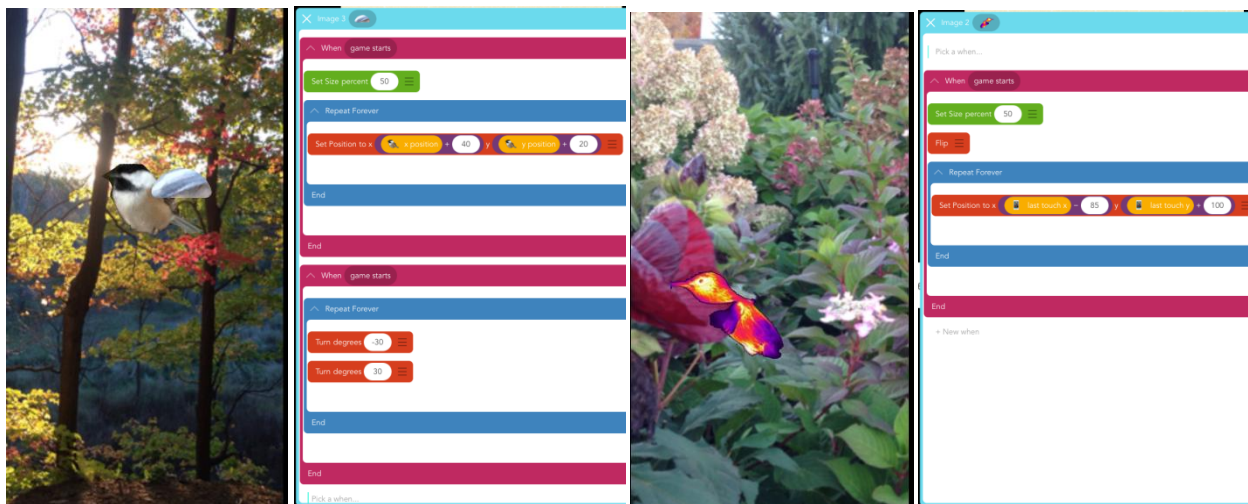
The seabed is also very pretty. There is also mathematics behind the movement of fish, if one takes the time to linger a little. We can simulate the movement of fish. Here we see a shark surrounded by a smaller fish. The two animals follow each other without ever touching each other. There is a mathematical model to discover. With the tip of our finger, we can move the shark and move it across the surface of the device. Using the sine and cosine functions to adjust the movement of the smallest fish ensures that it follows the shark without ever touching it. It's really fascinating to realize that mathematics can adjust the movement of fish in such a spectacular way. The use of personal photos also makes it possible to create a link between mathematics and the student's personal environment.

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Name of the program : Volcan <https://c.gethopscotch.com/p/y9k8okeq1>

The volcanoes, although very scary because of their power, are also very pretty. There is no shortage of photographers who seek to show the supreme beauty of volcanoes. These images are collected in the world's competitions of photography. Using Hopscotch, we can create models of a volcanic eruption, while using many mathematical concepts. Volcano eruption simulations are an important branch of mathematics that makes it possible to calculate the probability and the risk of eruption. These data are used by insurance companies to protect the population and help them financially after a natural disaster.



Name of the program: Oiseau vole <https://c.gethopscotch.com/p/yapwpcour>

Name of the program: Colibri <https://c.gethopscotch.com/p/yapwd0qjg>

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Do girls who like to take walks in the woods relate nature to mathematics? Is it only the rapidity to calculate the additions and multiplications that indicate who understands mathematics? The moving of birds also has a lot of hidden maths that can be simulated with Hopscotch. Understanding the mathematics of bird flight allows us to use the same mathematical concepts in the flight of aircraft. By knowing how the air moves around the wings of the bird, one can create airplane wings that simulates the flight of the bird. These are very advanced mathematics used by aeronautical engineers. The speed of calculation does not help at all in the deep understanding of the phenomenon of flight. It becomes important to discredit misconceptions.

There are many students who do very fast mathematical calculations but cannot see the deeper connections of mathematics with everything around us. There are also students who work very slowly in mathematics, but see the deep bonds, logically think, make many mistakes, but are able to correct these errors and create mathematical wonders.

Flexibility with Numbers

Often mathematical skills are conceived using tests. By 2016, only 50% of Grade 6 students in Ontario pass the Ministry's mathematics exam. At the international level, Canada ranks 13th in mathematics among all countries in the world. These tests are important since they inform us of the current understanding of our students in mathematics. However, these tests hide another reality of mathematics.

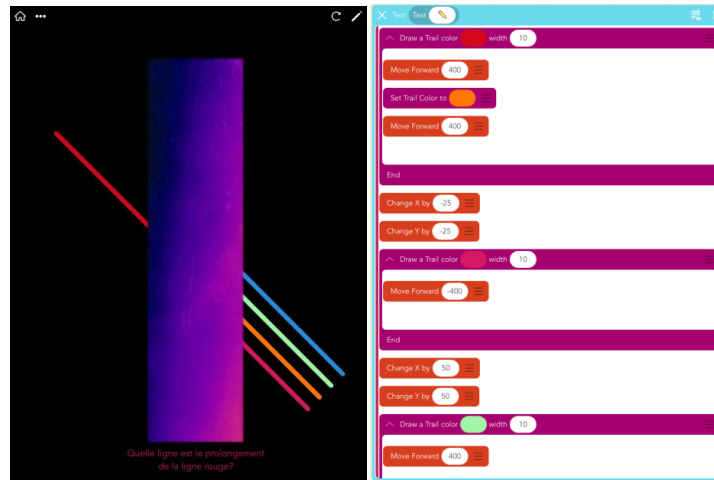
Some of our excellent mathematicians perceive mathematics in a completely different way. They use mathematics to understand reality with all the patterns present in the universe in order to understand the ultimate goal of the universe. I was a bit surprised when Karen French (2014) introduced her book "The Hidden Geometry of Life" with a verse from the Koran (2: 164): "... in the change of winds and in the clouds that pass between heaven and Earth, there are signs for those who can understand. " They use mathematics to understand the ultimate goal of life, the beauty of the universe, with confidence that they will succeed in finding the answer to their questions. Their intuition, their motivation, their drive, their emotional intelligence are the source of their mentality of growth towards mathematics.

There are also many mathematics in the arts and sciences. What there is in common is that there is a great idea, a deep connection, between mathematics and the

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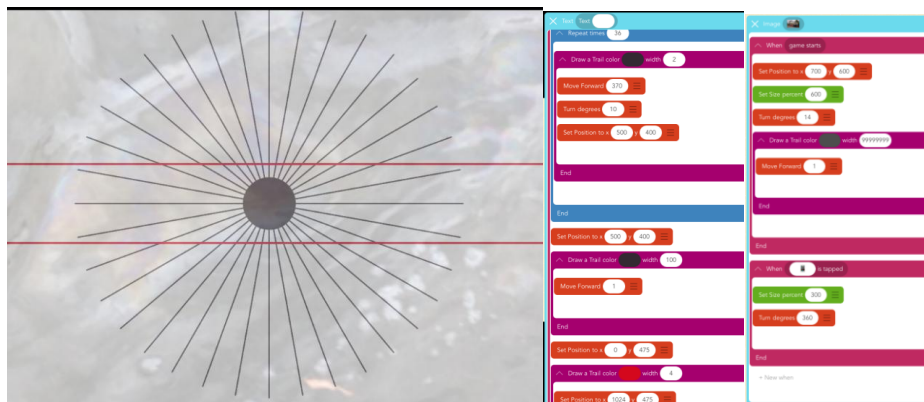
mathematician. Emphasizing this deep connection between mathematics and the world around us is important to have a growth mindset.

In the following examples, we code puzzles, optical illusions that stimulate the brain. In this puzzle, what line is the prolongation of the red line? The programmer must code the lines, but his work must be presented to a friend to solve the puzzle.



Name of the program : Ligne <https://c.gethopscotch.com/p/y9ri8vo47>

Are the two red lines parallel? The presence of the black circle and the black lines all around the circle are confusing and it is more difficult to notice that the red lines are actually parallel. The programmer who wrote the code knows logically that the lines are parallel, but his perception with the eyes could be very different.

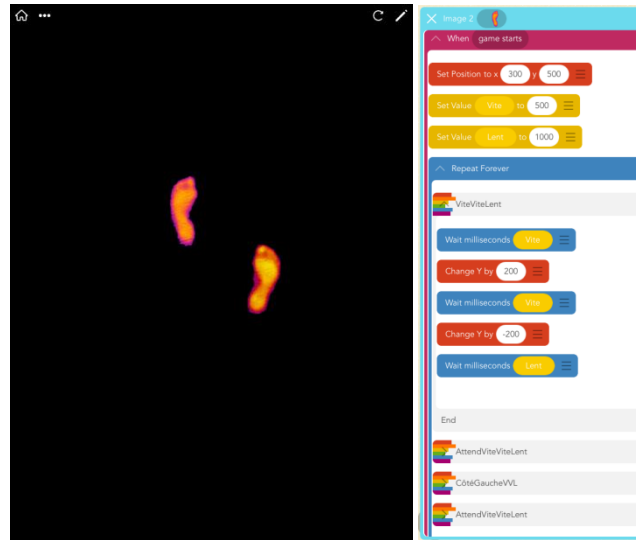


Name of the program : Lignes horizontales <https://c.gethopscotch.com/p/y9rfmxh84>

One sees problems of optics in the house and its relation with the yellow lines of the street. A house so inclined, which reminds us of the Tower of Pisa in Italy, can be solid

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and comply with building standards. The house is at Notre-Dame-des-Bois, at the foot of Mount Mégantic. In fact, it is not the house that is tilted, but the road. We must imagine the angle of the photo to understand. Once done, the Hopscotch program allows us to see the photo in greater perspective.



Name of the program : Notre-Dame-des_Bois <https://c.gethopscotch.com/p/y9rk8u19j>

Name of the program : Mambo <https://c.gethopscotch.com/p/ya99ungbj>

People with an artistic spirit can also understand the mathematics behind music and dance. The dancers have many emotions but also a deep sense of mathematics with a constant rhythm and steps that can follow a very elaborate mathematical choreography with changes in angles and direction while keeping the rhythm of the music.

These games and challenges offer a very different message about mathematics than the regular tests that are given to students. By highlighting the artistic side, creativity, links to great ideas, and the game behind these puzzles, we give a message of growth mindset to mathematics that tests cannot do.

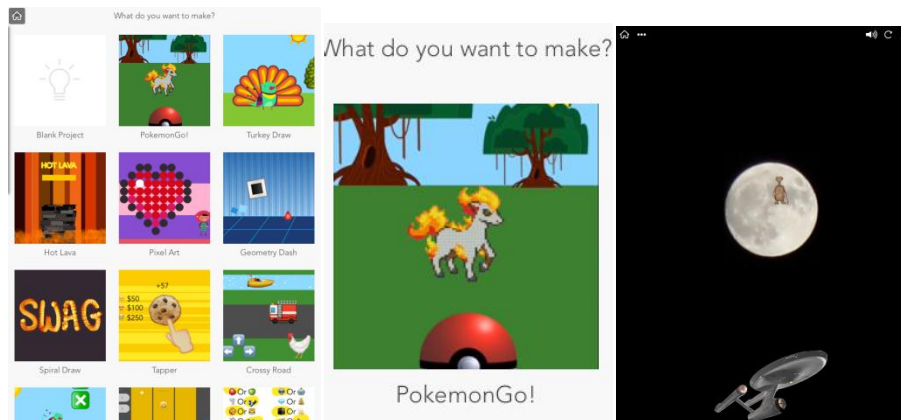
The rich mathematical tasks

In order to change the mindset of the student towards a growth mindset towards mathematics used by engineers, the non-profit society CODE.ORG offers activities and resources in order to introduce women and minorities to computer science. Their vision

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is that every student has the chance to learn computer science. Code.org recommends Hour of Code, one hour of programming offered to students, once a year in December, where each participant is given the chance to program for one hour in order to familiarize themselves with programming and help develop student's interest in coding. Several companies, including Hopscotch, have joined this movement to develop a growth mindset towards mathematics behind coding.

It's been more than 50 years since Star Trek's programs and films inspired our society towards aerospace science and technology. Several books, including Star Trek - the official guide to our universe (2016), explain the science behind Enterprise's travels. During the Hour of Code, we can explain the technology behind the Enterprise's travels. Hopscotch has published a book (Leavitt, 2016) and videos in order to support the teacher and students in their learning of programming. Each program takes about an hour for a novice to code, depending on their age and their ease with the technology, and can be used with content that interests each student. There are at least 13 different videos distributed by Hopscotch on the iPad and Hopscotch adds new ones regularly. These videos teach the basics of programming. In thirteen hours or a week, one can have an excellent idea of the basis of programming. Each of the following programs were done using the code explained in the video, using the Star Trek theme. The *Consciousness* program is inspired by the *PokemonGo* model.

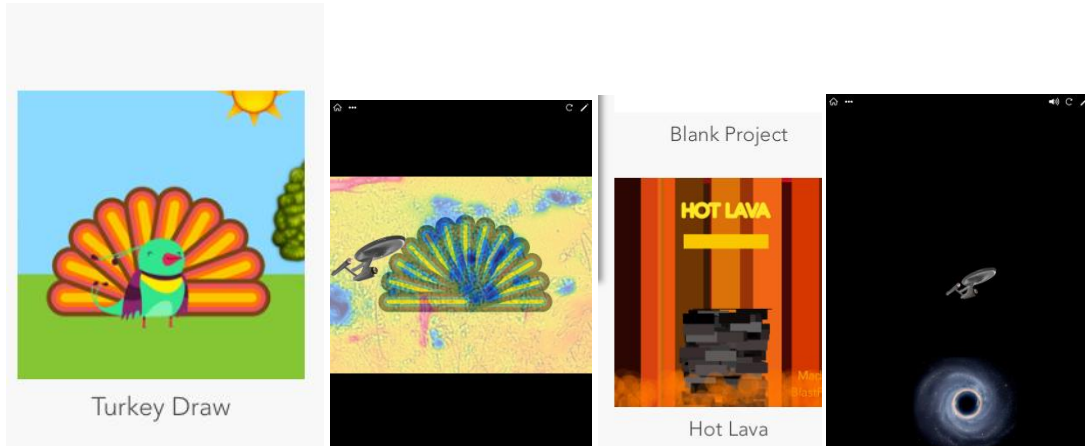


Nom du programme : Conscience – Pokémon Go <https://c.gethopscotch.com/p/ydr20v63c>

In the book Star Trek (2016) we read: 'I went to you because, despite your attempt to convince me otherwise, you seem to have a conscience, Mr Kirk. –Khan ' One sees there

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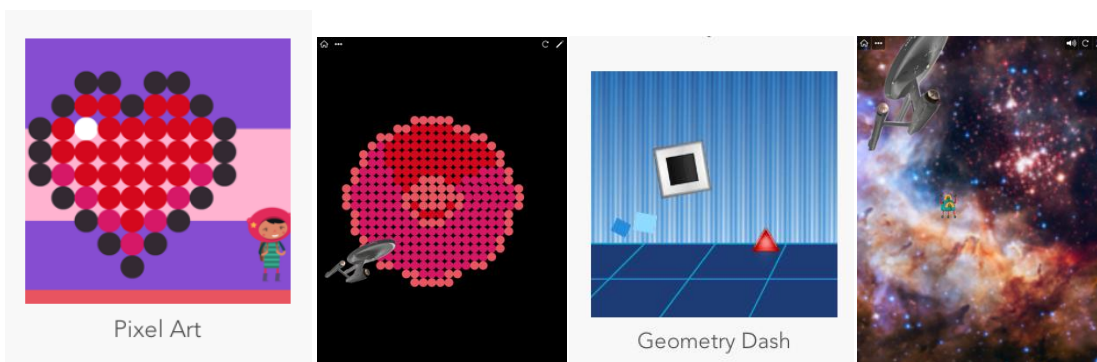
the frightening alien Khan and Enterprise, which received a lot of damage. This idea is transformed into the Hopscotch program to make it a little less frightening for children. An extra-terrestrial E.T. is in the atmosphere and walks from left to right in front of the moon. The Enterprise has the ability to go up or down, sliding our finger up or down on the iPad. If E.T. and the Enterprise go on the same path, E.T. disappears from space and goes aboard the Enterprise. The Enterprise continues his journey. One sees consciousness where the alien is not attacked but is greeted on board the ship.



Nom du programme : Exploration <https://c.gethopscotch.com/p/ydshdnuit>

Nom du programme : Trou Noir <https://c.gethopscotch.com/p/yds19e7av>

The Enterprise travels in space and sees everything so new phenomena. Here we see a singularity that resembles a turkey of the program *Turkey Draw* which is accompanied by a background image taken with an infrared camera. In the game *Black Hole*, we see the Enterprise who is attracted by a black hole and must sail to avoid it. The player must press repeatedly on the iPad to raise the Enterprise that is attracted to the black hole.

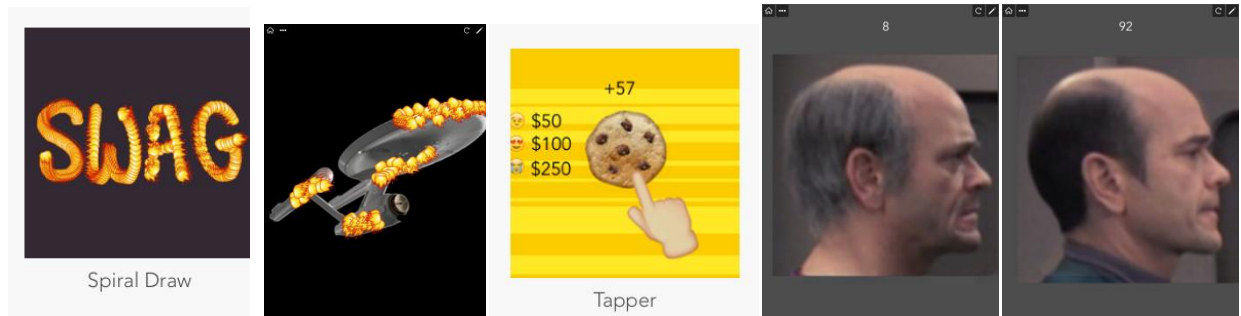


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Nom du programme : Pixel art Star Wars <https://c.gethopscotch.com/p/ydsovin91>

Nom du programme : Star Trek Geometry Dash <https://c.gethopscotch.com/p/ydt3ftc8f>

With the *Star Wars Pixel art* program, Enterprise encounters a different form of singularity with entirely different coding properties than the previous program. In *Star Trek Geometry Dash*, the player must avoid with the interstellar robots and go up while making a complete rotation before descending to avoid the collision. We see the image of a known constellation.

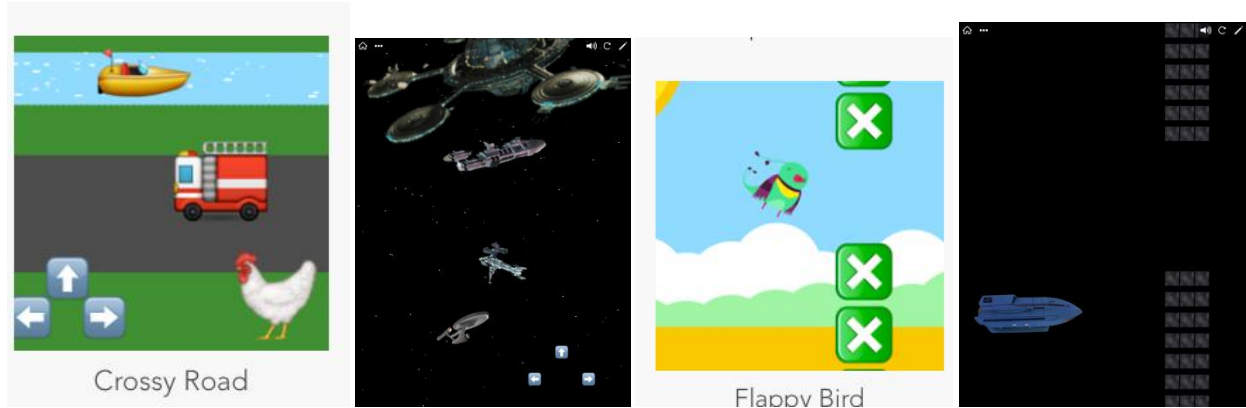


Nom du programme : Star trek sous attaque <https://c.gethopscotch.com/p/ydszi0jco>

Nom du programme : Star Trek Dr. Lewis Zimmerman <https://c.gethopscotch.com/p/ye0s0dxs0>

Using the *Spiral Draw* model, you can create a game where the Enterprise is under attack. By keeping the suspense, it is not yet known if the protection of the vessel is sufficient. In the *Dr. Lewis Zimmerman* program, we see the engineer Lewis Zimmerman of the Star Trek Voyager who created the artificial intelligence of the holographic doctor in his image. By tapping on the iPad, one can see the image of Dr. Zimmerman turning into Doctor of the Star Trek Voyager. The number of times you press the iPad to make the transformation is displayed on the screen.

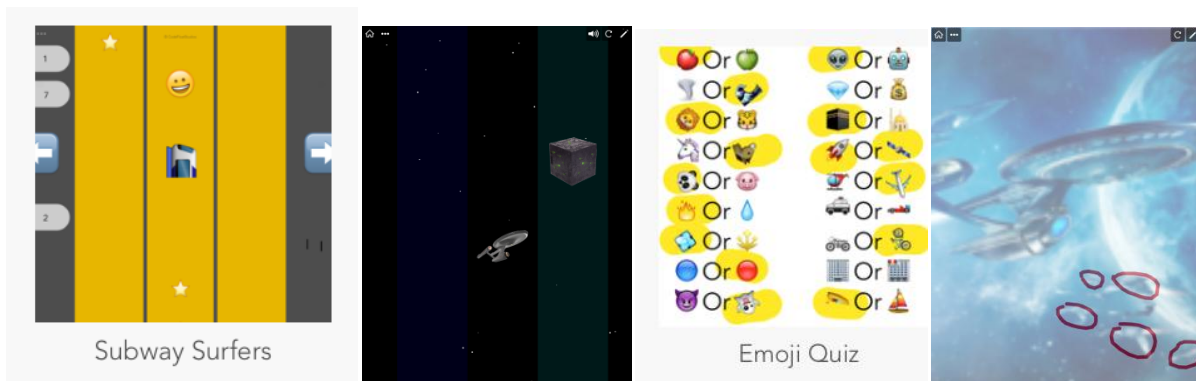
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Nom du programme : Star Trek Crossy Road <https://c.gethopscotch.com/p/ye0ulr494>

Nom du programme : Star Trek It will fit <https://c.gethopscotch.com/p/ye12e5c72>

With the *Crossy Road* model, we simulate the Enterprise ship which must go to STARBASE I, a spaceport in orbit around the Earth. The ship must avoid other ships passing through the area. Using *Flappy Bird*, we simulate a very tense situation of the movie *Star Trek into Darkness*. A shuttle of Enterprise driven by Captain Kirk and Spock is pursued by Klingons and end up in a cul de sac. Kirk sees a small opening and decides to bring his shuttle through the small opening. Spock says with the emotion of the scene: 'Captain, the shuttle is not going to pass.' Kirk answers with intense emotion: It will pass, it will pass! In the game *Star Trek It will fit*, the player must navigate the shuttle through the small area orifice in order to escape from the Klingons.



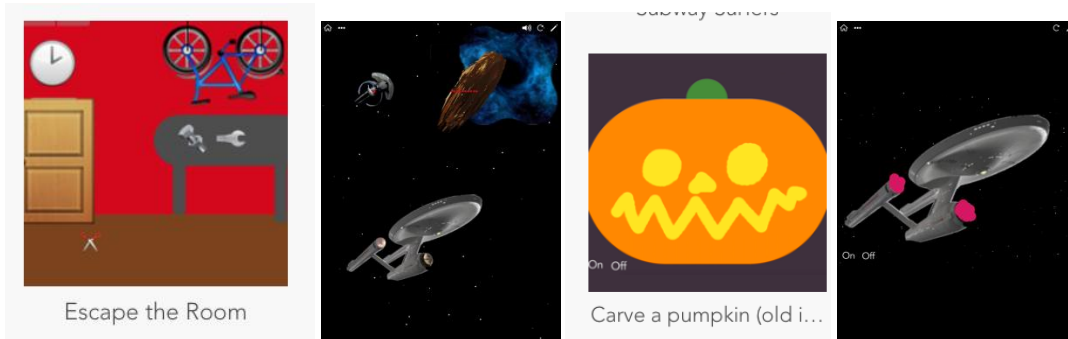
Nom du programme : Star Trek Borg Subway Surfer <https://c.gethopscotch.com/p/ye14ea921>

Nom du programme : Star Trek Emoji Quiz <https://c.gethopscotch.com/p/ye15jk3o4>

The *Subway Surfer* model makes it possible to simulate a moment in space where the Enterprise must escape repeatedly the approach of the Borg. The Borg cube travels up

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and down randomly through the three transport corridors. At the approach of the Borg cube, the Enterprise must move in order to avoid the collision or to be spotted by the Borg. The *Emoji Quiz* model can be used to analyze a Star Trek image. Where are the ships that surround the Enterprise?



Nom du programme : Star Trek Escape the Room <https://c.gethopscotch.com/p/ye17paaaq>

Nom du programme : Star Trek Carve a pumpkin <https://c.gethopscotch.com/p/ye1ct8cyz>

At the end of the Star Trek movie by J.J. Abrams, the Romulan ship is attracted by the singularity. The ship from Spock's future is on the way to destroy it and launches red matter. Kirk offers a refuge to the Romulan aboard the Enterprise but he refuses. His ship is absorbed by the singularity. The Enterprise must eject its core in order to free itself. Once the core is ejected, the Enterprise resumes its route. The *Escape the Room* model helps you plan this entire scenario. The model *Carve a pumpkin* can inspire to show the engines of the Enterprise when they are on and when they are off.



Nom du programme : Warm Star Trek <https://c.gethopscotch.com/p/ydsz0xeib>

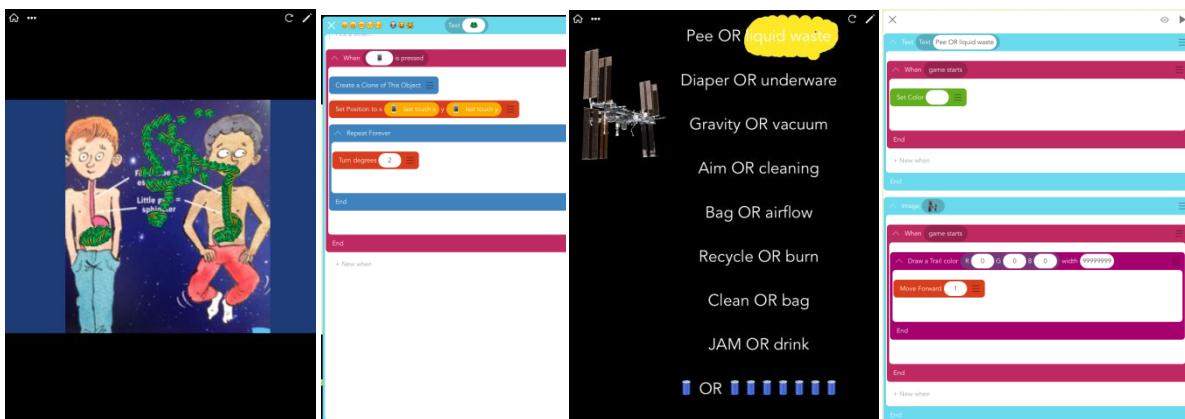
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Finally, for those who do not want to follow a model, they can always create their own challenge. Here we see Enterprise near Mars. The Enterprise moves on the screen with the movement of the iPad.

Star Trek became very popular because the fictional TV program became reality with the Apollo mission and the astronauts who went to the Moon. Pendant l'heure du code, on peut aussi voir des exemples réels des missions spatiales canadiennes. The Canadian physician and astronaut Dr Dave Williams demonstrated a growth mindset to become an astronaut. As a young man, when he saw the profession of an astronaut, many people discouraged him, pointing out that only Americans went into space, that this profession was not open to Canadians. He did not understand why this should be the case and still continued his studies to become an astronaut. He was able to pursue his dream and visit the International Space Station in 2007. Dr. Dave Williams published the first in a series of four children's books on space exploration to educate children about Canadian's contribution to space exploration.

In these three following programs that can be done during the Hour of code, we cross two barriers of fixed mindset, programming and becoming an astronaut. Following Hopscotch's *Emoji Draw* model, we show the science behind digestion in space, as learned in Dr. Dave's book. It is not advisable to burp in space, the risk being very great. In space, where there is no gravity, the air of the stomach is also distributed with the food. If you burp, you cannot predict what will come out. You could just see a little air or all the contents of the stomach!

Using the Hopscotch *Quiz App* model, we can write a quiz demonstrating our knowledge of space, while learning from Dr. Dave's book. With our finger, we can underline the responses at the touch of the screen.

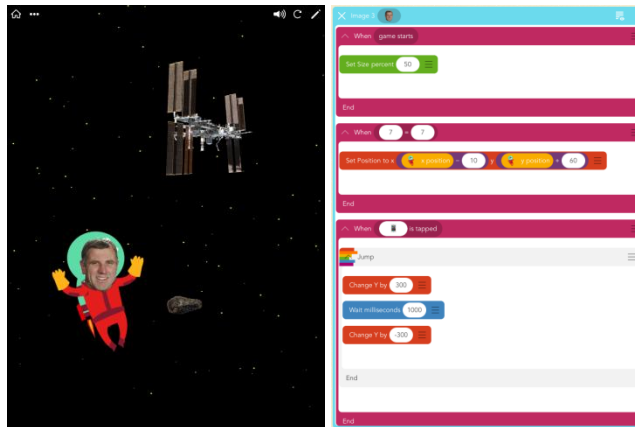


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Name of the program : To Burp or Not to Burp <https://c.gethopscotch.com/p/ycve5oefc>

Name of the program: To Burp or Not to Burp <https://c.gethopscotch.com/p/ycw1nv2ld>

Finally, a third suggestion for Hour of code is to write a first video game with Dr Dave and the *Geometry Jumper* model from Hopscotch. During an exit in space, called Extravehicular Activity (EVA), Dr. Dave may be called upon to avoid objects like small space debris. He manipulates his space suit, the Extravehicular Mobility Unit (EMU), to avoid debris.



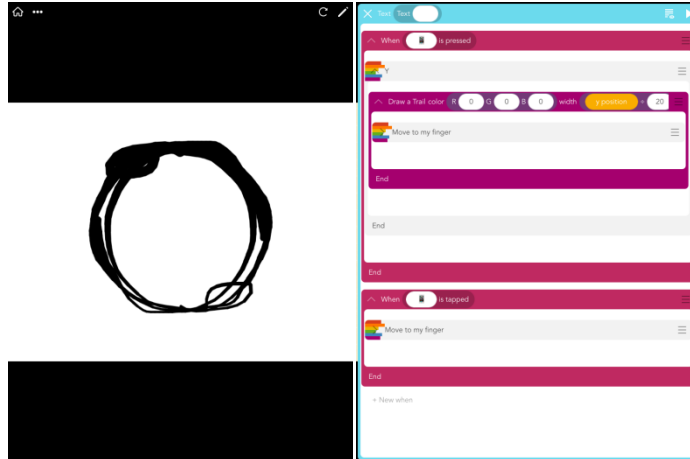
Name of the program: To Burp or Not to Burp <https://c.gethopscotch.com/p/ycw1m0wbd>

The movie *Arrival* (2016) may be another source of inspiration for a growth mindset. In the movie, at the moment when the extraterrestrials have arrived on Earth and under the protection of the army, a linguist and a mathematician try, at the risk of their own lives, to communicate with the extraterrestrials in order to understand their intentions. The aliens communicate with symbols.

The linguist Dr. Louise Banks and the mathematician Dr. Ian Donnelly show a growth mindset by making enormous efforts to communicate with aliens, even when other nations, such as China, were afraid of them when the word *weapon* surfaced in the discussion. Dr. Banks continued and wanted to understand, more since the word *weapon* can be confused with the word *tool*. These symbols communicated by the extraterrestrials can be coded with Hopscotch. We can also, like Dr. Banks, learn to read the Hopscotch language, by reading already written programs that are available in the application. These programs can then be modified and published on Hopscotch. Here is an example. While looking in the Hopscotch application, we found the Ying Yang

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program that looks like what we want to do. We read the code and change the elements we want to change. In this case, we only change the colors we want to use. To do this, we must like Dr. Banks, understand what the code means and make changes in color. We get the desired result; we can understand the language of the extraterrestrial.

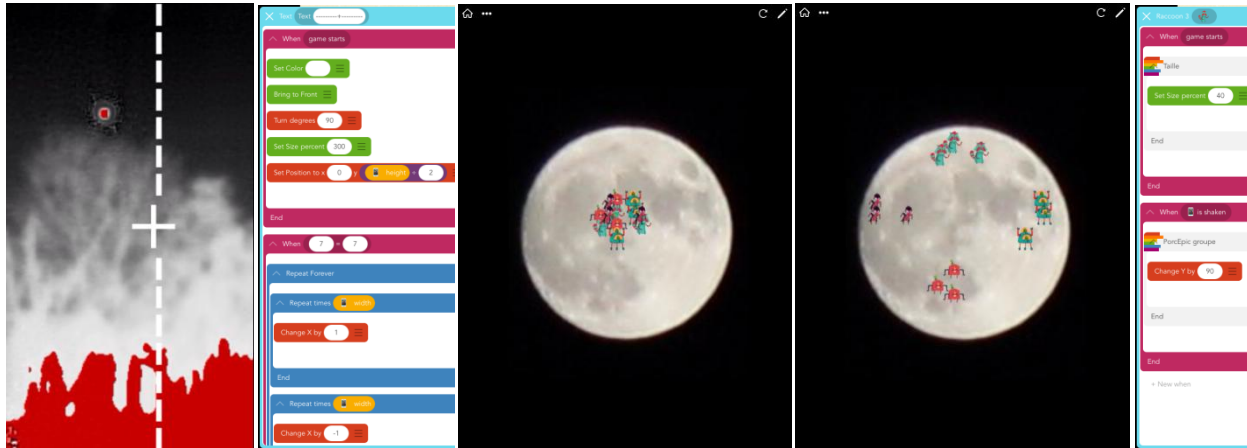


Name of the program : Ying Yang! <https://c.gethopscotch.com/p/xyzlds3r>

Name of the program : Symbole <https://c.gethopscotch.com/p/yd0z7tint>

One can see in the film *Arrival*, the technological instruments used by the army. They use technology in order to see in total darkness. You can use an infrared camera to take pictures in the dark. The FLIR infrared camera has several different filters that can be used to see the infrared image. The "*hottest*" filter lets you see what is warmer by using red, while showing the rest of the image in black and white. By observing the moon, using a FLIR camera attached to a phone, one can realize that the moon reflects a lot of heat towards the Earth. We see the red dot in the sky. We include our image in a Hopscotch program to simulate an infrared radar. We add the motion of the radar sensor which moves from left to right on the screen.

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Name of the program: Radar à extra terrestre <https://c.gethopscotch.com/p/yd0suengy>

Name of the program : Super lune division <https://c.gethopscotch.com/p/yd0ea3nm2>

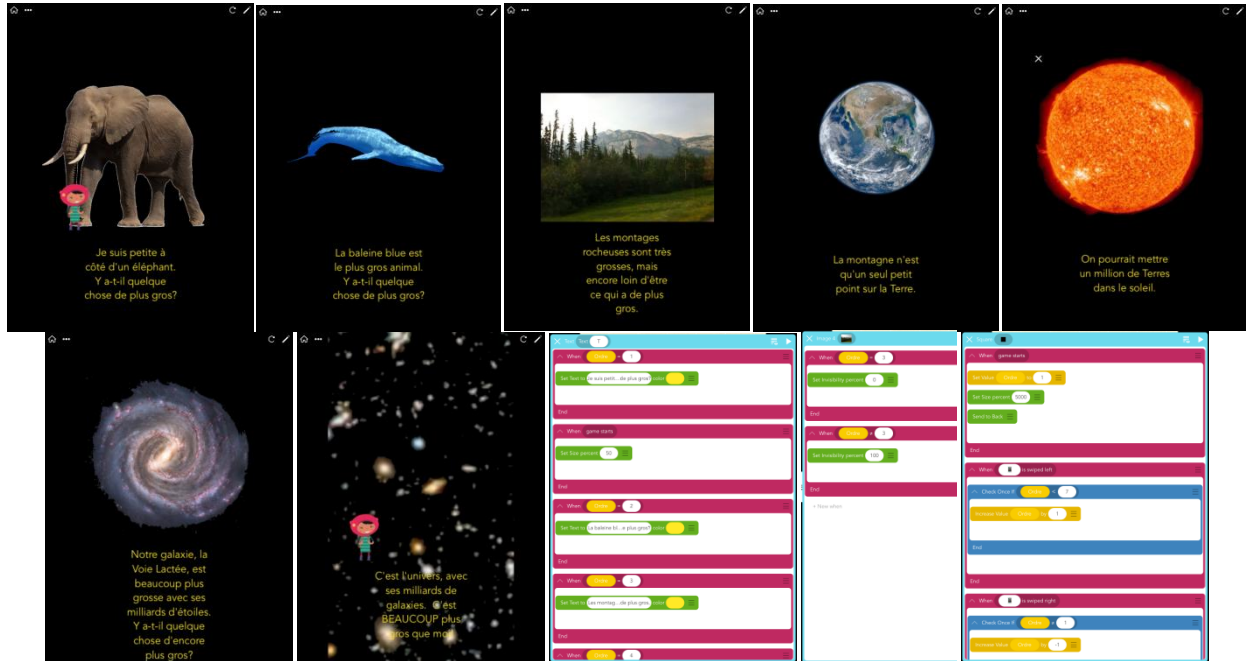
In fact, we have never seen extraterrestrials on Earth or anywhere else, but it stimulates our imagination. If extraterrestrials had come to Earth, we may wonder where they come from. Did they go anywhere elsewhere? With a slightly more expensive digital camera, or using an image of the Internet, we can get a picture of the moon. We cannot see extraterrestrials on the moon with our camera, but we can imagine that a vessel stopped on the moon. We will create a program demonstrating the division of aliens on the moon. At the beginning of the program, they meet at the center. We shake our iPad and the extraterrestrials move to different locations on the moon. We can see that this is a division since we obtained 4 groups of 3 extraterrestrials. The imagination of history has pushed us towards a growth mindset.

In the movie Arrival, the concept of the non-zero sum game is discussed. This is a situation where all the people who participate will benefit instead of having a winner and a loser. This tests the mindset of the teacher. Do we want to give each of our students the opportunity to succeed in mathematics (growth mindset) or will we give only a few students the chance to succeed because we do not give them all the means to succeed in the classroom (fixed mindset).

We can also think of the concept of the non-zero sum game from the empathetic point of view. How far does our empathy extend? Is our empathy for teaching only for a student group that is exactly like us? Will we benefit all our students, whatever their origin? Will the aliens be among the individuals we can help or is it the fear that will dominate us? Dr. Banks has chosen to help all of them, earthlings and extraterrestrials. If

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we were to help extraterrestrials in the future, where would they come from? If we broadened our field of teaching, how far would it go? What is the extent of our empathy?

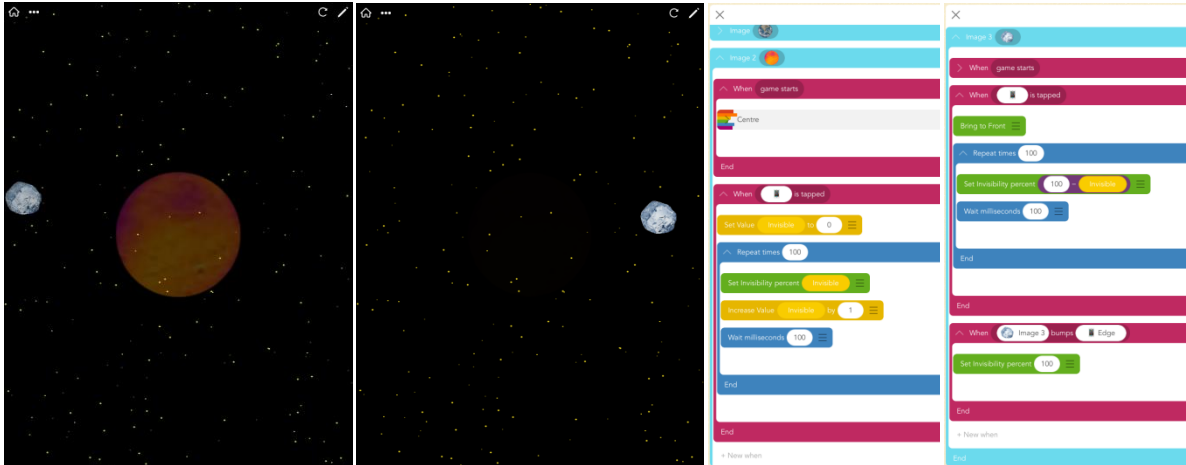


Name of the program : Grosseur <https://c.gethopscotch.com/p/y9r6leom6>

The progression of this student's empathy extends over the entire universe. One can see that a young lady is small next to an elephant. On a larger scale, we can see the blue whale that is the biggest animal on Earth. There's something even bigger on Earth. The Rocky Mountains are very large, but they are only a small point next to the whole Earth. We could put a million Earths inside the sun. On an even larger scale, our galaxy, the Milky Way, is much bigger with its billions of stars. There are, however, billions of galaxies in our universe. It's really much bigger than our girl from the start. She wants to project her empathy across the entire universe and demonstrate a non-zero sum game.

Space exploration will be necessary for humanity, not necessarily now, but certainly in the future if we want to keep humanity alive. The reason is the death of the sun. All life on Earth will be impossible in 500 million years because of the end of the life of the sun. We see here a simulation of the death of the sun and the loss of the Earth that follows.

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Name of the program : Mort du soleil <https://c.gethopscotch.com/p/ybfekclf6>

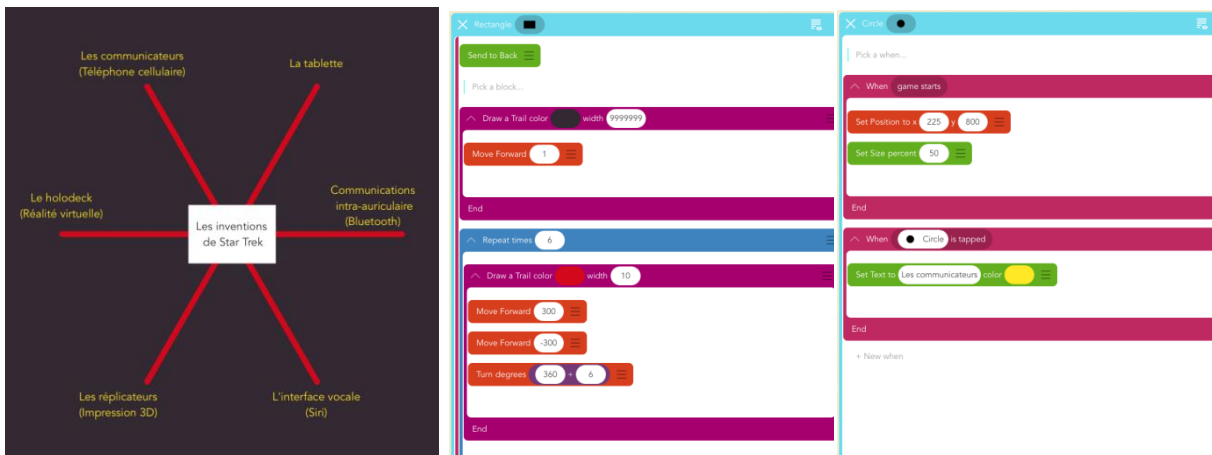
Il faudra beaucoup de temps pour développer la science et toute la technologie nécessaire pour faire des voyages extra-terrestres, de trouver une autre planète habitable et de s'y rendre. On peut commencer tout de suite, si ce n'est qu'en rêvant.

Beyond the hour of code, students can work all year with Hopscotch during Genius Hour. They have the freedom to discover new programming strategies and to code content they love, where they are interested and creative. The Genius Hour concept motivates students to be creative. It is inspired by the Google company model. Students work with relative freedom for a little more than an hour to complete their project. At the Google company, employees work 80% of the time on projects assigned by their company and 20% of the time on projects that they have selected themselves. Google employees are more creative and work best for 20% of the time they are allowed to be creative on a project they have chosen. Due to the employee's personal involvement, the Google company is more productive this way. It works the same way with the students. Often, students are at their best job during this time. In a way, by trusting our students, by guiding and encouraging them, they do an excellent job. Each student can work on their own level with simple or complex code depending on their ability on subjects or angles of their choice.

In order to change the student's mindset towards a growth mindset towards mathematics, we can use mathematical connections so deep and enveloping that students will be quite captivated. The connections chosen depend on the interest and culture of the students. The more personal is the link, the deeper the impact will be. An example that everyone knows is the world of Star Trek.

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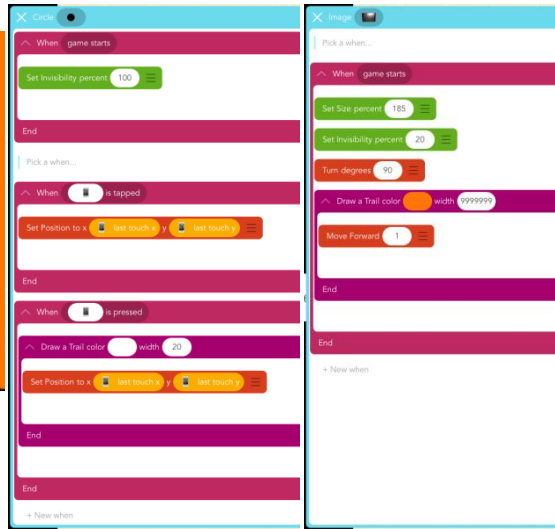
How can mathematical connections be established with the Star Trek TV series and films that have been inspiring for more than 50 years? Does mathematics relate to Star Trek? These are very open questions that allow several types of answers and representations. With Hopscotch, students can show their understanding visually and interactively. Many inventions that were fictional in Star Trek 50 years ago, are now possible, such as space travel, mobile phones, and tablets. Other fictitious inventions have not yet been invented, but scientists are working on fundamental research. Our project makes a list of these inventions, which can be read by pressing specific points on the iPad. The background, the decoration consists of mathematics.



Name of the program : Inventions Star Trek <https://c.gethopscotch.com/p/y9tqq3cgf>

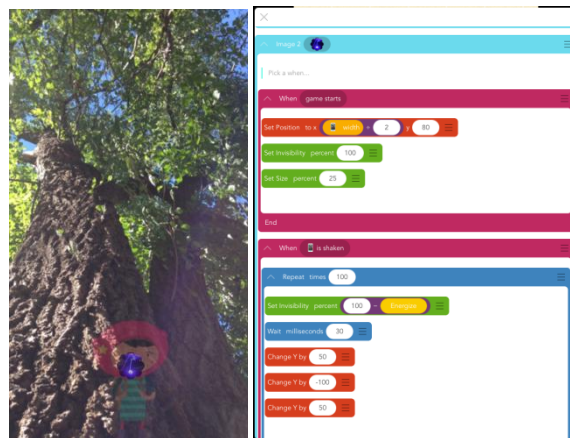
These inventions, real or not, can be programmed. Students develop a real, interactive project, based on an idea that they have generated themselves. We have here a tablet where we code how to write with a finger. What mathematical concept have we used? We used the Cartesian points, the variables. Is there a general rule between the relationship between mathematics and the use of coding with Hopscotch? Each program written with Hopscotch uses the highest level of mathematical thinking: the mathematical processes. Each Hopscotch program asks students to solve problems, communicate, reason, connect, choose an appropriate tool and model their understanding. Students develop a real and innovative product. It's really different than solving problems with mathematical worksheet.

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Name of the program : El Pot de distractions <https://c.gethopscotch.com/p/ya43lmyjw>

Once students know the few basic elements of each block of code, they can write all sorts of programs, using any sort of algorithms. The work is done by trying, making mistakes, testing and correcting our mistakes. We do not have to show each algorithm. Students learn by trying to understand and using their intuition. We see here an example of a simulation with a teleporter. Budding scientists are in the process of inventing it. At the touch of a button, the character appears in front of the tree, using the same cinematic effect as in Star Trek.



Name of the program: Energize <https://c.gethopscotch.com/p/y9hjsfuw5>

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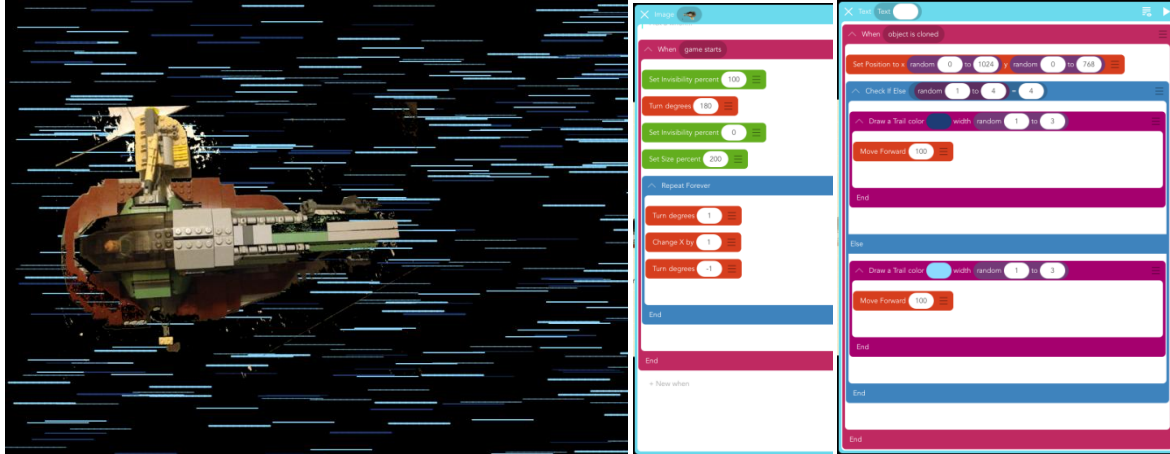
The tricorder device also has a visual element. We can use an X-ray photograph of our teeth, taken at the dentist and the photo of a device to record the music to code our tricorder. When we start our device, the tricorder moves on the screen and analyzes the problem of the girl. The image is formed on the screen after scanning. After the invention, we can discuss the mathematics behind this program.



Name of the program : Tricorder reading <https://c.gethopscotch.com/p/y9u3kqf4k>

We can extend the activities by including other projects that students do either in the classroom or at home. Some students spend hours building spaceships with LEGO blocks. There is a lot of imagination, visualization in 3 dimensions, measurement, design and love that go into building a spaceship with LEGO blocks. We can incorporate the photograph of the spacecraft designed by the student in the Hopscotch program. The spaceship fly at WORP speed with simulation and line drawing in the background. Again, we have another budding scientist who invented a new space transport.

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Name of the program : Worp speed 2 <https://c.gethopscotch.com/p/y7w2m95mz>

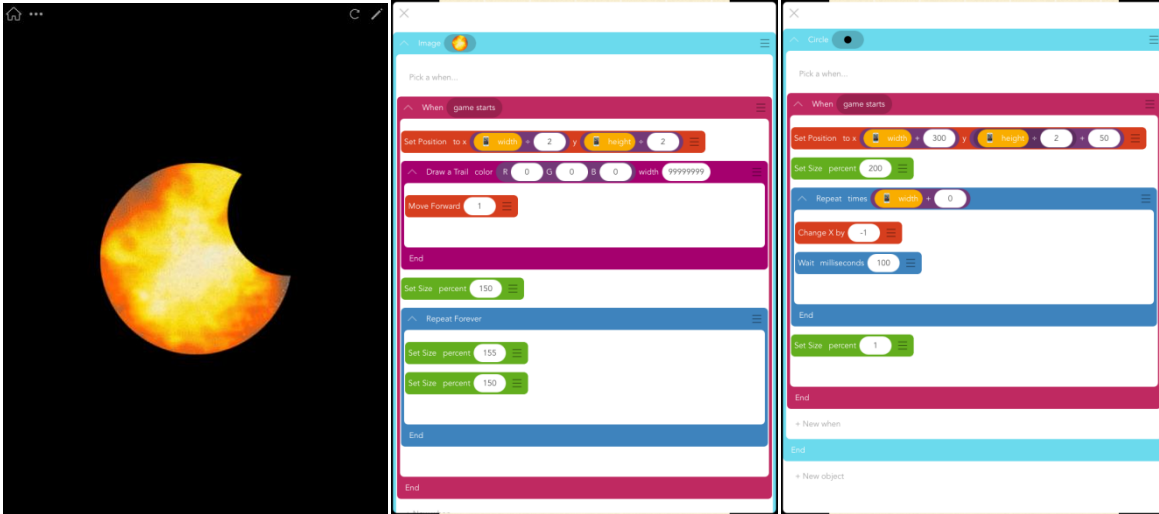
The inventions of Star Trek would not be complete without the holodeck. Students can program situations of any kind, using any kind of present, past or future settings where the characters interact with each other while developing stories. Nothing prevents us from exploring the life of mathematicians or scientists who have contributed much to our civilization. In this holodeck program, we have a character who moves in the forest. Its size must change according to its position on the road. As the character moves forward, the size increases and as the character moves away, the smaller the size of the character becomes. This is perspective.



Name of the program : Perspective <https://c.gethopscotch.com/p/yapy6g2jy>

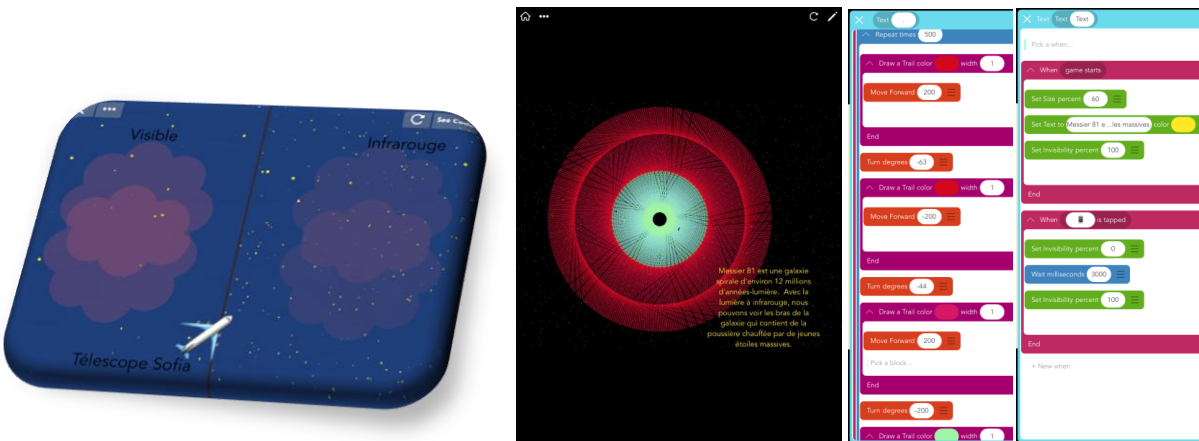
Genius Hour also allows us to explore current situations of science and technology in all fields, including space exploration and observation of natural situations. Here we see a partial eclipse of the sun with the moon passing by.

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Name of the program : Eclipse <https://c.gethopscotch.com/p/y7sji2wiw>

What do astrophysicists do? By doing a little research, students will find all the information they need in their project. For example, astrophysicists use the Sofia telescope on board an aircraft equipped with an infrared camera to observe the sky (Tisseyre, 2015). Infrared detects celestial objects with heat. It is possible to detect many more stars in infrared than with the visible spectrum of light. Infrared allows us to see the dust heated by young massive stars. We can create the code representing our discoveries.



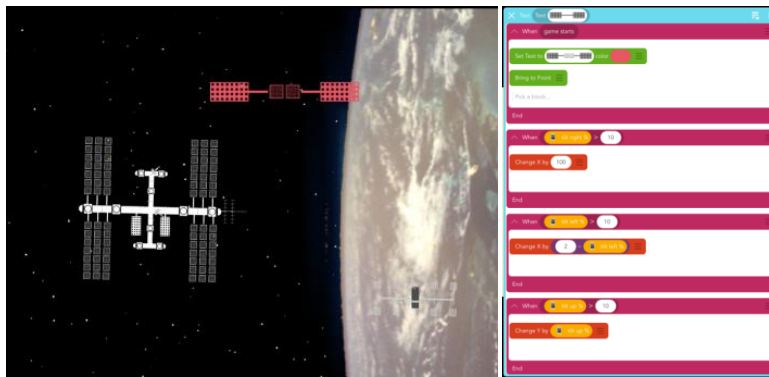
Name of the program : Infrarouge : <https://c.gethopscotch.com/p/xmqig22om>

Name of the program : Messier 81 <https://c.gethopscotch.com/p/yaxpki2nv>

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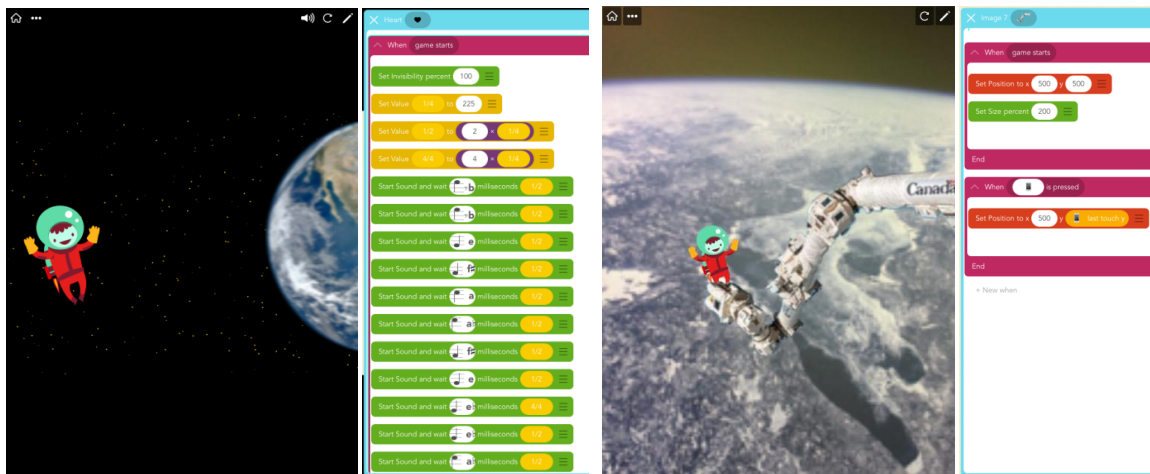
Messier 81 is a spiral galaxy at a distance of 12 million light-years. With infrared light, one can see the arms of the galaxy which contains dust heated by young and massive stars.

There are several Canadian astronauts who have traveled to the International Space Station. There are Roberta Bondar, Dave Williams, Marc Garneau, Julie Payette, Chris Hadfield and many others. The next astronaut scheduled to go into space in 2018 is David St-Jacques. You can see here the international space station and a nearby satellite.



Nom du programme : New SATellite <https://c.gethopscotch.com/p/yaxlb0cpc>

Astronaut Chris Hadfield made space exploration very popular among youth by writing messages on Twitter, giving several lectures and singing the Space Oddity song from the International Space Station.



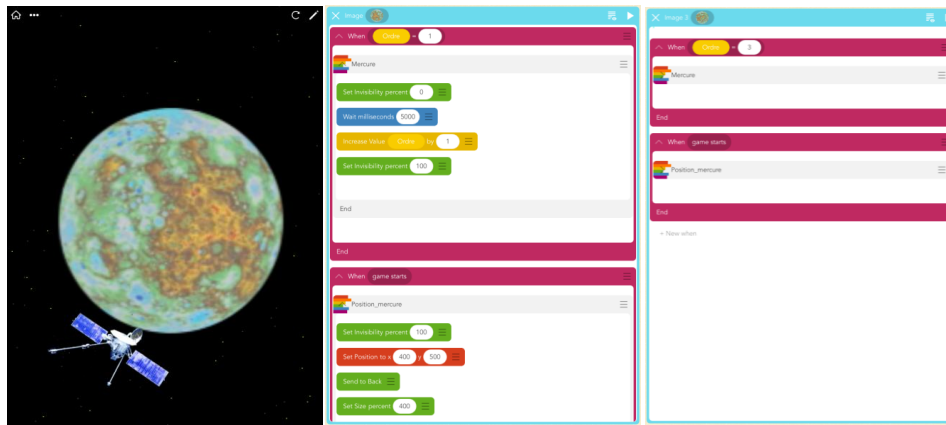
Name of the program: Space Oddity <https://c.gethopscotch.com/p/yca2j0urp>

Name of the program : Canadarm <https://c.gethopscotch.com/p/yaf4ofgbe>

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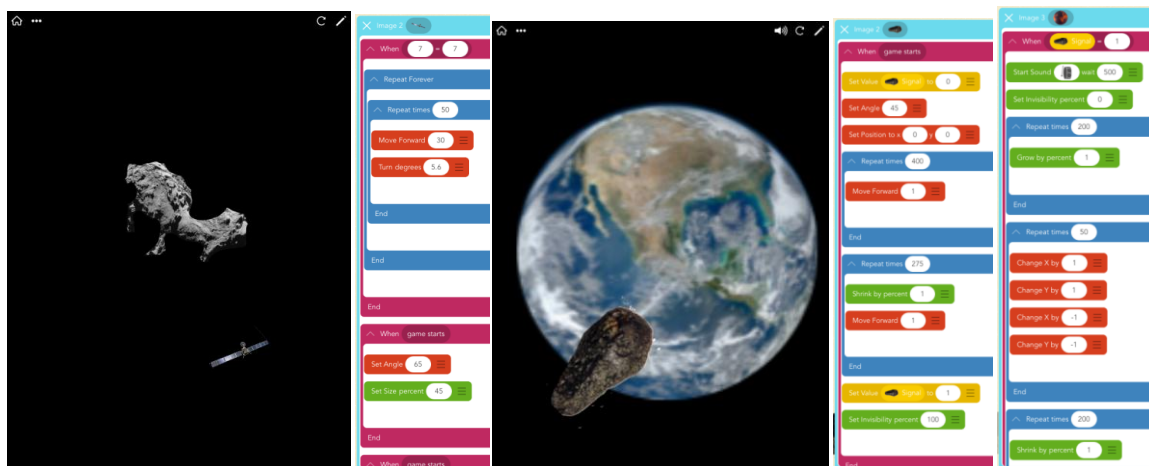
With Hopscotch, you can code the music of Chris Hadfield's song. We also see him in space, on the Canadarm, the Canadian robot attached to the international space station.

Space missions are not all inhabited. In fact, several probes were sent to explore the solar system. The NASA Messenger probe was sent in 2004 and made a detailed study of Mercury between 2011 and 2015. Other missions to Mercury are planned around 2017 by the European Space Agency.



Name of the programme : Mercure <https://c.gethopscotch.com/p/y9lrh6xh2>

The Rosetta Space Probe of the European Space Agency touched the comet Tchouri near Jupiter.



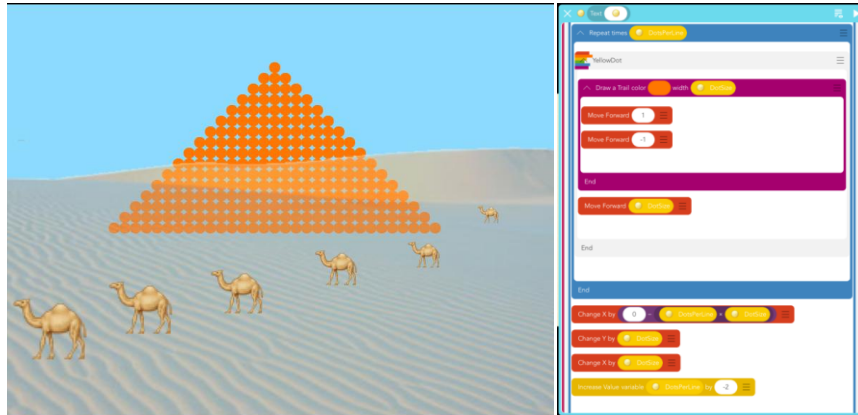
Name of the program : Rosetta Probe <https://c.gethopscotch.com/p/y9qyzkddu>

Name of the program : Asteroid <https://c.gethopscotch.com/p/y9k4d0615>

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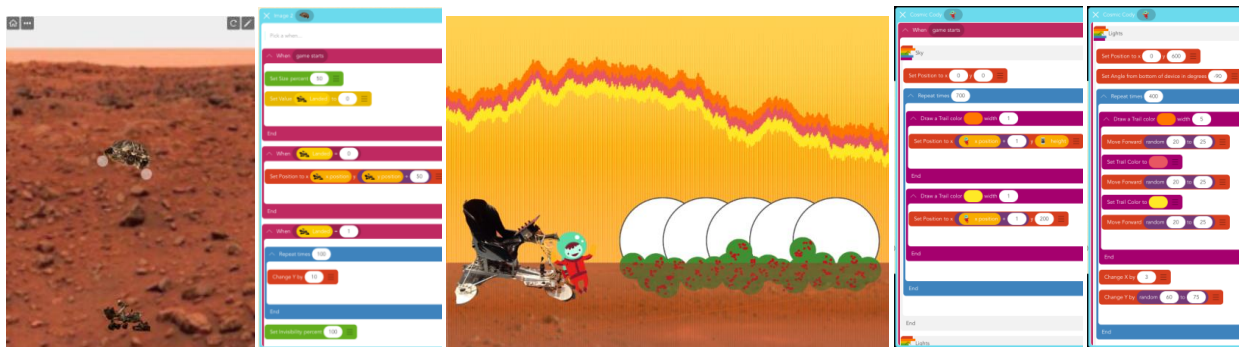
Although we do not often see comets that can destroy the Earth, it happened once at the time of the dinosaurs. In order to prevent another mass extinction, there are scientists who verify that the comets do not return.

How is space technology used? Sarah Parkak used a satellite with an infrared camera to take pictures in Egypt. In analyzing the photos, she discovered pyramids still buried. She estimates that 90% of the treasures of Egypt are still underground.



Name of the program : Pyramide <https://c.gethopscotch.com/p/y9s09sv5r>

The Canadians contributed to the development of the rover that went on Mars. They also experimented to see the effect of space on agriculture, such as tomatoes. Will it be possible to have greenhouses on Mars?



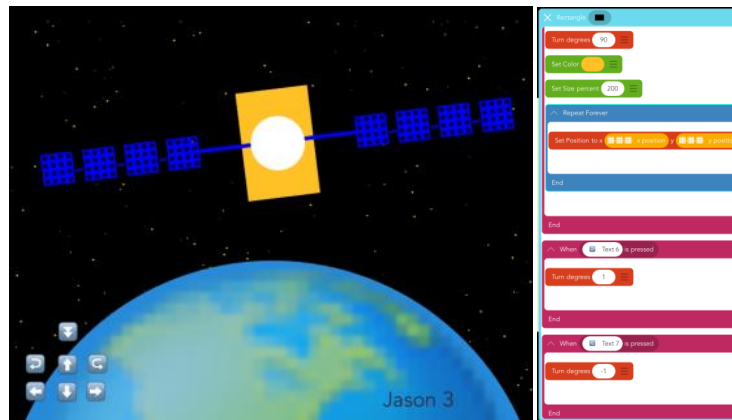
Name of the program : Atterissage sur Mars <https://c.gethopscotch.com/p/y9mwdsa4t>

Name of the program : Agriculture on Mars <https://c.gethopscotch.com/p/yav27w55z>

Can space technology help solve problems on Earth? The new Jason 3 satellite, launched in 2016, collects data on the height of the ocean surface and its topography. He is also studying heat inside the oceans, which is the key to understanding the El Niño

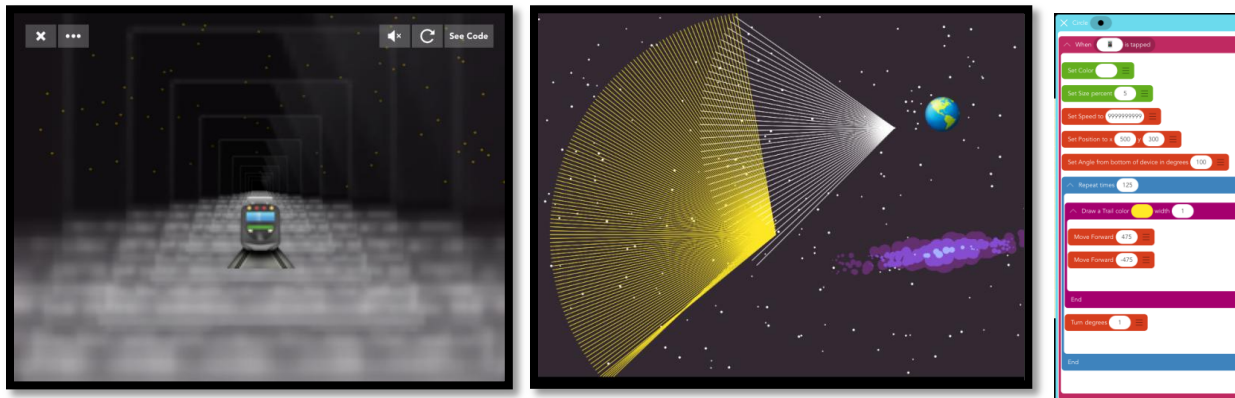
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phenomenon and predicting climate change. The data provide critical information on global warming.



Name of the program : Jason3 <https://c.gethopscotch.com/p/xp1hso9ej>

What is the future of space exploration? In the movie "*The mysteries of the invisible world*", we talk about nanotechnology and how carbon nanotubes can be used to build really solid materials. These solid materials could be used to make a space lift. This space elevator could save enormous amount of money while traveling beyond the atmosphere.



Name of the program: Space elevator: <https://c.gethopscotch.com/p/xxe9ws9ml>

Name of the program: Nanocraft <https://c.gethopscotch.com/p/xxf409g7k>

There is a new project, led by billionaire Yuri Milner, proposing to send a tiny vessel to the Alpha Centauri system. He proposes to send a NANO ship, which can be held

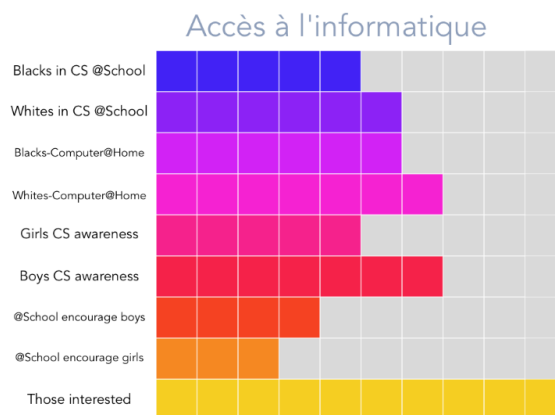
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between two fingers. It may take 20 years to develop this radically different technology. A normal ship would take 30,000 years to travel the distance of 4.37 light-years. But the StarShip ship could go to Alpha Centauri in just 20 years. It was Carl Sagan who in 1976 proposed the idea of a solar sail. Nature lovers are not waiting for the government to build their dream. They do it themselves.

During the Genius Hour, students create, innovate and share their mathematical project with an audience, the Hopscotch community. Using open-ended questions, they may continue to have a growth mindset toward mathematics and have the desire to pursue other projects later.

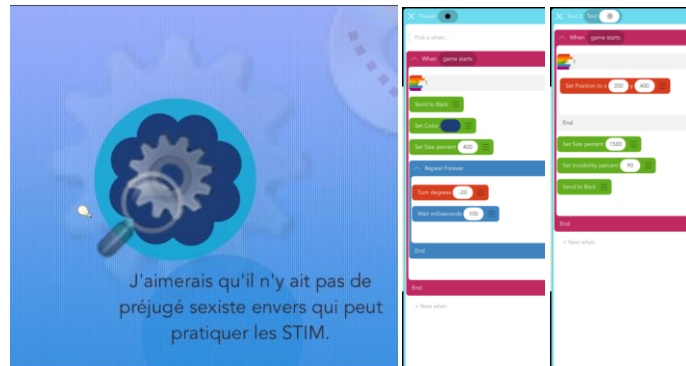
Mathematics and Equity

Every teacher, without exception, will admit that she wants every student to succeed in mathematics; however, our sometimes hidden attitudes, the stereotypes of certain students, sometimes have the opposite effect. Many minority students, including black boys, feel excluded from school and future high-paying jobs because they have not been valued at school because teachers have lower expectations for them at school because of the color of their skin (Toronto Star, 2016). The current status of inclusion of minority students in technology is reported (Hinton, 2016). Black students are less likely to have access to computer courses at school than white students. 47% of black students have access to it, compared with 58% for white students. Black students (58%) are less likely than white students (68%) to have a computer at home. Girls (48%) are less likely than boys (65%) to be aware of the potential of computers. Boys (46%) are more likely to be encouraged by their parent or teacher than girls (26%).



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Boaler (2016) indicates that when a student does not succeed well in mathematics, the teacher thinks it is a reflection of the student who would not be gifted in mathematics and not a reflection of his teaching. The growth mindset of the teacher where he thinks that every student can succeed is paramount. Each student must have the opportunity to receive a mathematical education with high expectations, regardless of his / her gender, color of skin, economic level, religion, place of birth or experience. Every student must have the chance to succeed.

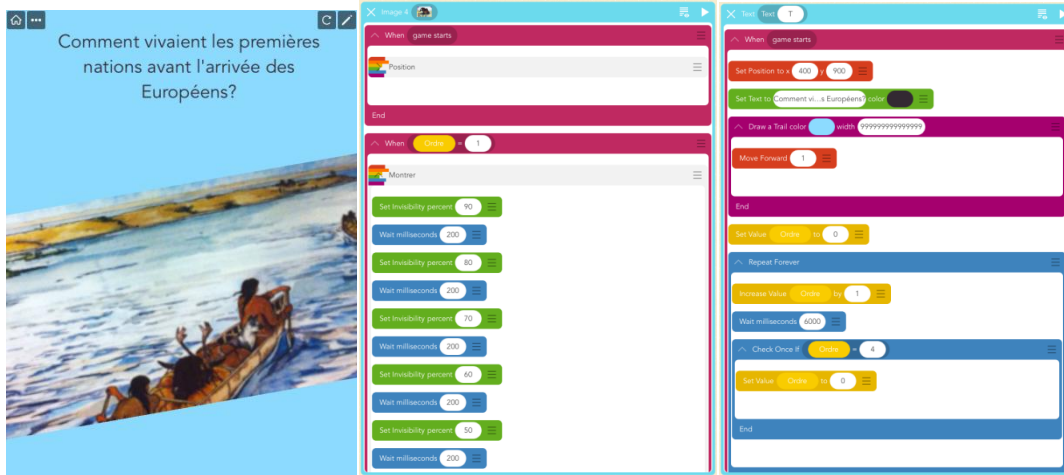


Name of the program : Tribes – Wishful Thinking <https://c.gethopscotch.com/p/yacaa4rx6>

On Canadian reserves, Aboriginal youth do not receive an adequate education because of lack of money and adequate infrastructure (Radio-Canada, 2016).



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Name of the program : Premières Nations <https://c.gethopscotch.com/p/y9znxpj54>

We have to include people of all colors. Who knows if the designer of Google's next search engine would be an Afghan refugee? Afghans arrive in Canada with enormous gaps because they have not had the chance to go to school in their country.



Name of the program : Blanc ou noir <https://c.gethopscotch.com/p/y9ubvlp91>

Name of the program : Malala <https://c.gethopscotch.com/p/ybh8kcew2>

More than 30 million girls around the world do not have the opportunity to attend school. Even with projects like the *Millennium Development Goal*, 500 million girls do not complete primary school (Brown, 2016). With equitable teaching strategies and a lot of encouragement, they can most certainly catch up and succeed.

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Sal Khan (2016) indicates that gaps in mathematical knowledge cause problems of understanding and not the ability of the student to learn. Mathematics is becoming more and more difficult because teaching continues with more advanced concepts, even if the student has not mastered the previous concepts on which the new teachings are based. As the student gets older, the gap increases. Changing the nature of homework can change the situation. Students can spend more time mastering the material by working at home. He has created thousands of exciting videos to help all students learn math at their own pace. By listening to the videos at home, students can see the video, stop it to think, rewind and review as many times as possible, until they have understood. The instruction time is changed so that each student can understand. The application Hopscotch offers several videos on the application, showing the basics of programming.



In his book "Les Devoirs", Thierry Karsenti (2015) looks at what research says about homework and student achievement. He notes a positive impact of homework on academic achievement and also proposes twelve conditions for duty to be effective. Coding with Hopscotch meets each of the winning conditions proposed by Dr. Karsenti.

First, homework is not "time-consuming". In Grades 3 and 4, the time spent on homework is 5 to 15 minutes, 1 to 4 times per week. Working on a Hopscotch program on a weekend meets these conditions in addition to supporting the cognitive commitment of the student who develops his computational thinking while coding.

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Name of the program: Animal à sang froid <https://c.gethopscotch.com/p/yapva8rmd>

For example, after a visit to a park while taking pictures, the student can very easily write a Hopscotch program in a few minutes. In this example, cold-blooded insects are seen with a digital camera and an infrared camera. The code allows rotation between the two images at the touch of a finger.

Secondly, the homework "does not unduly burden the work of the teacher". The Hopscotch application offers a several videos and examples that allow all students to learn, either by watching the videos or by reading the code of the programs available on the application. With some basic notions, the student can learn by himself, without a teacher. He can even include in his Hopscotch programs concepts learned during his favorite science show he watches at home.

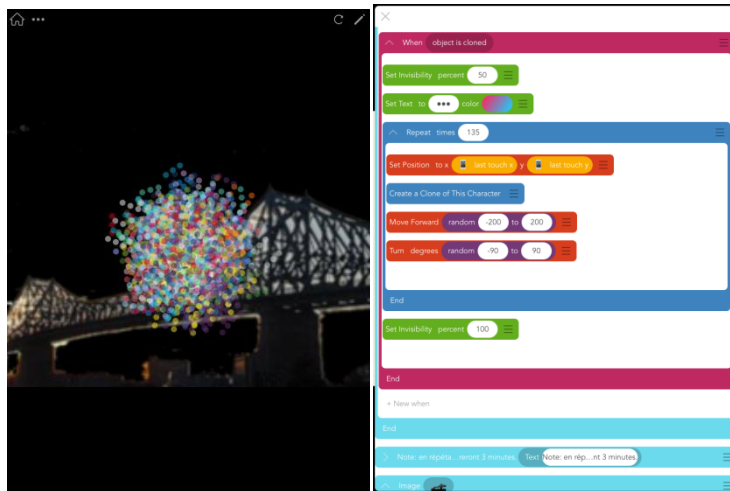


Name of the program : Géothermique <https://c.gethopscotch.com/p/ybxkjb5>

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This Hopscotch program was written in a few minutes after listening to the radio program of October 30 of Années Lumières of Radio-Canada. It discussed the flora that develops without light, and without photosynthesis at the bottom of the ocean thanks to geothermal heat.

Third, "they are neither too easy nor too difficult". To go further if he wishes, the student can see the code of the program he has played with and learn an additional command or algorithm. There are enough programs to read and challenges prepared by Hopscotch for several years. Instead of consuming and playing video games, students can write and produce video games.



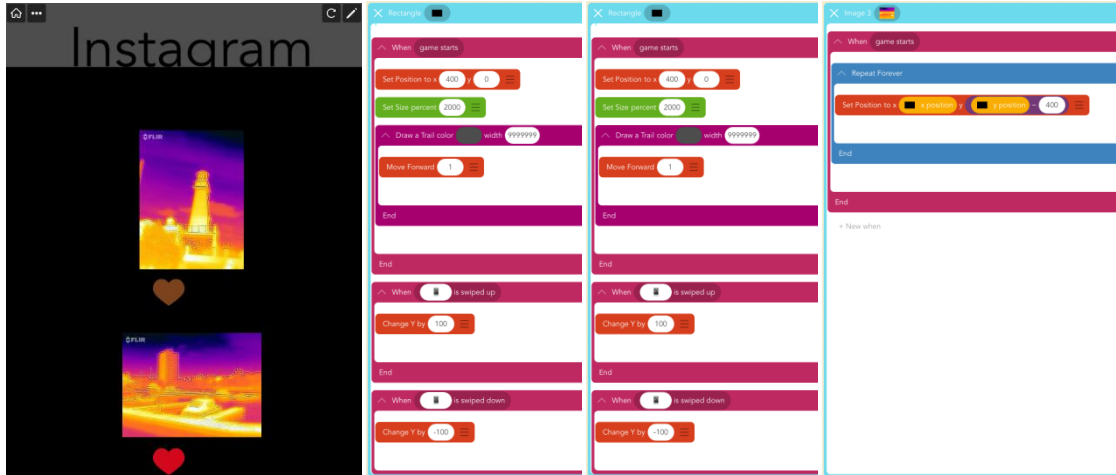
Name of the program : El – Feux d’artifice <https://c.gethopscotch.com/p/y9hd4cjvd>

Here we see a program that simulates the fireworks we see in Montreal in La Ronde. The student takes a picture of the location. He can be guided to code the lights by looking for an adequate program on Hopscotch, and by looking at how the algorithm works. The student can develop fireworks by himself afterwards.

Fourth, "they involve the family". The Gallup / Google poll indicates that the majority of parents want their child to learn to code. To code at home, parents must give access to the iPad to their child for a while. They must monitor the work of the child. If the child uses social networks like Instagram to share their pictures of their work, parents must do the monitoring. Even if you use mathematics in a Hopscotch program, what you learn most is problem solving. By showing homework with Hopscotch as a game and not mathematics, children will not develop a fixed mindset. They will instead have a growth

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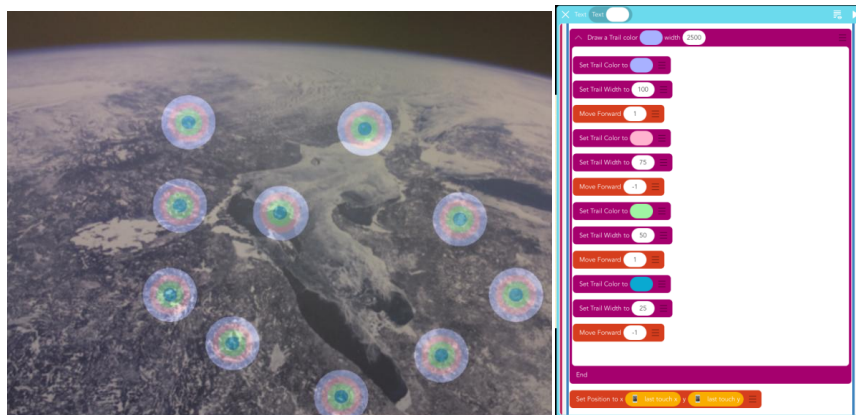
mindset since everyone can play. Hopscotch is a game that allows us to learn to code, which opens the doors to the job market and the knowledge needed to succeed in the future.



Name of the program : Instagram <https://c.gethopscotch.com/p/ya4i2s0qq>

Here we see a simulation of Instagram where we share images on social networks. This site is very popular among young people. The images go up and down with the movement of the finger. One can press the heart to love the images. Writing such a program directly shows how programming is connected to the world of work, using an application that students know.

Fifth, "they make judicious use of technology." Learning to code will give an understanding of the basis of technology and open doors to the world of work in an area that is in demand.

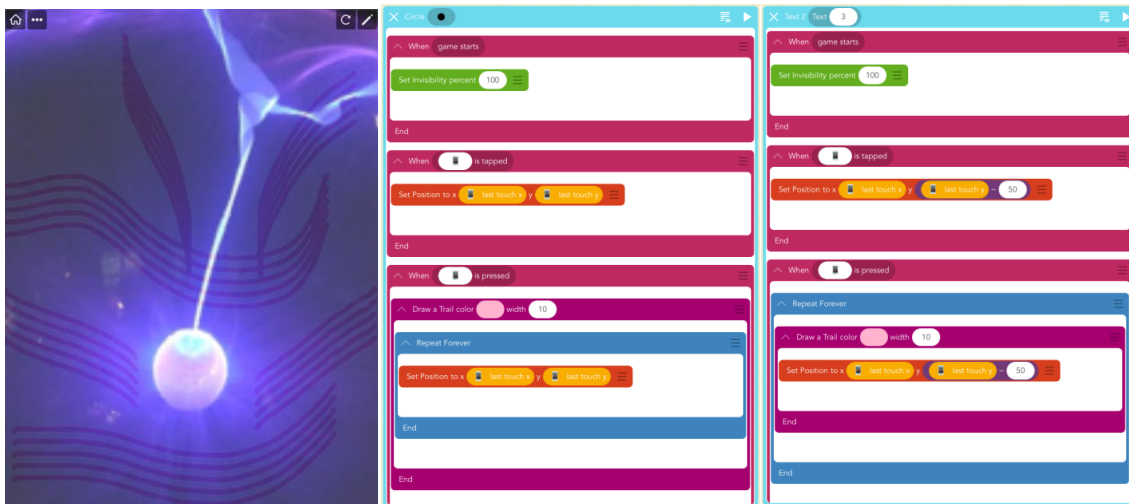


Name of the program : Farm Networking <https://c.gethopscotch.com/p/yam7ucdzi>

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In the United States, the children of agricultural workers do not have the opportunity to pursue advanced studies and poverty remains in these communities. There was a radio talking about a young woman who knew farming standards by watching her parents, and who had the opportunity to learn a bit of computer science. She developed an agricultural application that made it easier for her parents to work. Such an application did not exist and few people had this internal knowledge of agriculture. So she was able to innovate in an environment in demand, using with her own knowledge.

Sixth, "they participate in the construction of student motivation". Making a task that resembles a game is very motivating for the student. He does not realize that he is learning. It is engaging and it is not a chore. You will see pride in the students' eyes when they say, "Madam, I created a new game! "They learned to code easily while having fun.



Name of the program : 5 crayons <https://c.gethopscotch.com/p/y9rqpp1ab>

We see here a game to amplify the effect of the plasma ball seen at the Ontario Science Center. Five parallel lines are drawn at the touch of a finger.

Seventh, "they take socio-economic inequities into account". By coding at an early age, students of color, immigrants, students from a disadvantaged background have the opportunity to learn a profession in high demand and well paid. Each of your students could become the next Steve Jobs, or the next inventor of artificial intelligence. If the student does not have an iPad or iPhone at home, it is always possible to do a weekly programming club where all interested students can join.

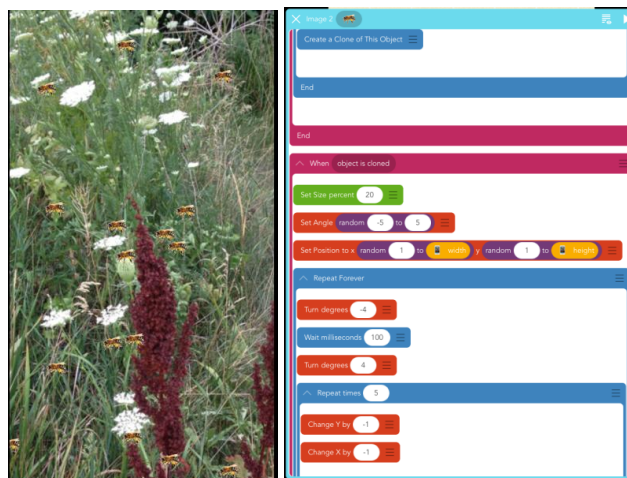
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Name of the program : AI – image – IA <https://c.gethopscotch.com/p/ybgex10ou>

Following the visualization of the TED video on machine learning of vision, we realize that artificial intelligence is in its infancy. To teach a computer to recognize images, we must first show him several examples of a concept so that the computer can learn to recognize the concept. Fei-Fei Li explained how she had to show thousands of examples of cats of all colors and positions to the computer so that she could start to recognize a cat. In this example, we teach the iPad how to recognize a fish. With each fish image we present, we must indicate whether it is a fish or not. At the end, the iPad knows what has been taught by keeping in mind if each image is a fish or not.

Eighth, "they specifically target students who are experiencing learning disabilities." There are teachers who use the code in the classes of pupils in difficulty in order to engage them academically. If their homework is to play what looks like video games to learn problem solving from time to time, they will be more motivated.

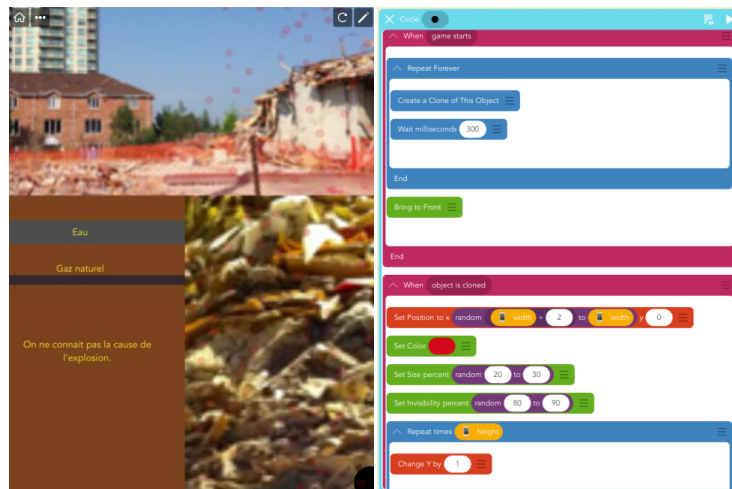


Name of the program : Abeilles <https://c.gethopscotch.com/p/ya446a6yh>

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The simplicity of the algorithm of a program does not prevent expressing a very important concept, such as the disappearance of the bees, while using the mathematical notions that the student must master. Knowing the dramatic impact of the disappearance of bees on our agriculture, no student will feel isolated from discussing such an important subject, even if its algorithm is rudimentary. Using important issues with programming will help all students develop a growth mindset.

Ninth, "they take into account the age of the students". For elementary school students, the duties of reading and writing are very important. Hopscotch allows students to write long texts with a medium they like. For a student who lacks motivation to write, the medium may be what makes all the difference. The student can write letters, books, a newspaper article, design posters, develop a website, write interactive stories, give explanations illustrating the program he has written. The program may also be a response to a reading of fictitious text or documentaries.



Name of the program : Cause de l'explosion <https://c.gethopscotch.com/p/y8r819m08>

In this text, we see a student who gives a visual explanation of an explosion that occurred near his house. She took a photo of the house after the explosion and visualized ducts of water and natural gas. Sometimes houses are built on former garbage dump that creates gases caused by the decomposition of waste. According to her theory, this gas, escaped from the old dump, could have caused the explosion of the house. Since the cause of the explosion has not been revealed, this theory is as good as another. It is very competent and innovative. His explanation shows critical thinking, a mathematical and also literary writing.

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Tenth, "they lead students to organize and become autonomous". Students can initially follow the videos offered by Hopscotch. They work on these programs independently. Once the basic knowledge is acquired, they can look at the code of the Hopscotch community programs, and choose new challenges depending on their interest. There is a large amount of programs to choose from for all tastes and all levels of difficulty. Students will have the opportunity to become innovative by creating their own program while pursuing their personal passions.



Name of the program: Auto sans conducteur <https://c.gethopscotch.com/p/ybhsmkv7u>

Here we see an example of a driverless car. How to write an algorithm so that other cars do not hit it. To do this, the driverless car scans its surroundings to see if there are other cars. The circle around the cars shows the area where the scan is being used. When both cars detect each other, they must change direction in order not to collide. In his presentation at TED, Wanis Kabbaj (2016) demonstrated how traffic with a driverless automobile could improve traffic congestion by removing traffic lights. Cars that detect each other no longer need the lights. Without regular stops, traffic would be improved.

Eleventhly, "they use particularly effective teaching strategies". Hopscotch has the advantage of offering a homework that makes sense to students and gives an interesting choice. In addition to playing a video game or having the impression of developing an application like professional coders, the choice to work with Hopscotch is very interesting and very motivating. The gifted student who does the minimum in class can be encouraged to excel by giving captivating assignments with Hopscotch. They

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often need challenges since everything seems easy. They can learn perseverance there. It is the same for the student who has taken a liking to coding.



Name of the program : CHIME <https://c.gethopscotch.com/p/xunmu28oi>

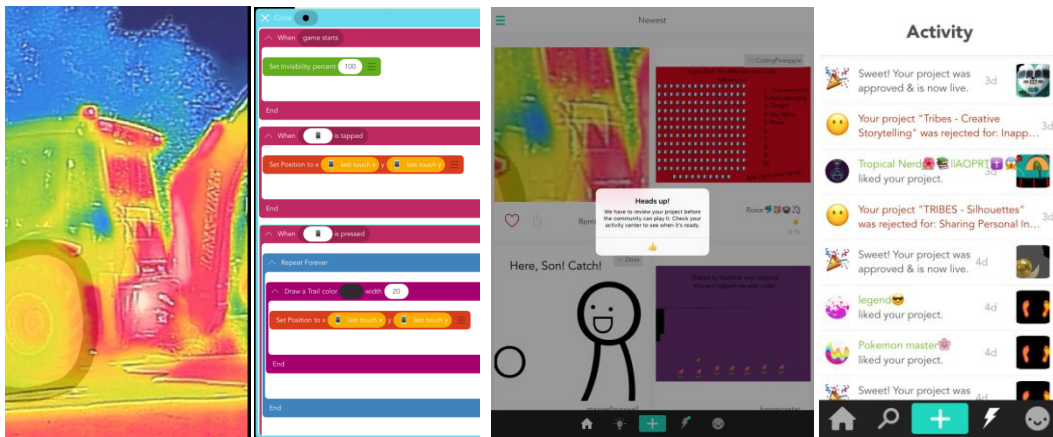
The first telescope was built in Baghdad, Iraq in 828. Four hundred years later, China was building one as well. Then another in Germany in 1558. It was not until 1935 that we had a telescope in Toronto and in 1978 at Mont Mégantic. A new fixed telescope is under construction in British Columbia. It will document the speed or acceleration of the expansion of the universe.

Twelfth, "they provide students with the help and resources they need". With support from parents, teachers, videos showing how to code a program, thousands of programs from the Hopscotch community, Hopscotch network discussions, the Hopscotch blog, and evaluation as a learning experience, Hopscotch application gives all the necessary resources that the student and the teacher need to succeed. Hopscotch is one of the few applications that offer such comprehensive evaluation for each shared project.

Here we see a very simple program to code. An infrared image to be analyzed. With the touch of the finger, we draw a line at the place where our finger is placed. Blue shows the coldest places and red shows the hottest places in the image. The analysis makes it possible to notice that the motor of the mechanical shovel is on since one sees the heat of the engine. One can also notice that there is no one inside because a human being has a temperature that is visible to the infrared; one sees only the green of the cabin with no contrasting red for the warmth of a person. In addition, the wheels are yellow, showing that the tires are relatively cold. When the tires are used, they become hot,

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which is visible in infrared. Analysis of the image shows that the mechanical shovel was switched on but as not used, burning gasoline for no obvious reason.



Name of the program : Remix infrarouge <https://c.gethopscotch.com/p/yby1t8139>

When a Hopscotch program is shared with the Hopscotch community, the app gives an assessment as learning of the program that has just been shared by suggesting 3 other programs allowing the student to get ideas to improve his initial code. Looking at the suggestions, it can be interpreted that our program could be improved by drawing perfect circles instead of drawing a circle with your finger. It could be improved by adding a title and text. It could also be improved by adding characters that interact on the screen. There are three suggested programs that the student can consult to find out how. In addition, if the student shares photos, these photos must be approved by a person designated by Hopscotch to keep the student's privacy or to ensure that the content is appropriate.

Hopscotch offers good support for students and is a superior resource for homework help.

Motivating the unmotivated student

Our students come from very different backgrounds, have different family situations, or have recently been in Canada as refugees. Their emotional state can greatly affect their academic performance. What to do when the student refuses to work?

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Some students visit psychiatrists because of deep injuries they have received and still come to school with post-traumatic stress disorder that needs to be cured. As a result of trauma, part of the brain stops working. These people suffer in solitude because they do not talk about their experience to anyone because of fear of being judged, or being misunderstood. Melissa Walker (2015) saw dramatic effects of therapy with art. Art allows to reach the parts of the brain that the speech could not reach. The expression with art allowed expressing repressed feelings in an encouraging environment and helped healing.



Name of the program : Masque <https://c.gethopscotch.com/p/yaow9y6lv>

One of Melissa Walker's patients created an elaborate mask that allowed the painful images to go away. She repeated this process a thousand times with other people with post-traumatic stress disorder. Nothing prevents us from using Hopscotch as an artistic medium, either with an already written program or starting from the very beginning.

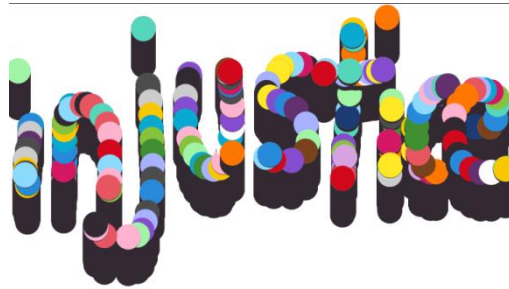
Emotional Intelligence

Daniel Goleman popularized the model of emotional intelligence. He argues that emotional intelligence is more important than intellectual quotient or parent education in academic achievement. In his TED talk, Daniel Goleman mentions a discussion with an assassin who had an intelligence quotient of 160. He was a certified genius. With all his intelligence, he found himself in prison for life. Why? He had committed his crime, while being very close to his victim. He admitted that if he had felt the distress of his victim just a little, he would not have been able to commit his murder. He had to cut that part

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of himself, otherwise he could not have done it. We see that there is no correlation between intellectual intelligence and emotional intelligence. Adjusting students' emotions in order to concentrate and work is essential.

Several models and techniques are available to help children with emotional intelligence. Danie Beaulieu has developed emotional intelligence techniques for the school environment. These techniques can be used for classroom management, to develop self-control, empathy, develop the ability to self motivate and educate intellectual and emotional plans. She suggests using inventiveness in applying the techniques of her book. By following this model, these techniques can be used in class and can also be coded.

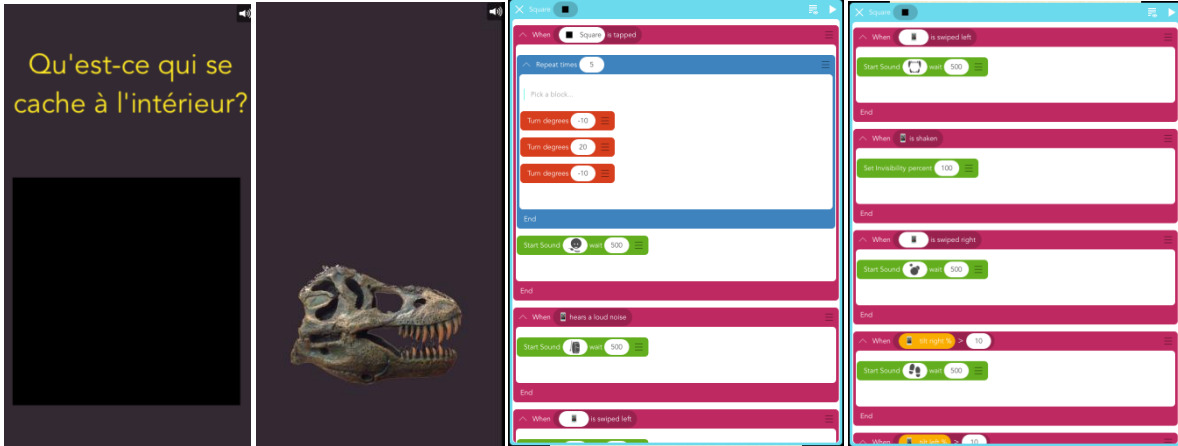


Name of the program : EI – carton <https://c.gethopscotch.com/p/y23hrsuy>

There may be a student who cannot work because of an obsession with hateful comments from his classmates at school. He can write with the iPad, a word that describes his state of mind. The student looks at what he has written, having the iPad very close to those eyes. Subsequently, he distances the iPad and looks a little further. From further on, one can see much more than just the problem. We take a step back, we enlarge our perspective. This parallel can be used to discuss the student's emotions and put the whole thing in perspective in order to calm the student.

What is hidden inside the box? The programmer tries to mimic the reaction of a dinosaur. According to the actions carried out with the iPad, one sees different reactions. It is an animal that eats. We hear footsteps, purrs, drops of water. We must use our imagination to decipher these reactions. Only when you shake the iPad, the box disappears and you see the dinosaur inside.

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Name of the program : El Contenant Opaque

<https://c.gethopscotch.com/p/ya4tmh490>

With the strategy *opaque container*, we make another parallel with the emotions. What is hidden inside the container is secret. We cannot see it. We can sometimes guess it. Looking inside, we can know what is hiding. The parallel is used to ask the student to reveal what is hidden in him.

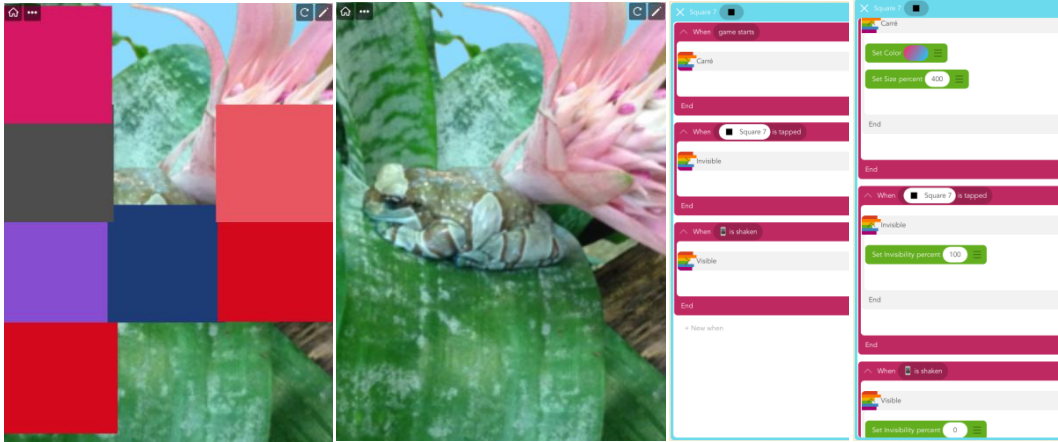
Danie Beaulieu offers many strategies with the books she has written. Many of them can be done technologically, with Hopscotch.

Motivation in 3-minutes

Sometimes students do not work because they have not been mentally and emotionally prepared to do their job. They need a little mental recreation in order to refocus on the new lesson. Sometimes students do not work because they are a bit asleep or distracted. The 3-minute motivation activities developed by Kathy Paterson (2014) help students refocus on their work.

In the Pop-a-lot activity, the bubbles burst, or in our example, the squares disappear.

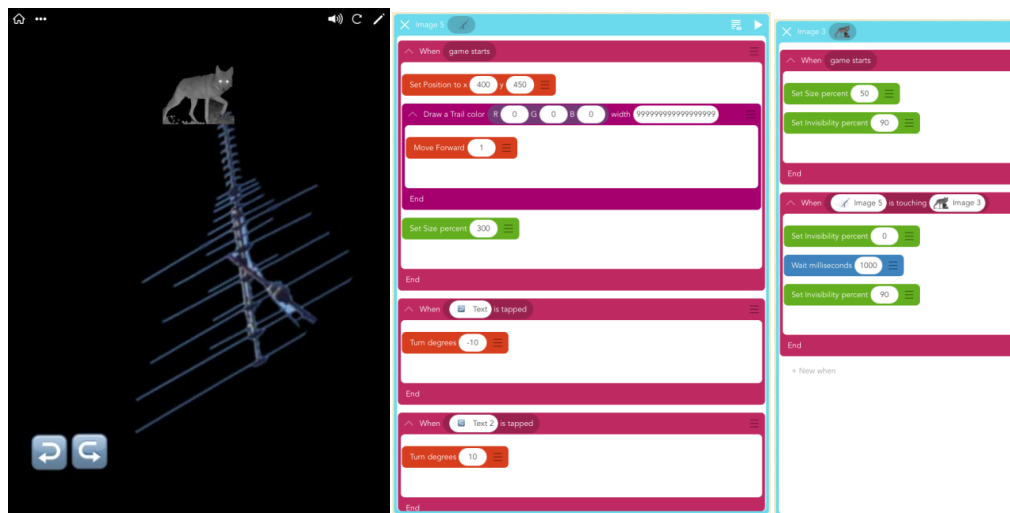
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Name of the program : Casse-tête <https://c.gethopscotch.com/p/yauhbmplj>

Once finished, we discuss how we feel after having made all the squares disappear. The activity will have allowed the student to calm down.

With the *Poor Me!* Activity, the student feels sorry for himself. He shows a very sad face, at his situation. The activity allows to communicate emotions. We can make the relationship between us, humans who cannot see in the dark. Imagine everything you cannot do in the dark. There is a solution, however. With an antenna equipped with an infrared camera, we can use it to see in the dark.



Name of the program : Coyote <https://c.gethopscotch.com/p/y9jswta2q>

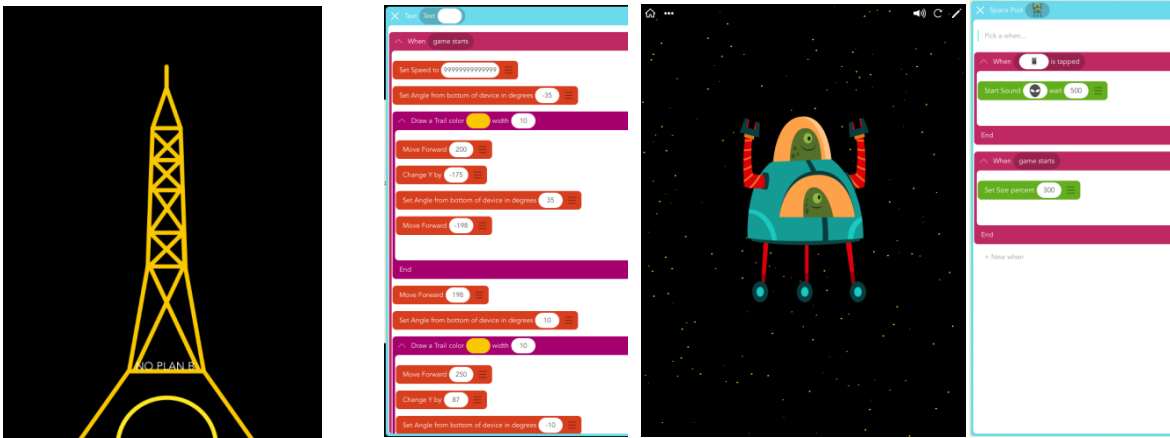
What are our emotions? By using Hopscotch, the student who is shy or who does not want to participate in the drama activity can still be included.

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TRIBES

TRIBES is a program that creates a positive climate in the classroom. Students learn to respect each other, encourage each other, include and appreciate all peers in the classroom. TRIBES also helps to develop positive attitudes towards their learning.

The activity of the ideal classroom allows to discuss with the students the rules to follow in our class, to change the climate of the class from negative to positive, to transfer the responsibility of the implementation to the students and to allow students to have some influence in the decisions of the choice of activities. For example, students may want to use technology to learn from a young age to develop a positive legacy. The Paris Climate Accord has just been ratified by several countries around the world. Learning to code in class in order to develop the next renewable energies is a noble goal in our ideal classroom. For those who adore space, who are inspired by space exploration, who dream of traveling to Mars or distant galaxies, their ideal classroom could include learning how to code in order to build the next spaceship for space exploration or at least to develop satellites essential for communication. The use of a fundamental mathematical tool to develop a great idea for the survival of the planet or a dream when our planet will be stabilized, are part of our ideal classroom.



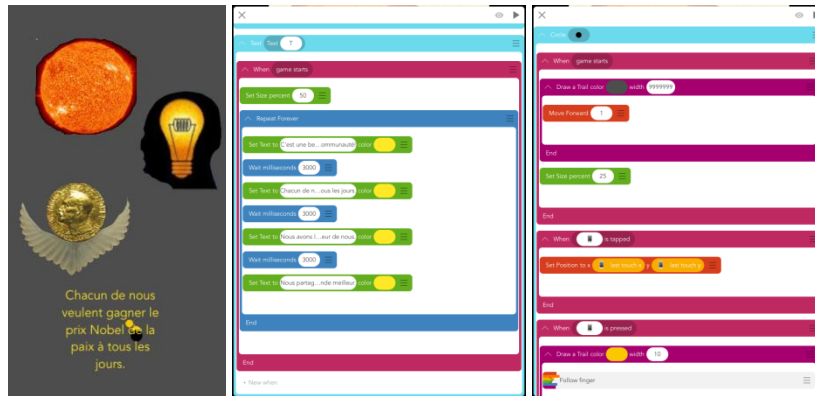
Name of the program : No plan B <https://c.gethopscotch.com/p/ycd5ltipk>

Name of the program: TRIBES - Barnyard Babble <https://c.gethopscotch.com/p/yac2qand5>

Gifted students also want to be included in our ideal classroom. They are able to work independently from the teacher and want to use their potential beyond the level of their curriculum. In our ideal classroom, when students arrive in class, already knowing

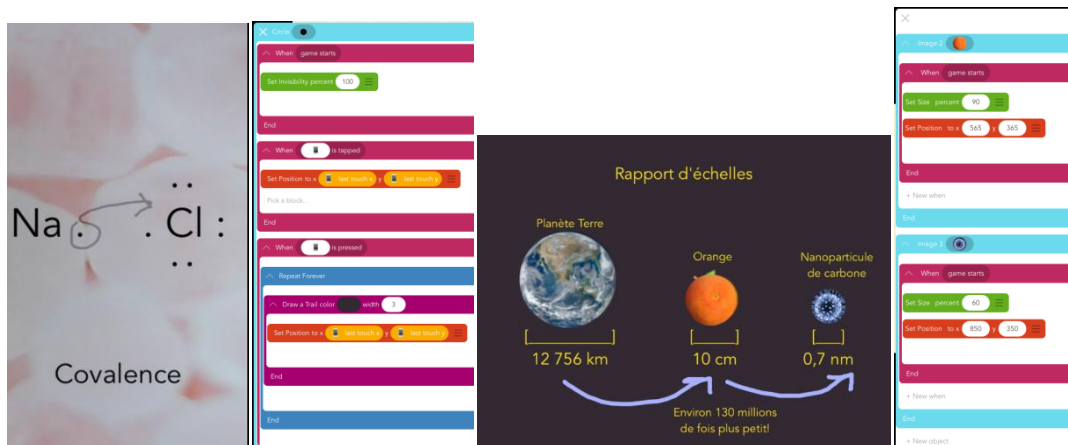
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everything we need to teach, they have the chance to work by project and develop projects beyond our expectations. They may have read or talked to their parents about Nobel Prizes. In our ideal class, gifted and talented students can explore complex ideas related to the curriculum. Can they use the ideas found in yesterday's news in the classroom?



Name of the program: TRIBES – What’s Your Bag? <https://c.gethopscotch.com/p/ya9vf8d1y>

The French scientist Jean-Pierre Sauvage and two other scientists were awarded the Nobel Prize for Chemistry in 2016 (Huffington Post, 2016) for their research on molecular machines. Using the science curriculum of Grade 5, a student could mount their understanding of the atomic structure of salt. However, with the idea of the Nobel Prize and a little research, a gifted student could demonstrate an entirely different understanding.

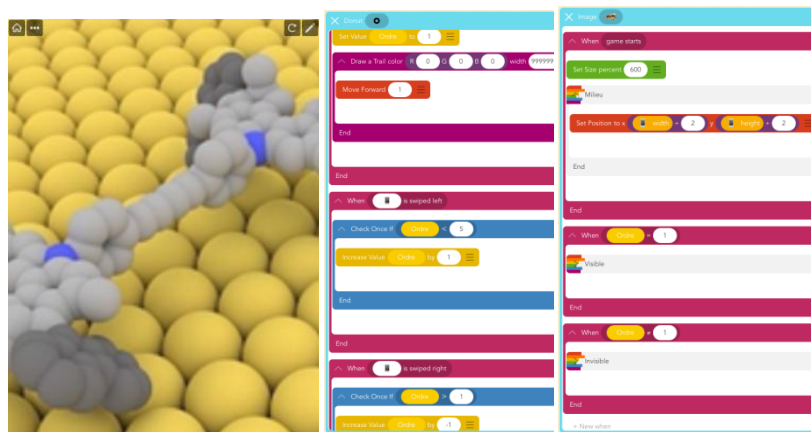
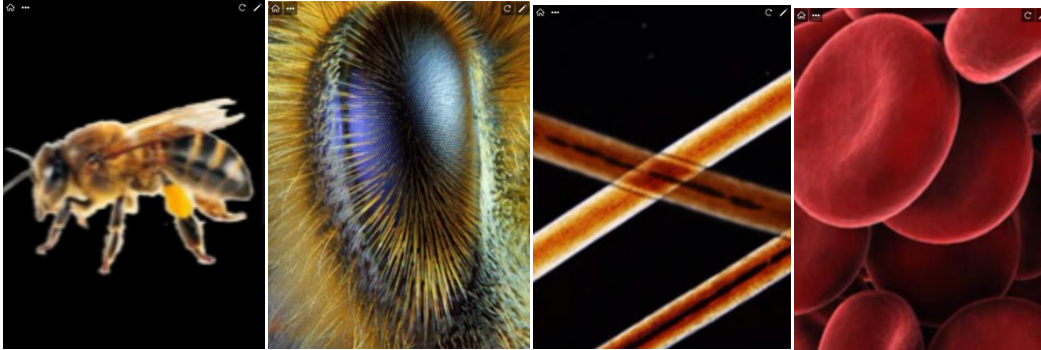


Name of the program : Covalence <https://c.gethopscotch.com/p/y9rt5qfom>

Name of the program : Echelle Nano <https://c.gethopscotch.com/p/y9hfb3eu>

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First, we need to understand the size of molecular machines. Compared to the Earth, an orange would be 130 times smaller than Earth and compared to orange, a nanoparticle would be 130 million times smaller than an orange. Can we show our understanding of the size of nanoparticles in a different way?

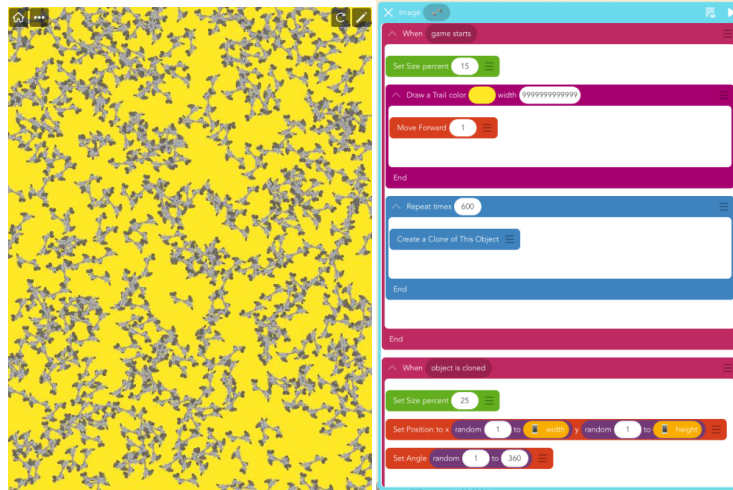


Name of the program : Nobel Nanoscale <https://c.gethopscotch.com/p/ya4eaujg>

We use the bee as a known base of the order of the centimeter. One then looks at something ten times smaller, the hairs around the eyes of the bee, of the order of a millimeter. Our journey towards the smaller continues by looking at a red globule, of the order of the micrometer. The journey ends at the level of the molecular machine, with its order of the nanometer. Moving from one image to another changes the scale, being ten times smaller each time.

We will then do like our Nobel laureate Jean-Pierre Sauvage and build a simulation of the production of molecular machines. The machines are able to move in response to light, temperature and other processes. The possibilities they bring are endless. Where can these molecular machines be useful? Let's stimulate our imagination.

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Name of the program : Simulation de fabrication de machine moléculaire

<https://c.gethopscotch.com/p/yaepm8f2f>

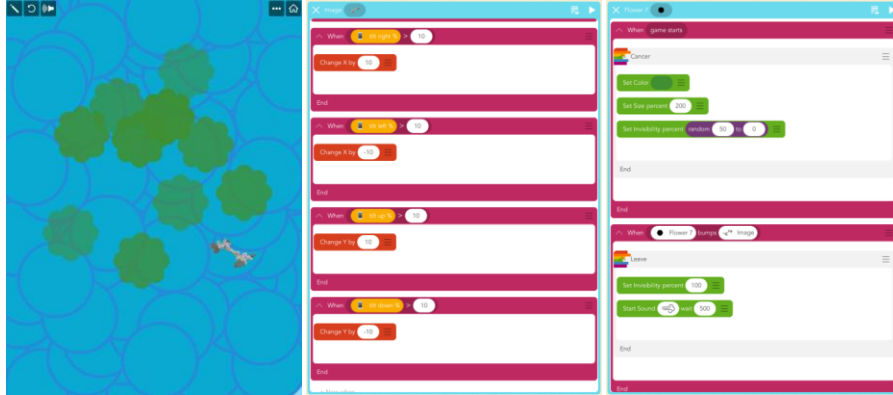
Nanotechnology is already used to develop graphene sheets. These sheets could be used to develop the next generation of very flexible and very thin solar panels. They are also used to replace rare earth minerals that are used in our telephones and computers that are almost exhausted now.



Name of the program : Feuille de graphène <https://c.gethopscotch.com/p/y9hgmcelm>

Molecular machines are still not used in medicine or any other field. Their application is still undetermined and remains to be discovered. Who knows if our gifted student will be the one who will get a future Nobel prize for the discovery of an unprecedented application of molecular machines.

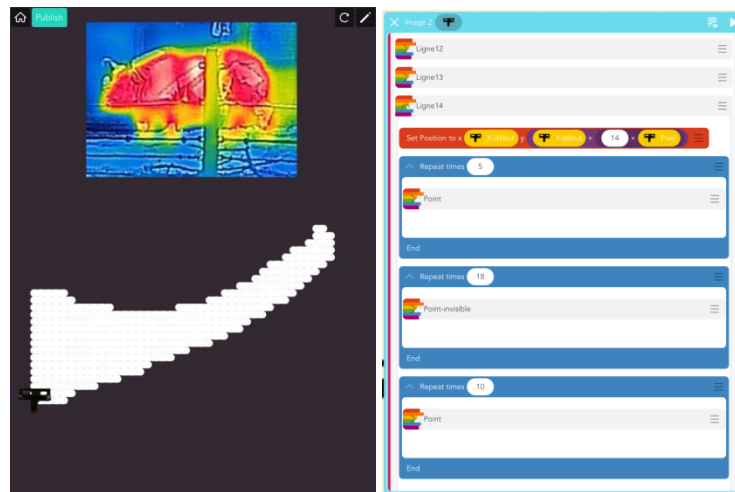
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Name of the program : Molecular machines <https://c.gethopscotch.com/p/yaf59jw4h>

Many gifted students have the time, motivation and interest to pursue such projects. We just have to show them the ABC of programming and where to find resources to satisfy their curiosity and they will do the rest on their own.

Finally, 3D printers can encourage unmotivated students by showing an application where technology can save a species of animal at risk. Rhinoceros horns are systematically cut in Vietnam because they are thought to have a significant medicinal effect. One company thought of building an artificial rhinoceros horn with a 3D printer that is quite identical to a real rhinoceros horn. The artificial 3D horns would be introduced into the market to compete with the true rhino horns to save the rhinoceros population (Al-Jazeera, 2016).



Nom du programme : 3D corne de rhinocéros <https://c.gethopscotch.com/p/yf8uufk17>

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Seeing important applications of technology encourages all students to make a difference.

Media education

Our students watch an average of four and a half hours of television per day (Databank Indicator, 2014). This includes watching TV shows, with computer, iPods, phones and iPad. They spend almost as much time in front of the television as in school. Students who spend more time in front of the TV may have behavioral problems caused by parental neglect.

Media education allows us to know the world of our students and to make a connection between a world very present in their life and school. Media literacy also provides a hook and a context that they need to motivate themselves while following our curriculum. The analysis of films, visual images, current affairs, advertising or propaganda helps our students to develop the critical thinking they need to navigate this world inundated with media messages. This need is absolutely fundamental so that the student can make good decisions throughout his life and not be unduly influenced by all the messages they are bombarded with on a daily basis. Any media message is presented according to the viewpoint of the author and does not necessarily represent the interests of the majority, the minority or even the student. The message can certainly be colored with a bias that students must learn to recognize in order to form an independent opinion on the subject. They must become media skeptics in order to use them wisely.

The book 'Making Thinking Visible' from Harvard University offers several strategies that can be used in the classroom to develop critical thinking while using the media. We will use these strategies to analyze a major theme, environmental education beginning with the movie Deepwater (2016).

DeepWater

The movie DeepWater (2016) gives a historical account of the explosion of the BP DeepWater Horizon oil platform and the worst ecological incident in the United States

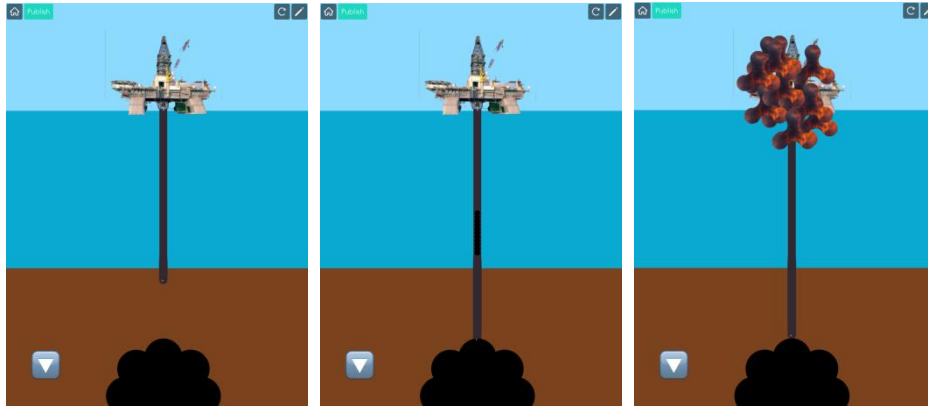
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caused by the huge oil spill in the Gulf of Mexico. For the vast majority of our students, the gasoline that is put into the automobile comes from the gas station. We do not know all that is necessary for the gasoline to go near us and its effect on our environment.

The SEE-THINK-WONDER strategy (Ritchhart, 2011) shows the importance of observing images to inform our thinking. What do we see? In the image strip, the girl decides to do a project on the work of her father, who works on the DeepWater Horizon drilling rig. She uses a can of Coke to perform an experiment that simulates the drilling that is done at the oil rig. An accident occurs and the soft drink spills all over the kitchen. What interpretations can be made based on our observations? The girl seems to decide the topic of her project. It is a project that is close to her heart: the work of her dad. It uses the tools that surround it: a rigid straw to simulate the drill pipe and a can of Coke that simulates the oil deposit. You might think that this is advertising for this company and a sweet drink that may not be ideal for health.

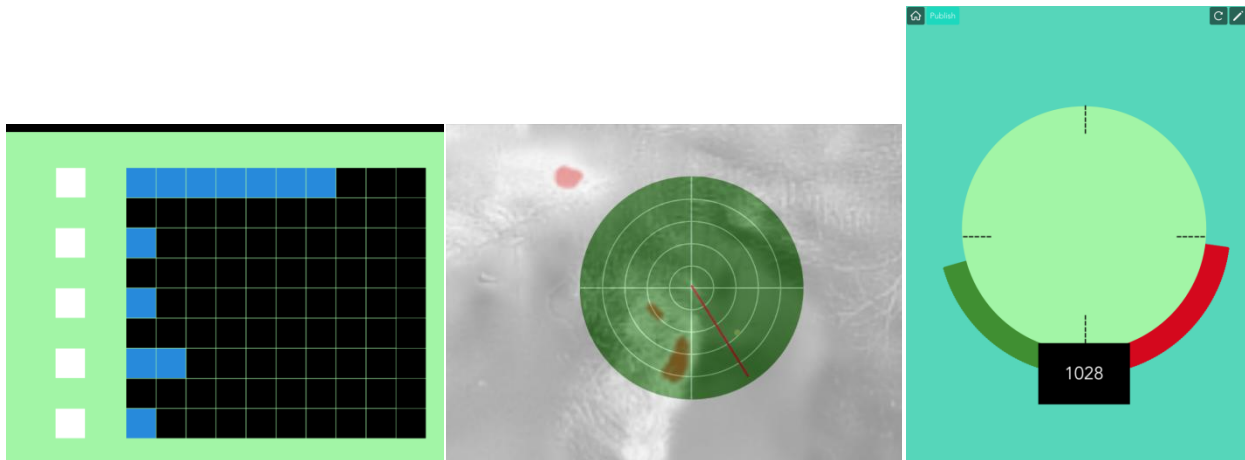
We can ask ourselves if other more rewarding tools can be used to carry out this project, which seems very interesting. One can use Hopscotch and code the oil platform with a photo of DeepWater Horizon. The program shows, in simulation, the operation of DeepWater Horizon. The drill goes inside a tube to the bottom of the ocean. It is lifted and dropped, forming a deeper hole each time. This regular movement allows the drill to go deeper into the ground beneath the ocean. The mud goes up to the platform. Once the oil slick is reached, the oil platform makes it possible to draw oil. One can also code the accident, the fire on the platform. Oil drilling is a job that requires a lot of precautions from engineers and technicians. If errors occur or market priority is placed before the welfare of employees or the environment, major accidents can occur.

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Name of the program : Deepwater Horizon <https://c.gethopscotch.com/p/yc2ikf5x3>

One can also notice in the trailer and in the film a flood of technological tools. There are the instruments onboard the helicopter, the boat, the computer with Skype that allows communication from the platform to the city. There are the instruments on board the oil platform, such as those that measure the pressure exerted by the drill pipe and the alerts caused by the pressure. There is satellite and satellite images. Coast Guards aboard helicopters use light amplifiers to better see in the dark. We have to wonder what each instrument is used for and how it can be made. Who is responsible for making these instruments? Is there employment in the manufacture of these instruments? Who is responsible for the explosion aboard DeepWater Horizon?



Name of the program : Lecture <https://c.gethopscotch.com/p/ycf6tmny3>

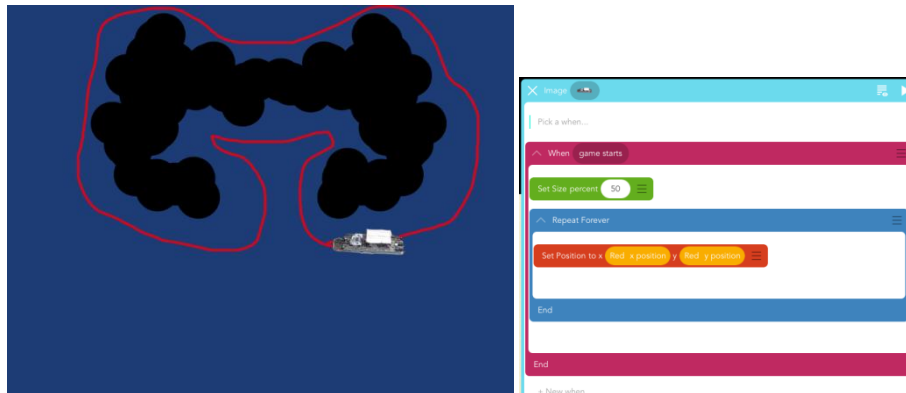
Name of the program : Lecture <https://c.gethopscotch.com/p/ycf9bq7zn>

Name of the program : Lecture radar <https://c.gethopscotch.com/p/ycf82v3qa>

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These instruments are crucial on board the platform. It is the reading of these technological instruments which informs the decisions that must take its user, the platform engineers. Instruments measure and regulate pressure during oil drilling and extraction. A poor reading and interpretation of the instruments caused the fire. Even if a reading error has caused the fire and the oil spill, one can only feel a huge responsibility putting on all the instruments used. We rely on instruments, but how do we know that they have been well written? What is the responsibility of computer engineers in these systems? Would it be useful to have basic computer skills?

The CHALK TALK strategy (Ritchhart, 2011) makes it possible to go further. It allows discussing controversial issues in a safe and calm environment, while giving more time to think. Using Hopscotch to show the idea visually, instead of verbally, allows one to choose when we are willing to share a comment and consider the point of view of others, which could be difficult with controversial topics. One wonders what ideas come to mind in considering the problem. What links can we make with the response of others? What questions do we think of in response to the ideas of others?



Name of the program : Déversement de pétrole

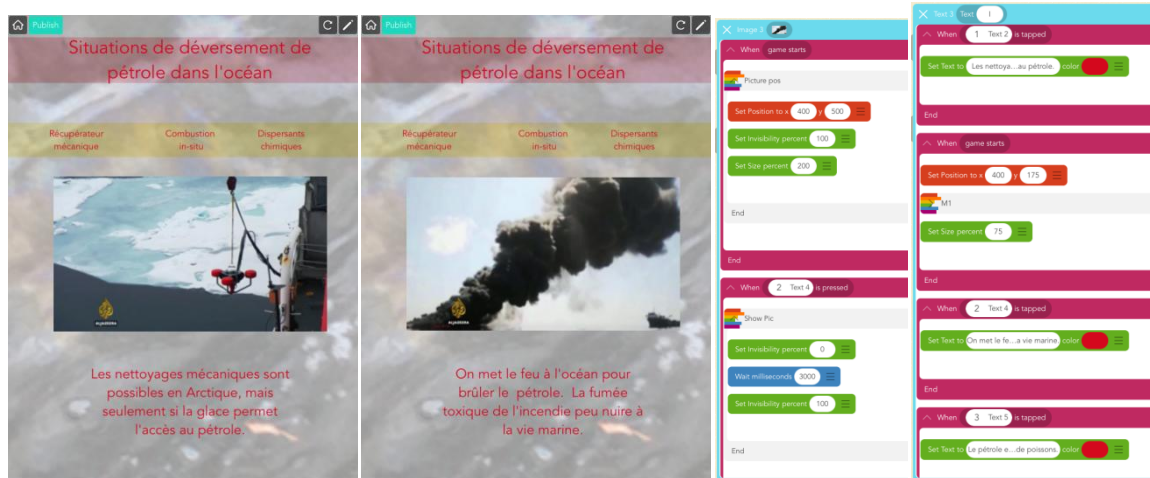
<https://c.gethopscotch.com/p/yc26zpwkq>

A lot of oil spilled during the accident with DeepWater. How is oil spilled in the ocean cleaned? The cleaning crew must contain the oil with buoys before they can remove the oil from the water or burn it. Such a catastrophe with the oil platform DeepWater Horizon and with oil tanker SS Pendleton in the film The Hours of Glory could give the impression that the extraction and transport of oil is the main cause of the pollution of the oceans by hydrocarbons. In fact, this is not the case. That is a misconception. It is the media that give this impression because of the large amount of time spent covering

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major accidents. Most of the pollution of the ocean comes from cars and industrial waste and not from oil tankers and not oil platforms (Fingas, 2011).

The following website shows some tools used when oil spills into the ocean. The images are taken from the site of al-Jazeera. There are mechanical skimmers to recover a small amount of oil floating on the surface. They can be used in oceans. They are also being studied for possible use in the Arctic where ice can mingle with spilled oil.



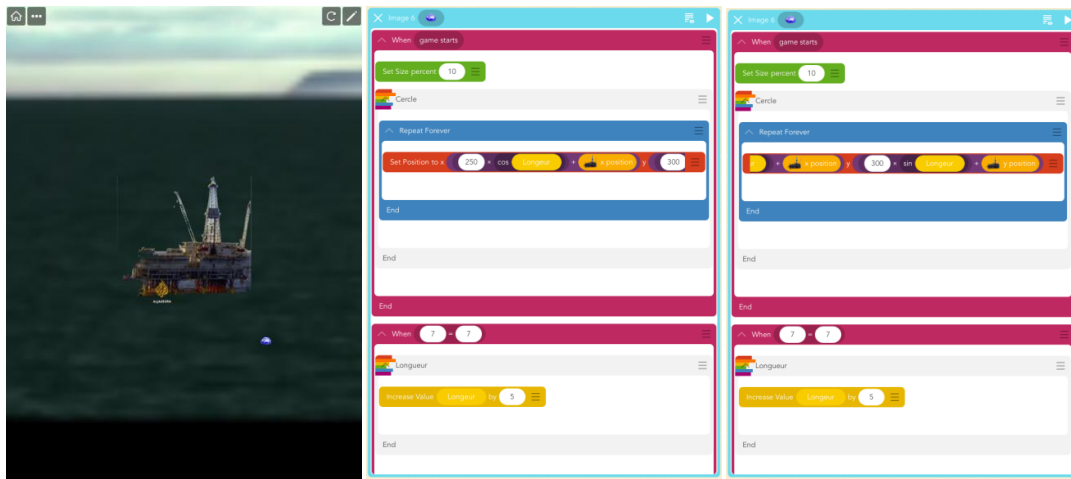
Name of the program : Nettoyer l'océan <https://c.gethopscotch.com/p/yaxi2l4dg>

Combustion can burn the ocean to burn oil. The toxic smoke from the fire can harm marine life. The third cleaning method discussed at this site is the chemical dispersant. Oil on the surface of the water separates the clusters of oil that is scattered throughout the entire ocean. There are, however, tiny traces of oil in the water, which is toxic to fish embryos. In the case of the DeepWater Horizon spill, several methods were used at a total cost of more than \$ 14 billion. The BP company will pay the US government \$ 5.5 billion for civil penalties for water pollution. \$ 8.1 billion will be paid by BP as compensation for the destruction of natural resources (al-Jazeera, 2015).

With global warming and melting Arctic ice, the region is becoming more conducive to navigation, exploration and oil drilling. Petroleum companies are doing research to investigate the possibility of oil drilling in the Arctic using oil rigs. Before they begin, they study the use of their tools, including those they must use to monitor the environment. The buoy, which is seen circulating around the oil platform, collects information about water and ice in the Arctic. It provides on-line information that

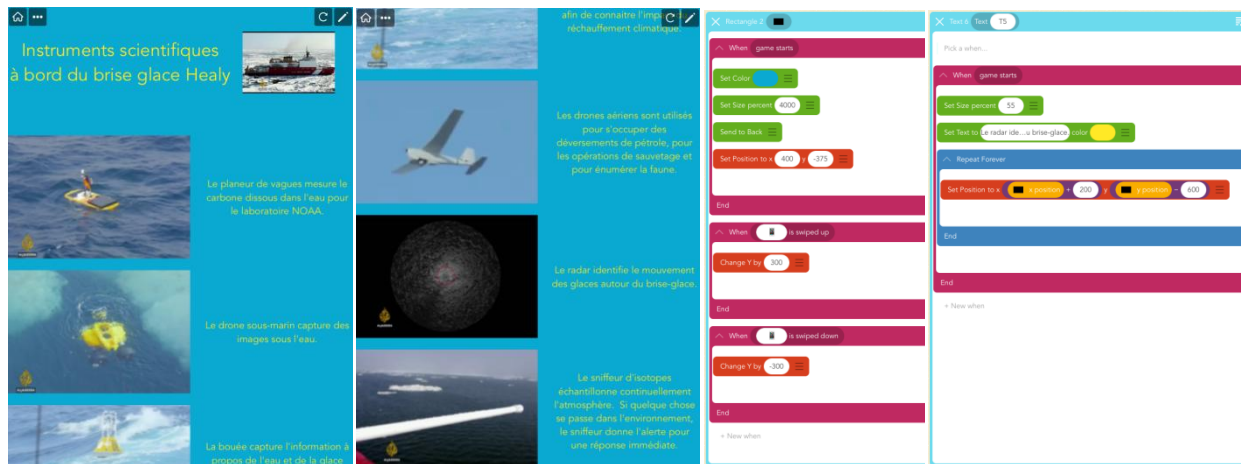
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provides information on climate change. The buoy also makes it possible to learn about the movements of water under the surface.



Name of the program : Bouée Arctique <https://c.gethopscotch.com/p/yb1zlj4r7>

The Healy Icebreaker has a lot of scientific instruments to help scientists. In the website created with Hopscotch, it can be seen that a wave glider measures the carbon dissolved in water for the NOAA laboratory. There is also an underwater drone that captures images underwater. There is a buoy that captures information about water and ice in order to know the impact of global warming. Aerial drones are used to deal with oil spills, for rescue operations and to list wildlife.

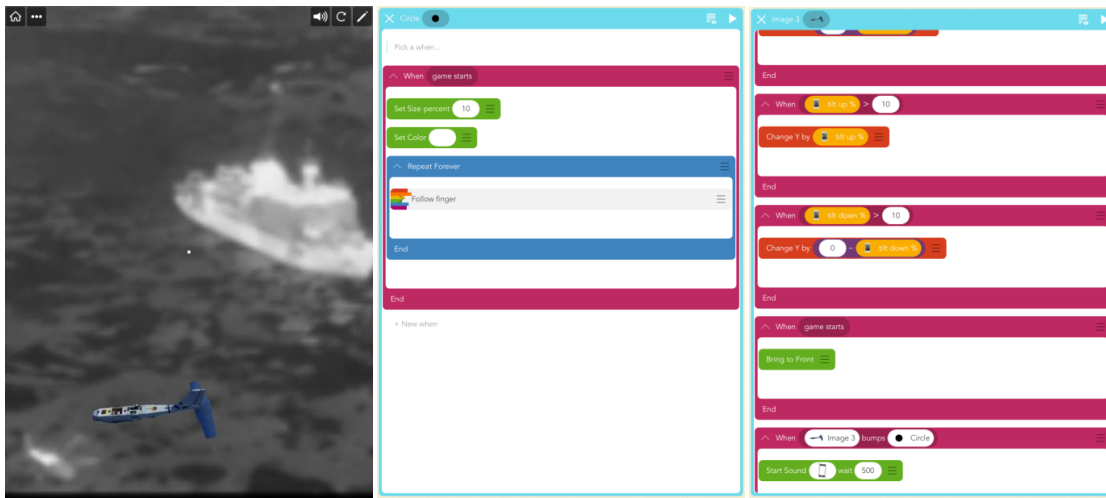


Name of the program : Instruments scientifiques brise-glace
<https://c.gethopscotch.com/p/yb2agz00a>

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There is also a radar that identifies the movement of ice around the icebreaker. Finally, there is an isotope sniffer that continuously samples the atmosphere. If something happens in the air, the sniffer gives the alarm for an immediate response from scientists.

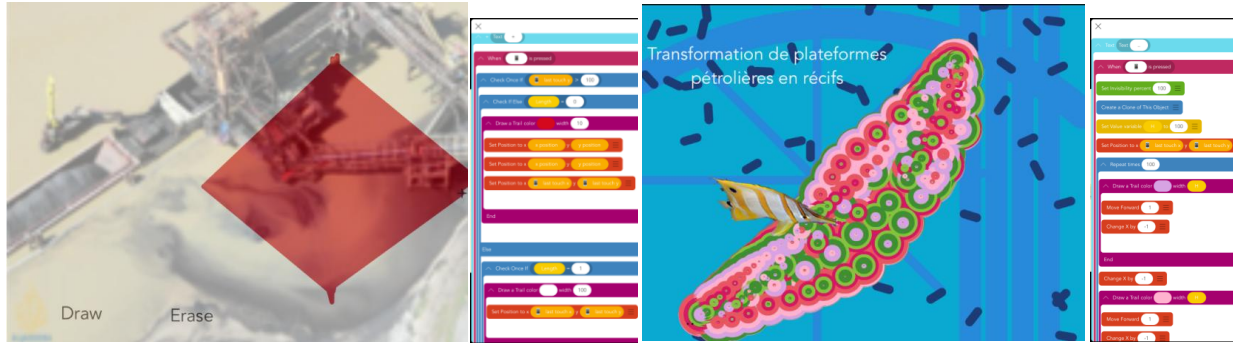
If a member of the crew is found in the Arctic Ocean, a drone equipped with an infrared camera is used to find the person in the ocean. The heat of the person's body being different than that of the ocean is visible in infrared. Once found, a helicopter or rescue boat can go retrieve the person.



Name of the program : Infrared Drone <https://c.gethopscotch.com/p/yb213cnam>

By looking at multiple media and not just one source, it is possible to get a more informed and independent idea on a topic. By consulting the site of al-Jazeera of Qatar, for example, one can realize that there is a whole movement that has developed to monitor the polluting corporations (al-Jazeera, 2015). Public Lab offers balloons and kites equipped with cheap technology such as the infrared camera, to take pictures in the air and document the environmental offenses of corporations. It is a global citizen movement that uses these photos as evidence in order to bring the companies to justice.

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Name of the program : Public Labs Activism <https://c.gethopscotch.com/p/ycfcg3iqm>

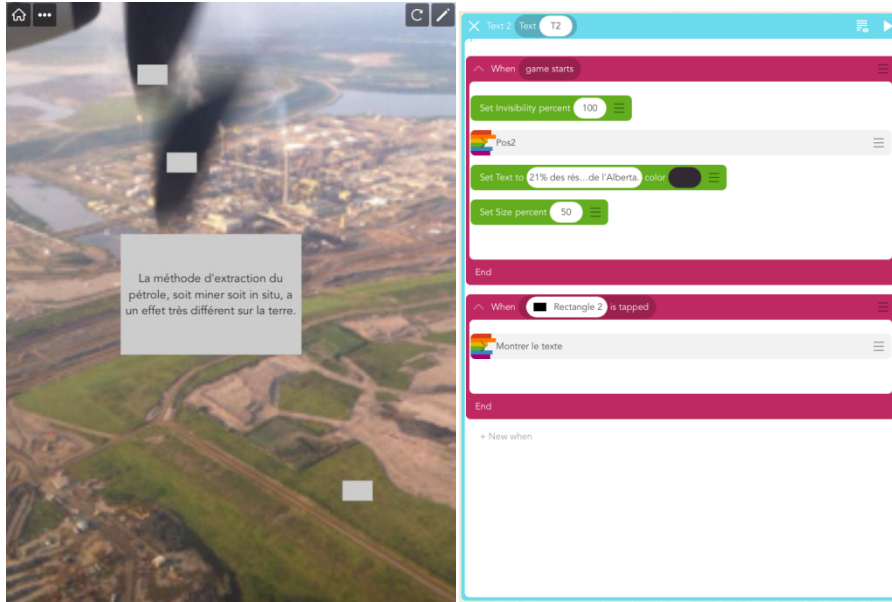
Name of the program : Plateforme pétrolière <https://c.gethopscotch.com/p/yc28wvzc0>

What happens to oil rigs when they are needed? It costs more than \$ 1 billion to remove it from the ocean. However, when abandoned by humans, marine life begins to occupy the platform, offering a more active sanctuary than coral reefs, thus rejuvenating marine fauna (McCarthy, 2016). These sites could become tourist sites to explore the new reef of invertebrates and crustaceans that cling to the pillars of the platform.

The movie DeepWater Horizon shows part of the oil situation in the United States, but what is the oil situation in Canada? The EXPLANATION GAME strategy (Ritchhart, 2011) allows us to try to understand. We name the aspect, we explain it, gives reasons and generates alternatives. A trip with INSIDE EDUCATION made it possible to learn the Canadian situation.

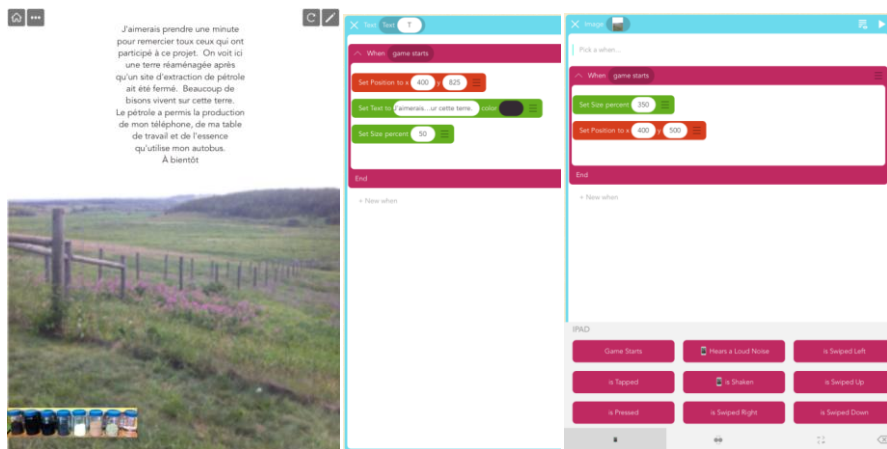
Mining oil in Canada. Canada is the third largest oil producer in the world after Saudi Arabia and Venezuela. There are two important ways to extract oil from Alberta's oil sands, either mined or in situ. Each way has a different effect on the earth. The most known way is mining, removing oil by mining sands near the surface of the Earth. We can see on the image taken from the plane flying over the oil sands the enormous extent on the territory. With the climate change situations and the Paris agreements, one can think that this form of energy is no longer necessary. Although other forms of energy are being developed, the reality is that alternative forms such as the use of biofuels will not be totally ready in our lifetime. A bit like the ThingLink application, this Hopscotch program annotates the image of the oil sands.

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Name of the program : Sables bitumineux <https://c.gethopscotch.com/p/y9z3dyx5s>

Redevelopment of oil sands. When a mining site is depleted and closed, the oil companies withdraw and redevelop the land. We see in the program a picture of a remodeled site with many bison that lives on this Earth, which was handed over as before.

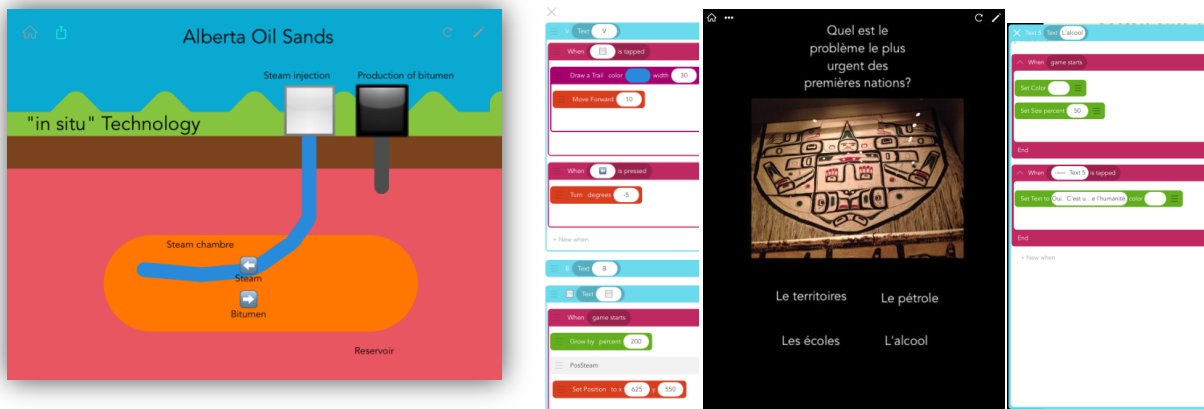


Name of the program : Lettre de remerciement <https://c.gethopscotch.com/p/y9zjrvxy9>

The oil that was extracted from this redeveloped site was used for our energy demands to travel by car, plane, bus. Oil has also been used to produce our telephones, work tables and many other household appliances.

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Technology in situ. The mines allow access to the easiest oil slick, closest to the surface. These readily available aquifers are becoming increasingly scarce and other technologies are being developed for access, including offshore drilling or in situ technology in Canada. The in situ technology allows to extract the bitumen that is deeply buried, where the shovel and the trucks cannot go. Water vapor is injected to separate the bitumen from the sand. Liquid bitumen is pumped to the surface. The oil sands drill code is a game where, like the engineers who build the site, the pipes for the steam and those for the bitumen must be excavated and inserted in order to extract the bitumen. The Kahoot program, with Aboriginal art, is a quiz that answers multiple choice questions.



Name of the program : Jeu de forage des sables bitumineux <https://c.gethopscotch.com/p/y07mr3tkj>

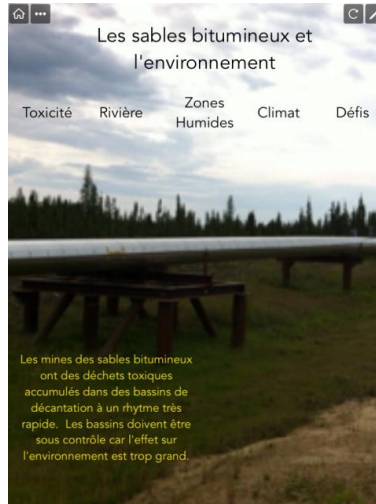
Name of the program : Kahoot <https://c.gethopscotch.com/p/y9jccvjx3>

Although mining sites are restored once the oil is extracted, the in situ method has far fewer negative effects on the environment. It eliminates large areas of extraction. A relatively small area is required for extraction. It also eliminates toxic waste and incantation ponds in mining. The in situ method is more expensive, but more respectful of the territory and the environment, a situation which the natives can rejoice, since they have lost a large part of their territory because of the oil extraction.

The effect of the oil sands on the environment. You can see a website that really works with information about the oil sands. Under Toxicity, we can read that oil sands mines have toxic waste accumulated in settling ponds at a very rapid pace. Ponds must be under control because the effect on the environment is too great. Under the River tab, there is no effect on the Athabasca River. We took only a small amount of water that is

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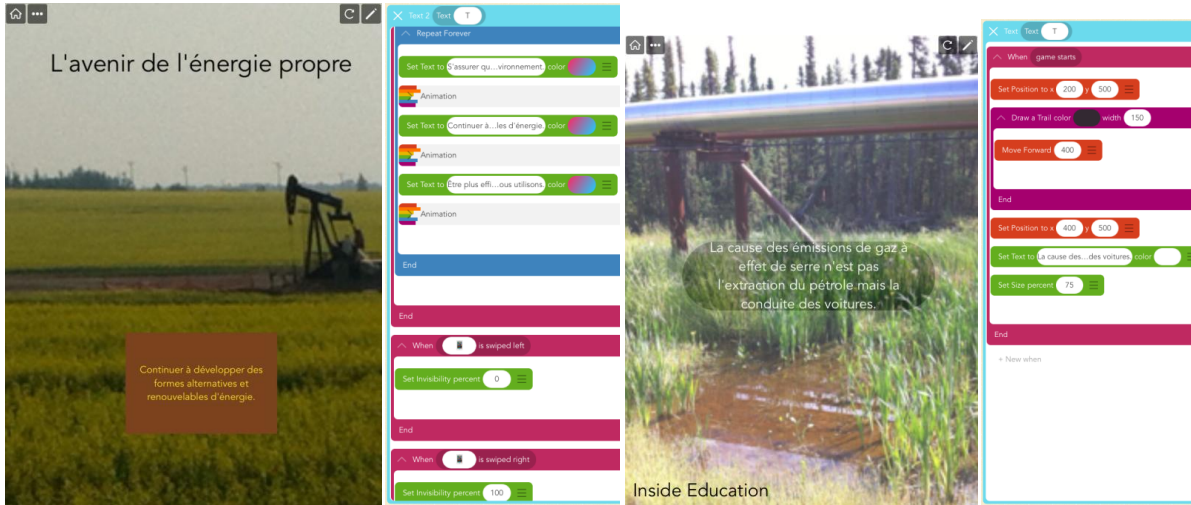
constantly recycled. Under Wetlands, we can read that the industry says it is restoring wetlands. A marsh is built, but it does not have the same potential as a wetland that has taken thousands of years to form. Under the climate tab, it is written that the use of oil is a source of emission of greenhouse gases. Its use is reduced as it is by encouraging public transit. You can also read about the challenges. We need better laws on the production and use of oil and we need to have a better understanding of the impact of that industry. There must be better collaboration among all those involved.



Name of the program : Site web sables bitumineux <https://c.gethopscotch.com/p/y9z9a3t76>

The future of energy in Alberta. One can see a removable display panel in front of an oil well in a mustard field, having three different messages. In addition to extracting and selling oil, Alberta is developing new clean energy resources. Alberta continues to develop alternative forms of renewable energy. The second message is that we need to be more efficient with the energy we produce and consume. In addition, it must be ensured that the energy is produced in an environmentally friendly manner.

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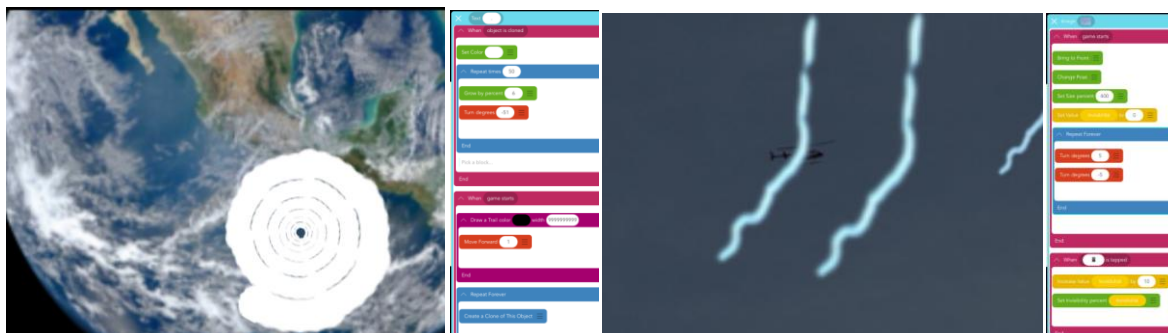


Name of the program : Avenir Energie Propre <https://c.gethopscotch.com/p/y9zf60m6c>

Name of the program : Gaz effet de serre <https://c.gethopscotch.com/p/y9zi4nmgo>

Recall. We must remember that there is pollution in the extraction of oil. However, the cause of greenhouse gas emissions is not the extraction of oil, but the use that is made of it.

What other theme is associated with oil? The biggest danger is global warming. Using the CSI strategy: COLOR, SYMBOL, IMAGE (Ritchhart, 2011), we can capture in one image the essence of the concept. Everyone can express this concept according to their perspective or understanding. The CSI strategy is a non-verbal way of expressing an idea, of making connections or of thinking in a metaphorical way, without, however, making propaganda.



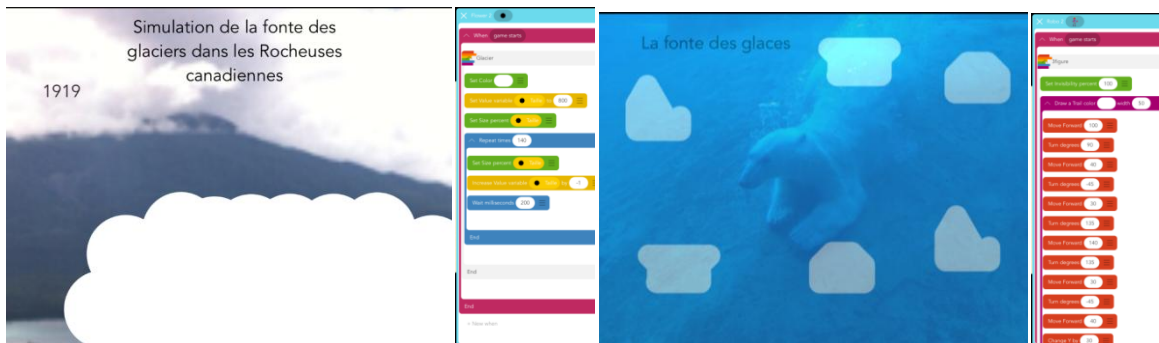
Name of the program : Ouragan Matthew <https://c.gethopscotch.com/p/ya1578kfp>

Name of the program : Éclairs <https://c.gethopscotch.com/p/yauhpwwt2>

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There are many scientific discussions to explain the frequency of hurricanes as a result of climate change. The US Oceanic and Atmospheric Agency (NOAA) after 40 years of observation believes that hurricanes are more powerful and more frequent due to climate change. A new profession has developed. Storm fighters fly inside hurricanes to obtain data that can explain extreme climatic events.

Melting glaciers is another symbol of global warming. A scientific study indicates that 70% of glaciers in British Columbia and Alberta could disappear by 2100 (Jobin, 2015). They used climate simulations and computer models based on climate data of temperature increases caused by the emission of carbon dioxide. These glaciers have an important role in the region's ecosystem.



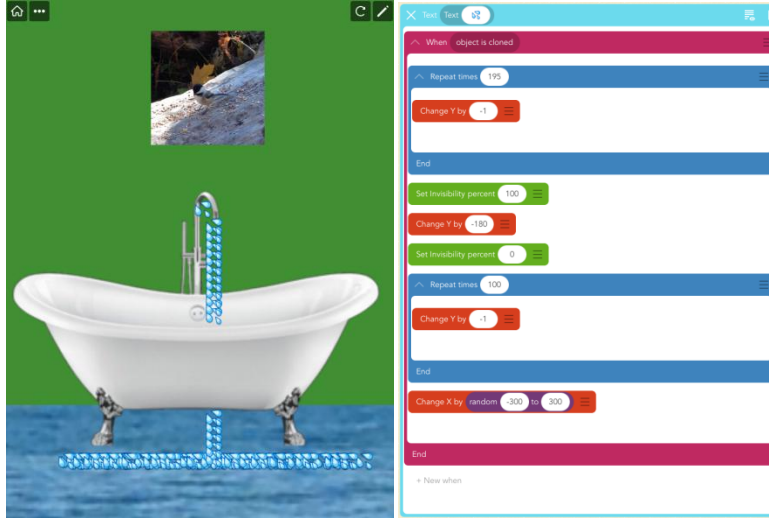
Name of the program : Fonte des glaciers <https://c.gethopscotch.com/p/yaxmwdkv3>

Name of the program : Fonte des glaces <https://c.gethopscotch.com/p/yb1t44lt1>

In the Arctic, polar bears that increasingly lose their hunting habitat, have to swim long distances to find a place to hunt. Some bears swam 400km to find a place to feed. The ice chips from the Hopscotch program were coded in response to an open question from the book by Marian Small (2014).

Wagner and Weitzman in their book Climate Shock (2015), where they analyze the problem of climate change from an economic point of view, use a completely different picture to explain the functioning of climate change. They make the analogy of a bath to explain the emissions of greenhouse gases.

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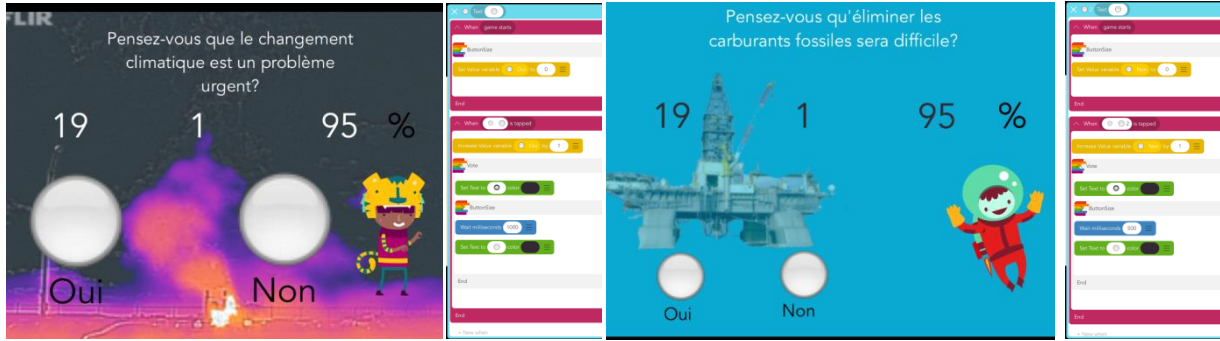


Name of the program : Flow <https://c.gethopscotch.com/p/yco2qgqv0>

The atmosphere is represented by a giant bathtub. The tap represents the emissions caused by human activity and the drainage system represents the planet's ability to absorb pollution. For our planet to survive, the inflow and flow of greenhouse gas emissions must be balanced. The question of the day underlying the Paris agreement is the extent to which the emissions, the influx, must be cut so that our system can stabilize concentrations, not to mention the enormous amount of emissions which are already in the bathtub and that the process is irreversible. To close the faucet is very difficult to accomplish and by prudence, it should be closed as soon as possible.

People's views on climate change can be represented by two question polls from the book *Climate Shock*. Do you think that climate change is an urgent problem? Do you think removing fossil fuels will be difficult? According to Wagner (2015), if you answered yes to both questions, you are in the minority. There are climate skeptics like the new US President Donald Trump. There are also all those who believe that solving the environmental problem is important and urgent, but do not want to change their way of living or transporting themselves. They want to continue to live their high level of consumption and transport.

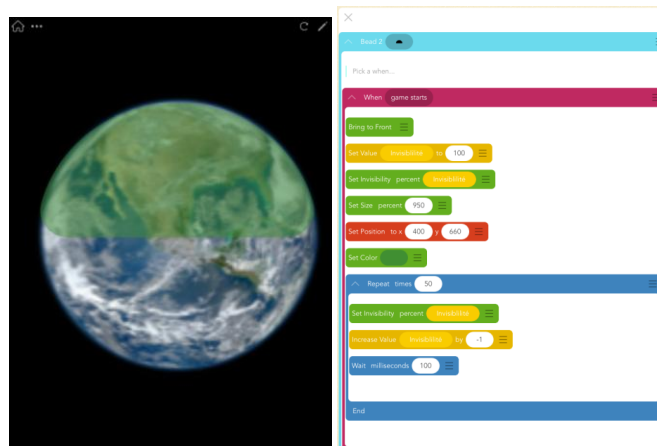
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Name of the program : Changement climatique <https://c.gethopscotch.com/p/ycnwsyhmr>

Name of the program : Carburant fossile <https://c.gethopscotch.com/p/ycnwv84ph>

Charles Tisseyre (2016) of the show Découverte gives the image of the greening of North America to represent the climate change, taking in evidence the satellite images of the NASA.



Name of the program : Le verdissement de l'Amérique du Nord

<https://c.gethopscotch.com/p/y8maerhdh>

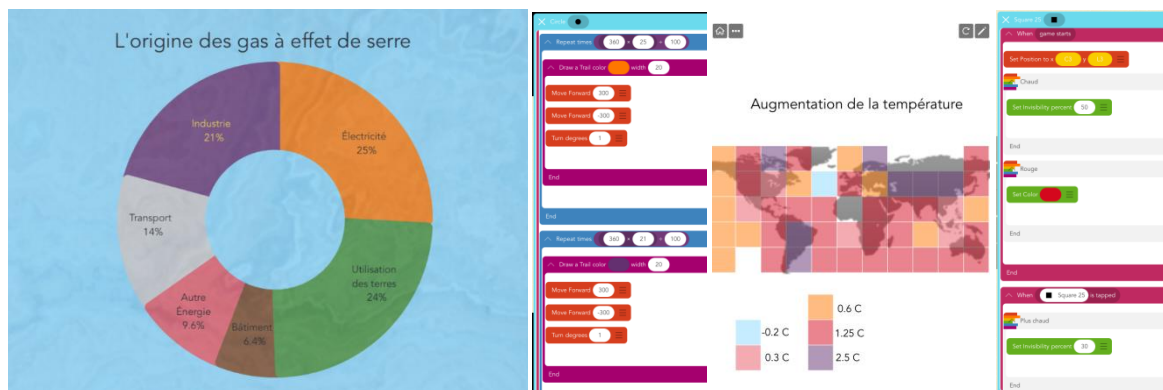
The satellite images of LANDSAT 5 and LANDSAT 7 show the evolution of the planet's appearance over the past 30 years. The change is more visible near the pole where the changes are most important.

BYOD

Koechlin (2010) cites Albert Einstein in her book Des questions pour apprendre: "I do not have any special talents. I'm only passionately curious. " What can we do to have small Einsteins in our class? What can be done to cultivate students' natural curiosity? Is it possible to include the interest, passion and questions of students, to help them ask better questions, and to pique their curiosity? Students develop much of their curiosity at home, with their own toys, their own devices, their own source of knowledge and their own questions. By including the student's environment in the classroom and developing questions around their passion, we can continue to arouse the curiosity of our students.

On the technological side, the Bring Your Own Device (BYOD) model is incorporated into the classroom so that students can use their device anytime and anywhere with their personal digital device (Fievez, 2005). There are economic sides to schools, but I see pedagogical benefits. Students can integrate their interests, questioning with their programming skills. It is possible to combine a number of technological devices that engage students in programming: books, e-books, the Internet, radio, television, digital cameras, infrared cameras and microscopes, for instance.

Books or magazines, both paper and digital, stimulate the passion of many people. They can be used as a constant source of inspiration for programming. Here we see an illustration showing the origin of greenhouse gases in statistics. The map shows the places on Earth where there is global warming and the degree of warming. These are two ideas from the book of Juniper (2016).

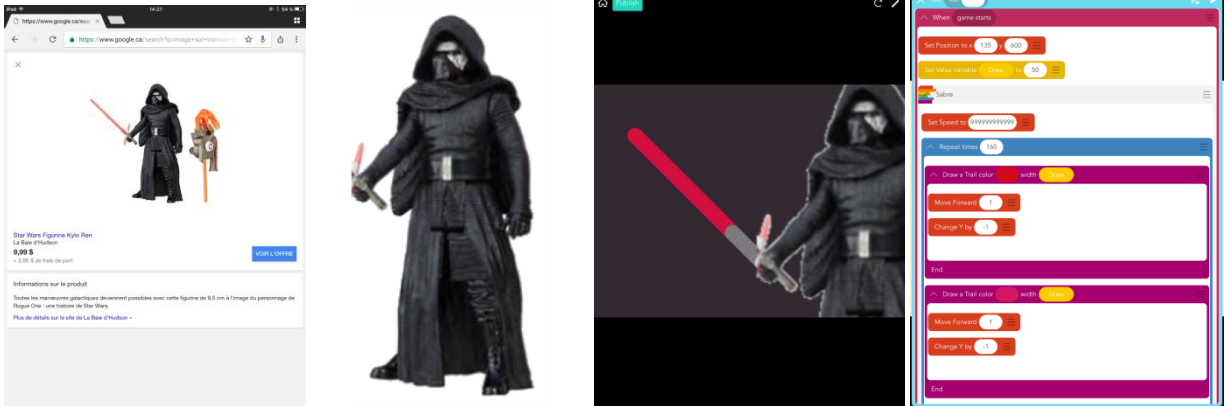


Name of the program : Origine gaz à effets de serre <https://c.gethopscotch.com/p/yeo1ar046>

Name of the program : Terre plus chaude <https://c.gethopscotch.com/p/yeoc8hooe>

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Movie enthusiasts will be delighted. The Internet offers a large amount of images and even images on transparent background that can easily be incorporated into a Hopscotch program. The image can be manipulated with an application like "Eraser". Here we see an image of a toy figurine of the movie Star Wars. This image of the figure is included in the program and we can code the light saber as presented in the Star Wars movies.



Name of the program : Le sabre laser <https://c.gethopscotch.com/p/yf6lll1fw>

Musicians can play **music** or compose music with Hopscotch. Several objects can operate in parallel so that you can program music with the treble clef and the bass clef. We hear, in the next program, a melody of Star Wars.

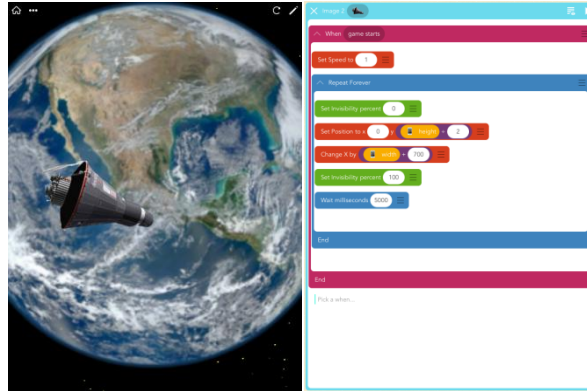


Name of the program : Star Wars Tune <https://c.gethopscotch.com/p/xe0of2p8w>

Radio enthusiasts will have a lot of ideas for programming. For example, the death of John Glenn (RIP) was recently learned by listening to the radio. Looking for more

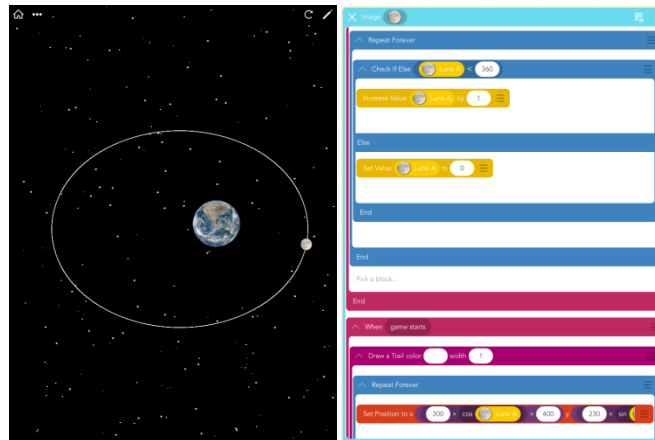
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information on the Internet, one can discover the impact of this astronaut who in 1962 piloted the capsule Mercury, the first American capsule to orbit the Earth. He also had the opportunity to return to space aboard Discovery in 1998.



Name of the program : Project Mercury <https://c.gethopscotch.com/p/yeric8k6c>

Photographers can during their trips or observations in nature take beautiful **photographs** that can be included in Hopscotch programs. During the Super Moon, several amateur photographers took a photograph of the moon. They can then listen to a scientific analysis on television during the show Discovery and code their understanding. Here we see the elliptical orbit of the moon and a simulation of a digital telescope that allows to adjust the size and brightness of the image.



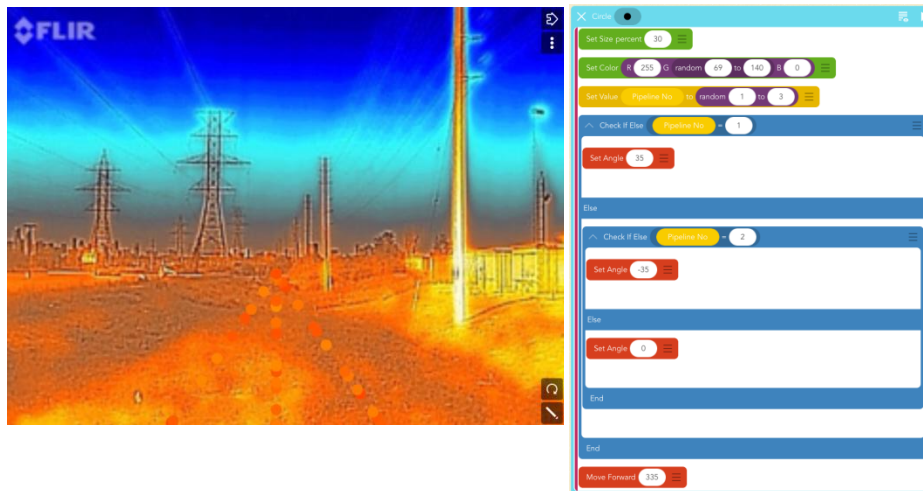
Name of the program : Orbite de la lune + tracé orbite
<https://c.gethopscotch.com/p/yf4wuj7u2>

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Name of the program : Super lune <https://c.gethopscotch.com/p/yf488paby>

The **FLIR infrared camera** can be attached to a phone or iPad. It makes it possible to see a completely different world using heat. Each person or object transmits infrared waves that can be detected. The objects transmit waves according to the Planck equation. The majority of the curve of the Planck equation is in the infrared zone. The infrared camera detects the waves that are emitted by the person or object. It's passive. You can see up to one meter deep in infrared. In this example, we see the location of a pipeline. Does everything work well? It seems so. With an infrared image, we simulate the transport of oil inside the pipeline, underground.

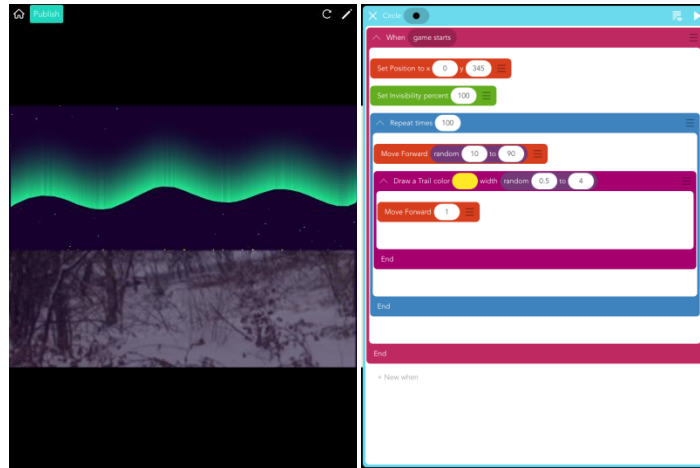


Name of the program : Pipeline de la ligne 9B <https://c.gethopscotch.com/p/yf3navlmv>

Live cameras provide the opportunity to observe what is happening in the world in real time. One can see images of nature, such as a nest of peregrine falcons, traffic on highway 401 or the sky for example, seen from several observatories in the world. Those

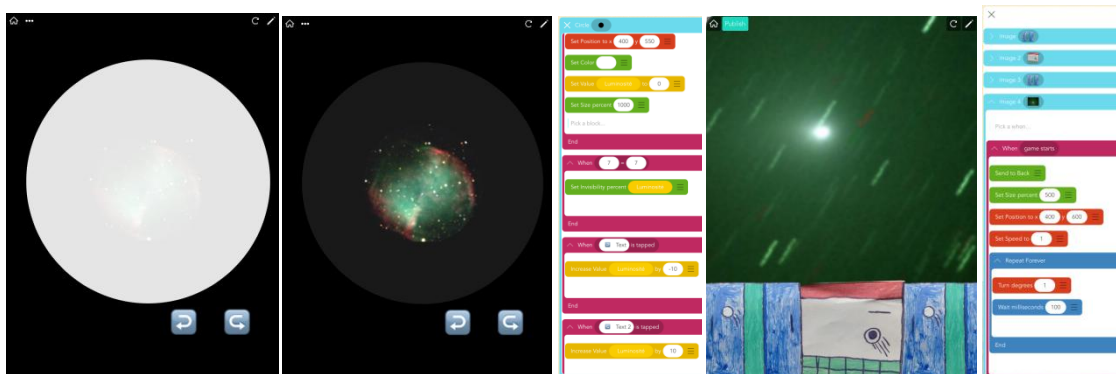
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images can be accessed at any time using the Internet. The Aurora Service site shows locations where the Northern Lights are visible, in addition to giving a forecast of solar storms. By using a live camera, one can subsequently draw the aurora borealis that one sees.



Name of the program : Service Aurora <https://c.gethopscotch.com/p/yfgdii3qy>

It is possible to take wonderful pictures with a **telescope**. The book Turn Left at Orion provides detailed instructions to easily find many space objects to help beginners in astronomy. It is also possible to use the York University telescope which offers weekly sessions with scientists and allows to see the sky with their telescope. The meeting is done online using the Internet. In the next two examples, images from the York University telescope were used. A digital focus button is programmed to view the Dumbbell nebula. We also see the rotation of the sky, seen from the Earth using the image of comet Hartley and a drawing of a pupil.

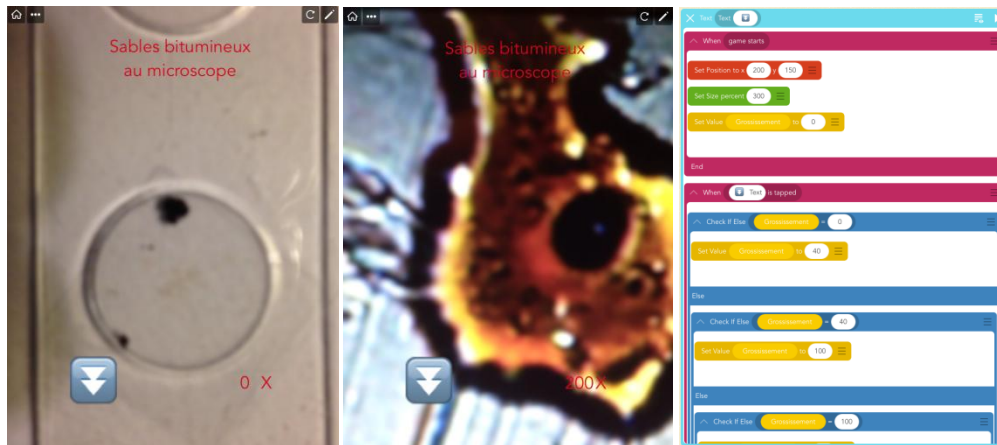


Name of the program : Telescope focus <https://c.gethopscotch.com/p/yfgg8r2ra>

Name of the program : Rotation du ciel <https://c.gethopscotch.com/p/yfgjkg7h>

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Microscopy lovers can use the digital images of the **microscope** in their Hopscotch program. Here we see a grain of oil sand with the naked eye and a microscope. The Hopscotch program simulates the digital microscope by showing a picture taken with each of the 4 objectives. You can see the oil inside the sand.



Name of the program : Sables bitumineux au microscope :

<https://c.gethopscotch.com/p/yerbwqcas>

The prepared slides offer another source of images. Here we see an image of a bass tree. The image is animated with an imaginary worm that walks inside the tree.



Name of the program : Vie d'un arbre <https://c.gethopscotch.com/p/yevttm8gq>

The **pen** or **pencil** to write is another very useful tool with Hopscotch. It allows to write the ideas in draft form that one wants to include in a website for example. We see here a microscopic image of a leg of mosquito. It offers the background of a website that was prepared with Hopscotch on the effect of the Zika virus on global health. There is no

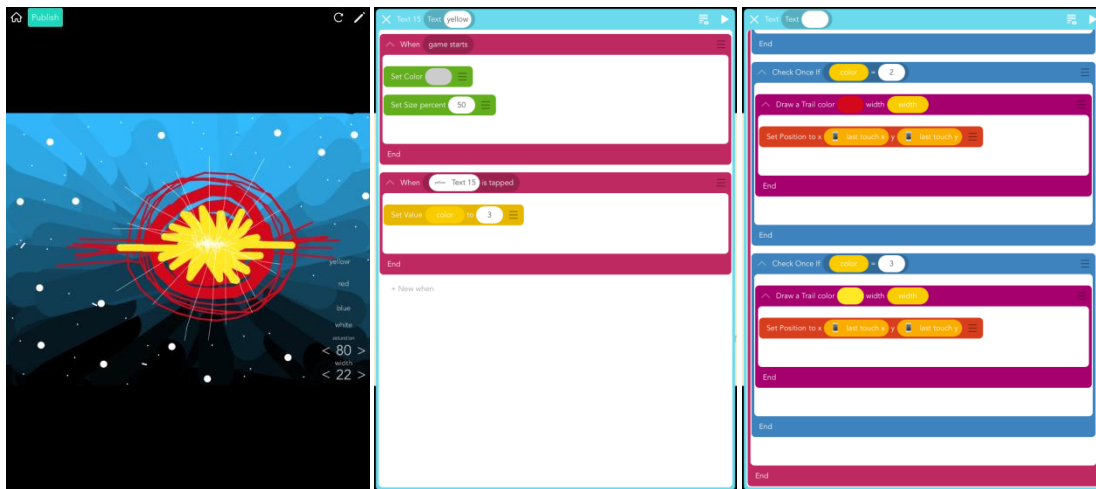
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cure for the Zika virus and the mosquito population must be controlled to eliminate the disease (al-Jazeera, 2016).



Name of the program : Maringouin site web <https://c.gethopscotch.com/p/yerndfe0g>

Those who like **drawing** can draw with Hopscotch by creating their own design from the very beginning or by modifying many existing programs that allow drawing. In this example, the big bang is drawn by modifying an existing program. I added the red and yellow colors, which allows the beginner programmer to learn to read the code, to understand it to modify it and then to make his own drawing.



Name of the program : Le Big Bang! <https://c.gethopscotch.com/p/yfjnxusux>

The BYOD allows the differentiated instruction while following the interest and the questioning of the students.

Assessment of a Hopscotch project

The purpose of the assessment is to learn about student learning. Teachers traditionally use the assessment OF learning to document in report cards what students know. As the video of Lorna Earl (2006) suggests, evaluation includes much more than that. There is also assessment FOR learning that seeks to understand what students think before instruction. Evaluation AS learning provides regular feedback, and gives the basis we use to develop new opportunities for practice. During the assessment AS learning, students are also encouraged to reflect on their own work and self-regulate their work. Students are encouraged to evaluate their own work. She indicates that most of our time should be devoted to evaluation AS learning. We can use all the tools available for all three types of evaluation, but that's what we do with the evaluation that makes the difference.

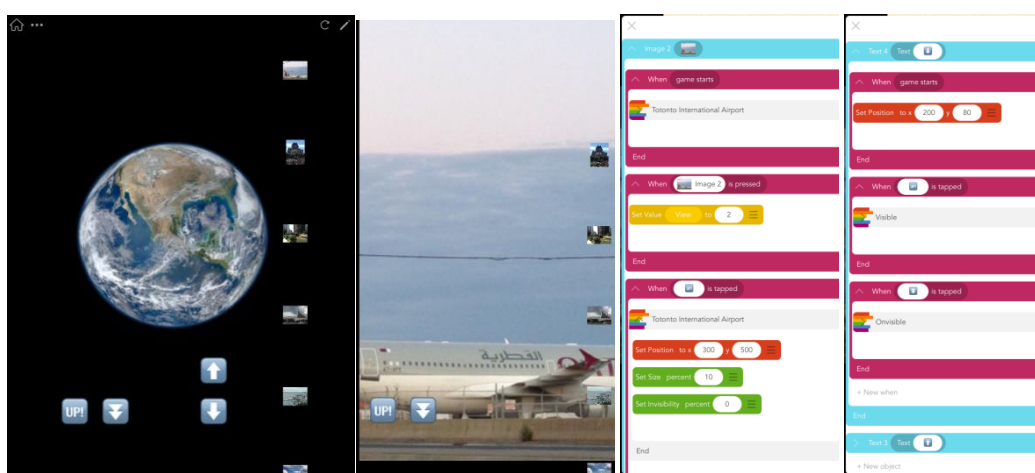
Evaluation AS learning

As far as Hopscotch is concerned, evaluation as learning is an important part of the application. Hopscotch not only lets you learn to code, it provides a safe environment for all types of learners, whether they are beginners or advanced coders. Let's look at an example.

This Google Earth program was written using Hopscotch. To write a program like this, I searched the Hopscotch application and found a program already started that I had to complete or modify. In order to remix a program, we must be able to read the existing code, understand how it works in order to be able to make changes. Using the buttons, we can move the Earth to the right or left. The other buttons change the size of the Earth. Some buttons allow the visualization of the Earth from space and some from the surface of the Earth. I modified the code to be able to see the entire planet Earth, not just America. I also removed a part that I did not want, Google Moon, and I had a view of the surface of the Earth. After editing the program, I published it and made it available on the Hopscotch community. Hopscotch analyzed the code and suggested changes I could make to the program. For example, I notice that in one of the suggested programs following the publication there was a large selection of images. The programs suggested by Hopscotch during assessment as learning gave me the idea to add other

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buttons to view the Earth that could be selected and consulted. I unpublished the code to the draft stage and added several other views of the earth and republished my program with the Hopscotch community. The next day, after hearing conversations with the family on other topics, I thought of adding different icons, at least showing a house with a tree. I unpublished the program again to the draft stage, made the changes and I republished it. The application provides support, the support needed for evaluation AS learning. Teachers must ensure that students are aware of its existence, how to use it to improve their work, even when the teacher is absent.



Name of the program : Google Earth <https://c.gethopscotch.com/p/y7vzalyto>

Evaluation using Hopscotch is particularly effective in the field of S.T.E.A.M. : Science, technology, engineering, art and mathematics. The app reflects what scientists, technicians, engineers, professional mathematicians use on a daily basis while including a strong piece of art. Hopscotch provides support where students feel safe for troubled learners. The application is easy to use and allows you to develop reading responses in a way that students find fun and interesting. Support for gifted learners is broad and deep. They can work beyond what is expected of them through the school curriculum. They can learn at school and at home, even if the student's knowledge exceeds the teacher's knowledge. After reading a scientific text, for example, students can show their understanding with a written answer in Hopscotch. The written answer takes a mathematical, scientific, artistic and engineering point of view. The application provides assessment as learning to each learner, each time they publish a program.

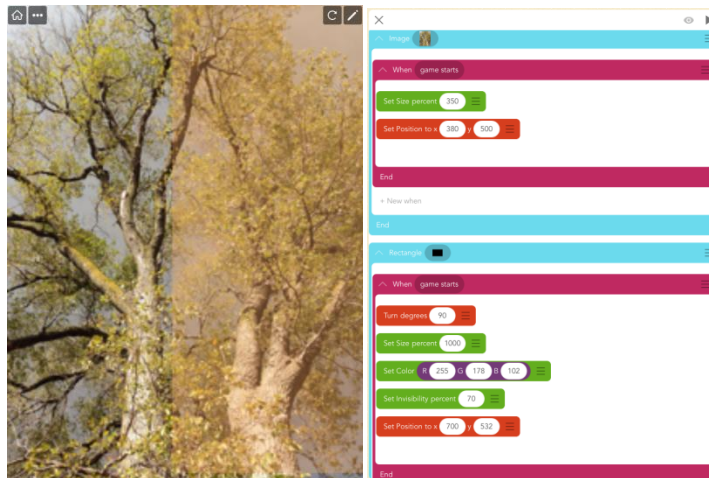
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Co-construction of success criteria

When teachers co-construct success criteria with students, they benefit from the most powerful aspect of assessment. Teachers and students develop a common understanding of what to learn. By discussing what needs to be learned, the learning objectives, teachers and students clarify their understanding. By examining examples of work with the evaluation criteria, students have a better understanding of what is expected, and will work to achieve this clear objective with more motivation. A Hopscotch program will need to be evaluated according to the expectations you are working with.

Let's say that we work with reading science or mathematics. As with troubled readers and French immersion readers, students should discuss what they are reading to understand the meaning of what they are reading. Allington and Gabriel (2012) propose six elements of a successful reading program. One of them, particularly relevant for troubled readers, is that every child should write about something personally meaningful. Students should write about something they care about. In this example, we will write a Hopscotch summary of a text about the environment. Let's develop the success criteria for a summary.

- 1- I have included important parts of the text
- 2- I have included the main idea
- 3- I made a link to another text or a personal experience



Name of the program : Pollution de l'air <https://c.gethopscotch.com/p/yd8byxupb>

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In our response to the reading, in this program, we see the effect of air pollution on the atmosphere. The left side is a photograph of a tree in a clean atmosphere. To the right side, air pollution was added in contrast. Pollution covers half of the entire image. The opaque block that is used to represent pollution is coded to be 70% transparent. This gives the effect of pollution. A pollution of the air like this is visible to the naked eye on the horizon, when you look at a large city a few kilometers away.

The student wrote using a tool that is personally important and fun for him. As a result, he spends more time and effort with his work. For many students, using such a tool means going up a full level in their final assessment.

Portfolios

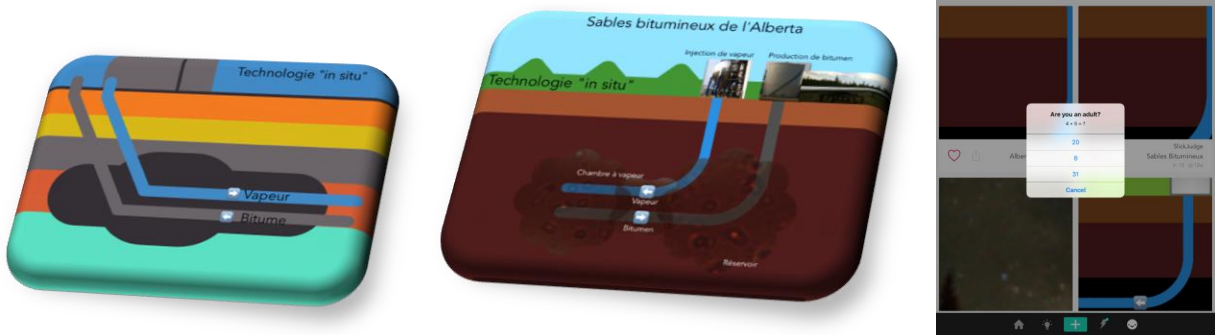
Portfolios can be used to evaluate students' work over time (Government of Ontario, 2008). The portfolios contain works selected by the student that show their best work and show what the student has learned. The portfolio shows aspects of student learning that cannot be captured during the test. It shows evidence of learning specific curriculum expectations. It demonstrates mastery of part of the curriculum. There are also several audiences for the portfolio. The audience could be the teacher only, the class, a region or the whole world (Danielson & Abrutyn, 1997).

The following two Hopscotch programs could be considered an equivalent response to reading an article on the oil sands. The two reading responses show the same scientific concepts that are explained. Both programs have been coded differently and show very different levels of thought. The left program was written only by drawing lines of different sizes, lengths, angles, colors and starting points. The final result is an image showing the operation of the in situ technology. The Hopscotch project was photographed and shared only with the teacher.

The right program is actually an interactive video game with real images of the oil sands. The photos were taken during a trip to Alberta with Inside Education. It shows the same in situ technology for petroleum extraction in a video game. Similarly for the first programs, the lines were used to create the image. The interaction was added. Steam and bitumen lines are drawn when the buttons are pressed. For example, by pressing the white button, you draw the water line and pressing the arrow will change the direction in which the line is drawn. We see some of the difficulties that engineers face when building technology for oil extraction. If the angle is not right, the pipes will not

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go to the bitumen. If the vapor line is not above the bitumen line, this will not allow the bitumen to turn into liquid by the steam. Using gravity, the liquid bitumen falls to the lower pipe to be collected. Thought is more advanced in the code of the second program. The repetitive code is placed in the self-created blocks showing different levels of abstraction. An object can perform several different functions based on events that occur in real time. The completed project is shared with the world, the Hopscotch application and social media.



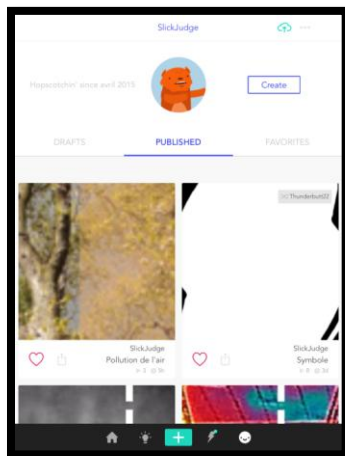
Nom du programme : Sables Bitumineux : <https://c.gethopscotch.com/p/yf1ohqxuz>

The link can be shared with friends with social media. Anyone can use the link, with any device and play with the program that the student has just designed, even if he does not have Hopscotch or a programming knowledge.

All versions of the code were written by the same person. These portfolio examples show the progression in thinking about code, progress in creativity, advancement of trust and interest, and progression through sharing with an audience.

At the time of writing, only one Ontario Hopscotch programmer, SlickJudge, has created more than 537 different projects with Hopscotch that could be used from Grades 3 to 10 across the curriculum. Programs are available 24 hours a day, 7 days a week, 365 days a year, worldwide where the Internet is available. Everyone can use them for free, for learning purposes.

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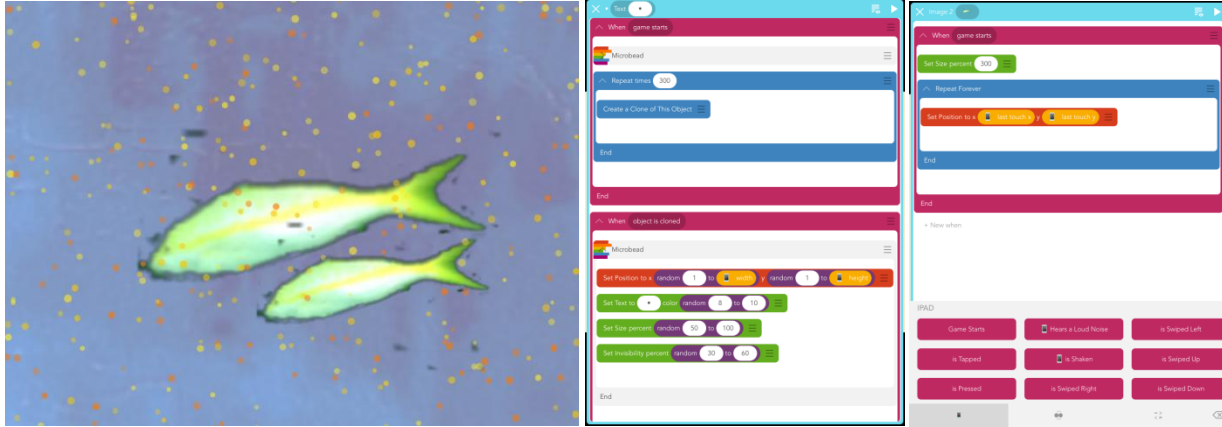
Links to Hopscotch programs are accessible using any device with Internet access. The Peel District School Board introduced BYOD. If the school does not have a computer, students can bring their own device for use in the classroom. Students are invited to be curious and creative with their own device. The Hopscotch code can be written using an iPhone. Many of my most disadvantaged students had a telephone and brought it to school. Instead of being distracted by his phone, we can use their phone to stimulate their curiosity, inspire them and be more engaged in the classroom.

Highlighting misconceptions

A written answer or a visual response to a text is very useful in science at the beginning of a unit to identify misconceptions that students have about a particular topic and what they would be interested in exploring further. Evaluation could be done by discussing in class, or in writing, and evaluated for the next day.

One misconception is that plastic does not damage the environment. We've seen the plastic oceans in the Pacific, but there's also all the micro-plastic hidden in our cosmetics, such as bath products, facial cleansers and toothpastes that damage the environment (Environment and Change Climate Canada, 2015). It was noted with the Canadian "Chemicals Management Plan" that microbeads in cosmetics and toothpastes are not dissolved in water and cause pollution in water. They enter our food chain through the fish that eat plastic microbeads. With the help of the Canadian government, data is being collected to regulate its use.

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Name of the programme : Microbilles chaine alimentaire

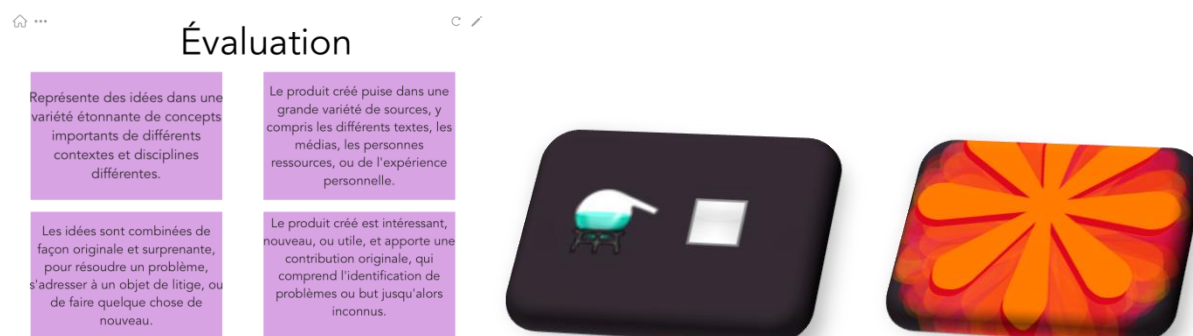
<https://c.gethopscotch.com/p/ybz14oivw>

Students may have many misconceptions. Knowing the misconceptions at the beginning of the unit and identifying the students' interest would benefit their learning. Hopscotch provides a tool where the most shy and reserved student can show their understanding by discussing with the teacher. We could also know what resources students use most to inform their learning, and have a discussion about which Internet resources are most credible.

Creativity and Innovation Rubric

Creativity and innovation are at the heart of the school curriculum. Tony Wagner has interviewed a large number of for-profit and not-for-profit workplace leaders in several different spheres to find out what skills are required in their field. After many interviews and research on the competencies required to succeed in the work field, he indicates seven skills that one must have in order to survive at work. Note the word, survive. They are as follows. 1. Critical thinking and problem solving. 2. Collaboration between networks and lead with its influence. 3. Agility and flexibility 4. Initiative and entrepreneurship. 5. Access and analysis of information. 6. Effective oral and written communication. 7. Curiosity and imagination (Wagner, 2012, Kindle Empl 530). These skills are absolutely essential, but they are no longer sufficient. The challenges our students will face are very difficult. In the world of technology and science, Canada and the United States lose their dominance for the benefit of Asian countries. Innovation is the skill that is, and will be, the most in demand and the most needed.

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Name of the program : El – Mélange explosif : <https://c.gethopscotch.com/p/y20zj6473>

After watching an episode of Star Trek, students realize that some chemicals and combinations can cause explosions. Giving the chance to build a simulation of what happens with certain chemicals using Hopscotch could be much safer than doing the chemical reaction at home or in the classroom. This Hopscotch program could also show how someone feels as a result of constant discrimination against them. With the image of Deanna Troi in mind, the Star Trek Enterprise Vessel Advisor, the student could show how to creatively discuss feelings in order to improve well-being and learning skills as a result of reducing tension. Brookheart (2013) provided an interesting rubric to assess creativity. It involves the following descriptors: 1- Variety of ideas and context, 2- Variety of sources, 3- Combining ideas, 4- Communicating something new. The qualifiers in the image below correspond to a level 4. The Brookheart (2013) heading could be modified to include knowledge to be assessed in other areas. In addition, each descriptor of the heading could have a different weight or importance in order to take into account the main observable behaviors.

Moderation with other teachers

Moderation with other teachers is a process where teachers meet to assess student work against predetermined success criteria (Literacy & Numeracy Secretariat, 2007). Teachers participating in moderation assess students' work in a more equitable and coherent way and share effective practices that meet the needs of all students. In his webcast, Douglas Reeves says that at the beginning of such a process, teachers could very well evaluate a student's work at very different levels ranging from 1, 2, 3 to 4. Teachers had very passionate arguments about their point of view and it was recalled that the other teacher is not the enemy; The enemy is the ambiguity (Reeves, 2007). If teachers do not

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have a common understanding of success, they will not be able to evaluate the students' work properly. If mathematics is not evaluated correctly and its use with technology, it raises a question of ethics. Since coding has deep links to the mathematics curriculum, we will use a section of the Ontario mathematics curriculum. The topic shows the levels of thought. Often, students are able to do mathematical calculations, but have no idea of the problems they solve. This section helps to evaluate higher levels of thinking in mathematics.

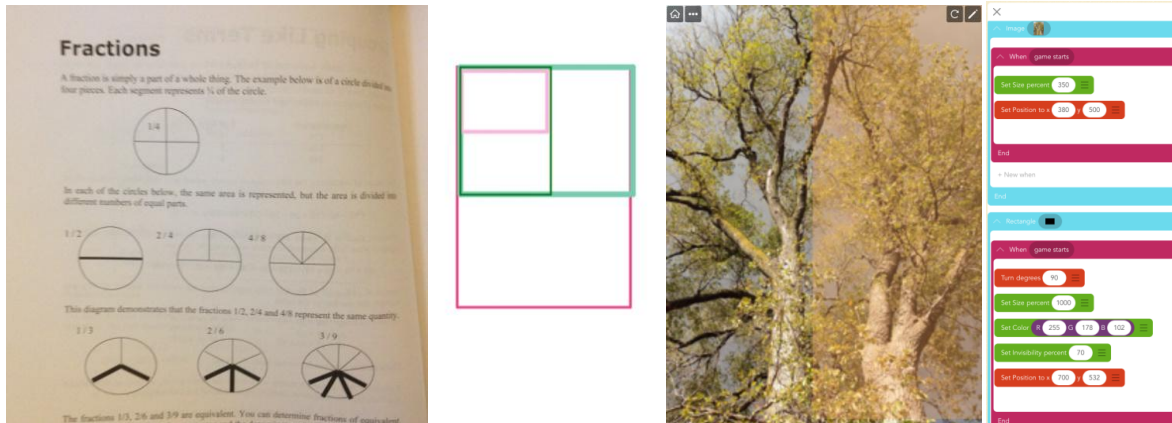
Thinking <i>The use of critical and creative thinking skills and/or processes*</i>				
	The student:			
Use of planning skills - understanding the problem (e.g., formulating and interpreting the problem, making conjectures) - making a plan for solving the problem	- uses planning skills with limited effectiveness	- uses planning skills with some effectiveness	- uses planning skills with considerable effectiveness	- uses planning skills with a high degree of effectiveness
Use of processing skills* - carrying out a plan (e.g., collecting data, questioning, testing, revising, modelling, solving, inferring, forming conclusions) - looking back at the solution (e.g., evaluating reasonableness, making convincing arguments, reasoning, justifying, proving, reflecting)	- uses processing skills with limited effectiveness	- uses processing skills with some effectiveness	- uses processing skills with considerable effectiveness	- uses processing skills with a high degree of effectiveness
Use of critical/creative thinking processes* (e.g., problem solving, inquiry)	- uses critical/creative thinking processes with limited effectiveness	- uses critical/creative thinking processes with some effectiveness	- uses critical/creative thinking processes with considerable effectiveness	- uses critical/creative thinking processes with a high degree of effectiveness

Before the evaluation of the work, teachers would first place students' work in three categories: low, medium, high for discussion. We have the PolicePrep program. In the middle, we had a Hopscotch game, which was not coded by the student, which was used to describe fractions. To the right, we have a Hopscotch program, coded by the student. In reality, such an assessment is not complete without speaking to the student or having a written sample of the student, explaining their reflection, or knowing the grade level of the student.

Before the evaluation of the work, teachers would first place students' work in three categories: low, medium, high for discussion. We have on the left a page of the PolicePrep program. In the middle, we have a Hopscotch game, which was not coded by

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the student, which was used to describe fractions. To the right, we have a Hopscotch program, coded by the student. In reality, such an assessment is not complete without speaking to the student or having a written sample of the student, explaining their reflection, or knowing the grade level of the student.



Nom du programme : Tap Twice To Draw Rectangle : <https://c.gethopscotch.com/p/y4horj9gx>

Nom du programme : Pollution de l'air <https://c.gethopscotch.com/p/yd8byxupb>

In these examples, it is the teacher's design of activity that would allow a student to show higher levels of thought. The worksheet allows the student to understand the problem, make a plan to solve and model the solutions, but does not allow students to show critical thinking and creativity. The second example does not include any coding by the student. The student plays a game to show his understanding. The student can understand the problem, make a plan to solve the problem, make a solution model and form a conclusion. Students use critical and creative thinking to find the best points to model the fractions by touching the screen of their device. The student can demonstrate all expectations at level 3. The third example allows the student to go beyond all expectations of thought by allowing an elaborate, critical and creative plan to show fractions by writing code in a real context. It all depends on the activity, but coding allows a student to develop his critical and creative thinking skills while allowing them to go beyond ministry expectations.

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Learning Skills

The development of learning skills and work habits go hand in hand with students' academic development (Growing Success, 2010). It is an integral part of Ontario students' character development. Hopscotch does not only allow the development of academic skills, the app is designed to also allow the development of students' learning skills of responsibility, organization, independent work, collaboration, initiative and self-regulation.

Learning Skills and Work Habits	Sample Behaviours
Responsibility	<p>The student:</p> <ul style="list-style-type: none">• fulfills responsibilities and commitments within the learning environment;• completes and submits class work, homework, and assignments according to agreed-upon timelines;• takes responsibility for and manages own behaviour.
Organization	<p>The student:</p> <ul style="list-style-type: none">• devises and follows a plan and process for completing work and tasks;• establishes priorities and manages time to complete tasks and achieve goals;• identifies, gathers, evaluates, and uses information, technology, and resources to complete tasks.
Independent Work	<p>The student:</p> <ul style="list-style-type: none">• independently monitors, assesses, and revises plans to complete tasks and meet goals;• uses class time appropriately to complete tasks;• follows instructions with minimal supervision.
Collaboration	<p>The student:</p> <ul style="list-style-type: none">• accepts various roles and an equitable share of work in a group;• responds positively to the ideas, opinions, values, and traditions of others;• builds healthy peer-to-peer relationships through personal and media-assisted interactions;• works with others to resolve conflicts and build consensus to achieve group goals;• shares information, resources, and expertise and promotes critical thinking to solve problems and make decisions.
Initiative	<p>The student:</p> <ul style="list-style-type: none">• looks for and acts on new ideas and opportunities for learning;• demonstrates the capacity for innovation and a willingness to take risks;• demonstrates curiosity and interest in learning;• approaches new tasks with a positive attitude;• recognizes and advocates appropriately for the rights of self and others.
Self-regulation	<p>The student:</p> <ul style="list-style-type: none">• sets own individual goals and monitors progress towards achieving them;• seeks clarification or assistance when needed;• assesses and reflects critically on own strengths, needs, and interests;• identifies learning opportunities, choices, and strategies to meet personal needs and achieve goals;• perseveres and makes an effort when responding to challenges.



Nom du programme: WikiLeak: <https://c.gethopscotch.com/p/xyewpx09y>

A student using Hopscotch can demonstrate **responsibility** by completing their work on time. Completed work is shared on the Hopscotch app and made accessible to everyone. The student makes a positive and ethical contribution to the world. Intellectual property is respected since if a student build upon another person's project, references are cited and the author of the first project is listed. A student shows **organization** by completing all parts of his assignment and by maintaining his own portfolio of best works. Coding also forces the development of more organized thought. Hopscotch Programs that are not well organized, just do not work. A completed program is an organized program. With Hopscotch, students are strongly encouraged to develop **independent work** practices. They use their time wisely by completing their work and by learning about a highly needed profession from an early age. They can use all the resources available to them, including classroom materials, social media, featured programs and searched programs provided by the Hopscotch

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community. They are able to work in the classroom and continue at home with their own device. Students are able to work with minimal supervision. Students show **collaboration** by integrating the feedback provided by the app and their peers to improve their own learning. Using the Hopscotch app, students become active members of an online community. By sharing their work online, they assist others by sharing their ideas and expertise. The type of projects they decide to code can show solutions to real conflicts in the world. Coding is new to most teachers and schools. Students using Hopscotch show **initiative** by using new ideas and opportunities for learning. Coding with Hopscotch is so interesting, students develop a positive attitude towards learning. Many students would work on several projects without being asked. Students develop curiosity by exploring the app and learning what they can do with code and integrating their learning into their work. Students show **self-regulation** by persevering when a project that seems difficult. They ask for help in the classroom or with the app by posting questions on the Hopscotch forum or sending emails. The student is able to set individual goals, as to how involved his projects and code can be. The student is able to select and review other programs and codes that will help him achieve his goals. The student is able to reflect and be critical by reflecting on the suggestions provided by the app when publishing a project and use those ideas to improve his learning.

Innovation

Should young coders be left to learn at home, only with their own means? Will we build military systems to bomb the Third World countries or will we let the angry young coders build the next Stuxnet computer virus to control our nuclear reactors? Stuxnet is the nuclear bomb of computer viruses. We must develop an ethics of technology with our students at the same time as we develop technical skills. By including aspiring engineers in our school, we can guide them in order to build an economy of innovation. They may be building the infrastructure needed to stop climate change. They could be building the next innovative revolution to help in the medical field, artificial intelligence, or sustainable development or spatial development.

The responsibility of teachers is already enormous. Many feel threatened by technology or math, not to mention programming. Teachers do not have time to do everything.

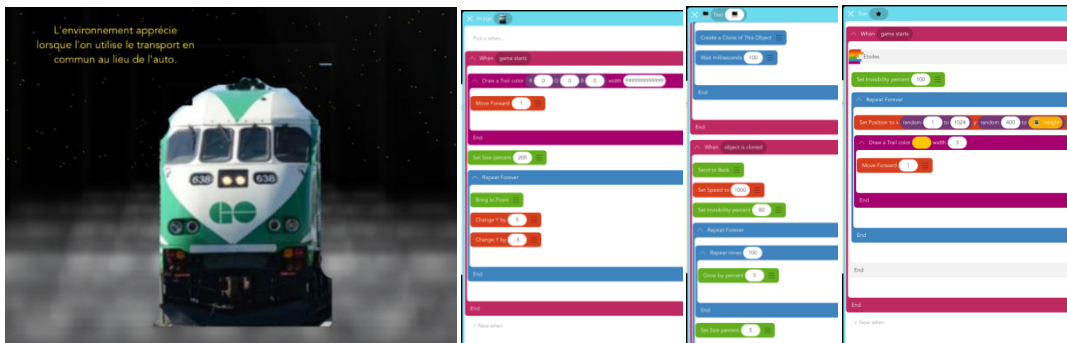
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There may be a solution. Teachers can use students' intrinsic motivation and interests, while working with parents to create a culture of innovation. By introducing classroom programming and triggering student passion, the teacher offers aspiring engineers the opportunity they need to become the next Steve Jobs, Apple's founder, Sergey Brin the mathematician behind Google, or Matthew Radnofsky, the engineer in charge of the Apollo Mission who brought the astronauts to the moon.

Teachers face a difficult challenge: to motivate the generation of video game players while creating a culture of innovation. Wagner (2012) indicates that the three elements that encourage intrinsic motivation are: games, passion and purpose. Children develop their skills through play. The research on the importance of game is impressive. Also, passion is essential to understand and master something deeply. Exposing students to what they might become their passion is part of the teacher's role. Once they have discovered a passion, students will work hard to master it. The final ingredient is their goal. After playing and mastering something new, students need to find the goal to support their efforts, in a desire to make a difference, make the world better.

The ISTE Student Standards of 2016 include Computer Thinking. The ISTE Standards for Teachers Accompanying Student Standards are still in the draft stage but include, as a facilitator, "Model and support students in the use of digital tools or applications to deploy a deliberate design process for creating or innovating solutions".

We have several transit services that run at the same speed as automobiles. Would it be possible, with the help of IT, to design public transport that travels as fast as airplanes, thus saving energy?

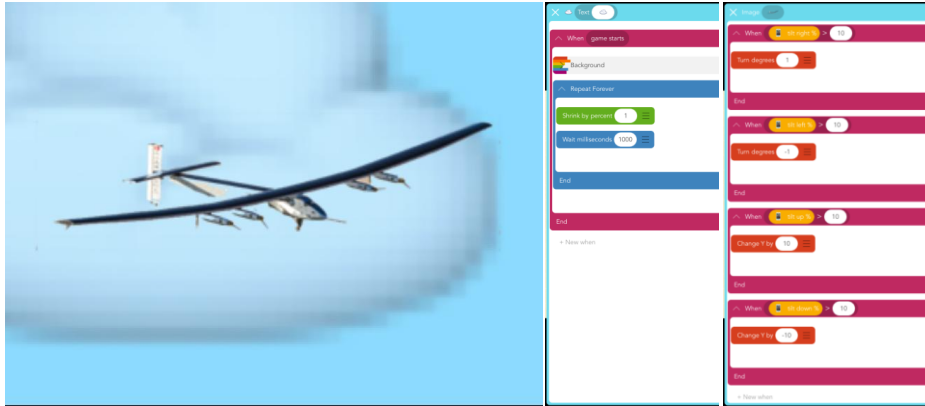


Name of the program: Tribes Something Good

<https://c.gethopscotch.com/p/yacao985q>

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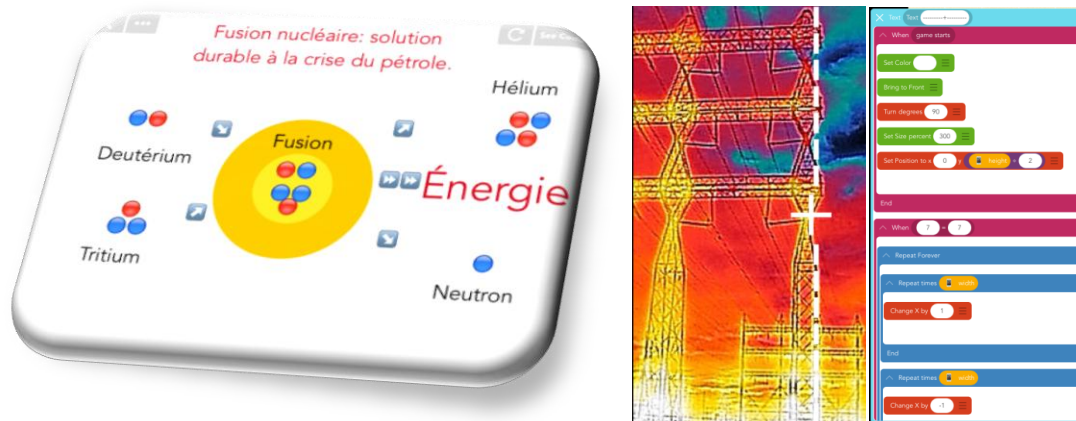
The solar airplane *Solar Impulse 2* has been around the world using only solar energy. The aircraft crossed the Pacific in 62 hours without using a single drop of oil (Al-Jazeera, 2016). This demonstration inspires many people to know what can be done with solar energy and a little innovation. Is it possible to use solar energy in our current aircraft in order to make at least part of the journey by plane using solar energy?



Name of the program : Solar Impulse 2 <https://c.gethopscotch.com/p/ya1ek5ya4>

Nuclear reactors in Ontario use nuclear fission. It is a well-functioning industry. They do not cause greenhouse gas emissions, but in a possible accident such as Three Mile Island, Chernobyl or Fukushima in the aftermath of the magnitude 9 earthquake, we are reorienting decisions on nuclear power. Canada and France have had excellent results with nuclear power. There may be another solution with nuclear power: nuclear fusion. Nuclear fusion is the same nuclear reaction that is found in our sun. We have just opened a reactor based on fusion in Germany (Al-Jazeera, 2015). Two isotopes of hydrogen are fused to give another element, helium. The reaction gives a lot of energy. Would it be possible to develop our nuclear power plants to make them safer?

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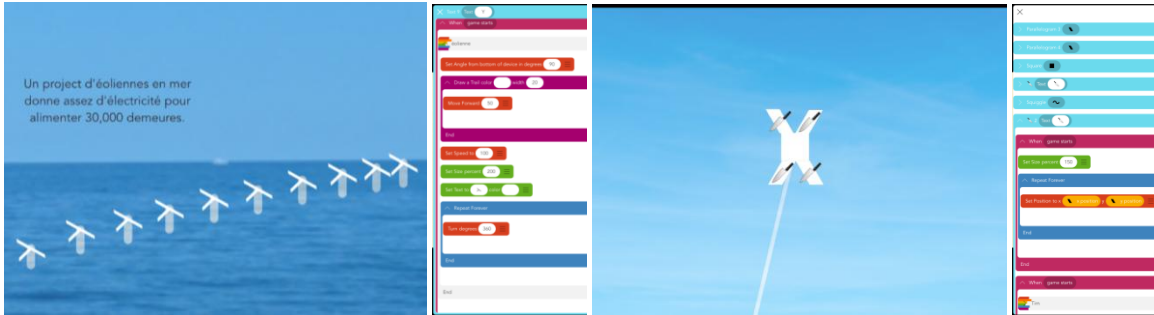
Name of the program : Fusion nucléaire: <https://c.gethopscotch.com/p/xkhiunuf3>

Name of the program : radar infrarouge <https://c.gethopscotch.com/p/yd0shhdu2>

Fusion is a viable solution to global warming. It releases an enormous amount of energy during the marriage of two atoms of hydrogen. The advantage of fusion instead of fission is that it produces very little waste. It is the same reaction that is found in the sun (Kaku, 2011). Several groups of engineers around the world are working to manufacture nuclear reactors based on fusion. A Quebec physicist, Daniel Laberge, innovates and embarks on a different technological direction. He uses the piston. His reactor will have 200 pistons arranged around a sphere. Hydrogen plasma is injected into the center of a lead vortex. Pistons that strike once at every second will give a shock wave that will propagate to the hydrogen plasma, making it 1000 times denser. With a higher density, hydrogen atoms will have a greater likelihood of colliding and merging. The technique of Daniel Laberge has the advantage of being inexpensive compared to other fusion methods used by other engineers (Découverte, 2016).

Wind turbines are already used on Earth and at sea. Can we improve their performance? Some Canadian and American companies are thinking of capturing the wind at high altitudes. According to their calculations, if only 1% of the high-altitude wind energy could be captured, there would be enough energy for the entire planet (Rand, 2010).

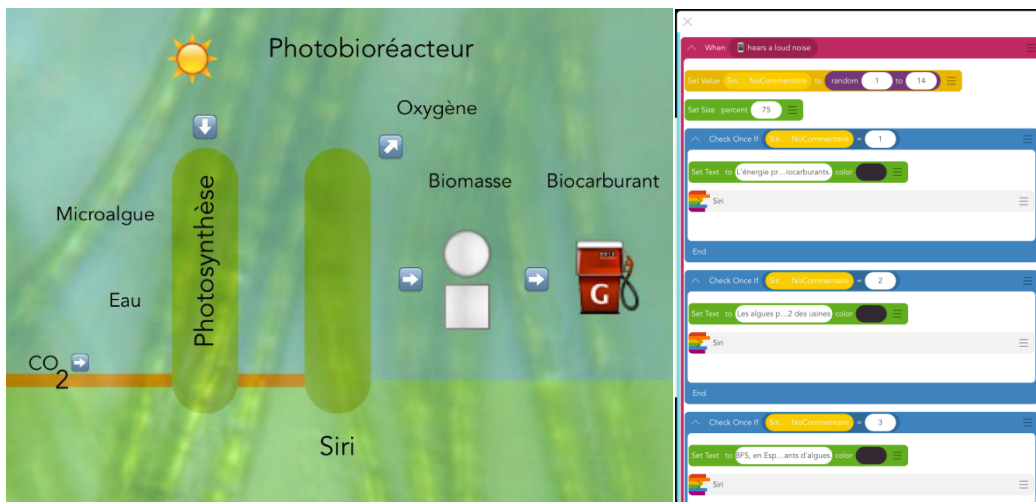
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Name of the program: Eoliennes <https://c.gethopscotch.com/p/ycnvutpm7>

Name of the program : Eolienne en haute altitude <https://c.gethopscotch.com/p/ydimjntyc>

Oil is a non-renewable fossil fuel. However, it is possible to create renewable oil using micro-algae. Several companies are now testing it. Much of the research involves identifying the algae in nature that contain the most fatty acids and which will be the most effective. Innovative companies build photo-bioreactors to grow algae (Découverte, 2015). The models are very diverse. Algae are fed carbon dioxide from industrial waste such as cement plants. With much sunlight, they develop, do photosynthesis and produce oxygen that returns to the atmosphere, with a clean effect of cleaning the atmosphere. From the biomass of the algae, one can extract a fatty acid that is used to make a biofuel almost identical to the oil that is used today.



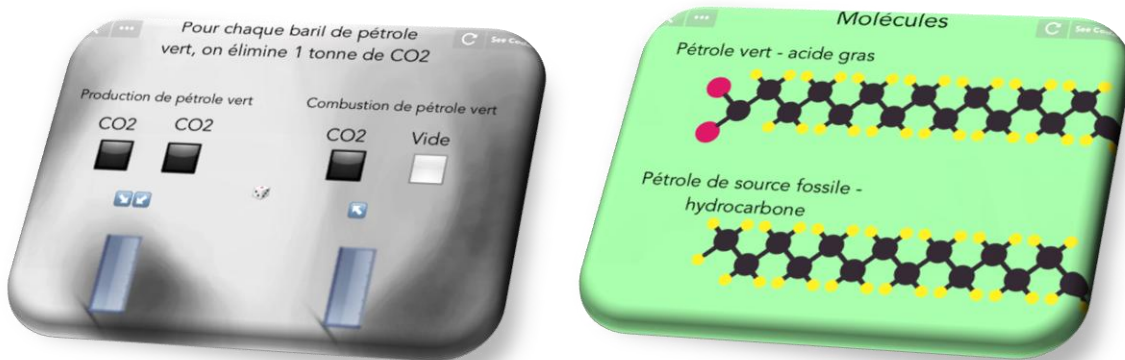
Name of the program: Algue Erreur <https://c.gethopscotch.com/p/y9h9m1xpz>

This biofuel is manufactured by removing two tons of carbon dioxide from the atmosphere for every barrel of renewable oil produced. It's a miracle technology. It removes carbon directly from the atmosphere. It does not mask symptoms, it solves the

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problem of carbon in the atmosphere. The company BFS, which is the first to develop this technology, indicates that the use of 20 million barrels of BFS green oil per day would reduce CO₂ emissions by 20%.

How does the green oil molecule differ from the petroleum fossil molecule? They are almost identical, and the fatty acid obtained from biomass algae could replace fossil oil or at least be combined with fossil oil in our fuel.

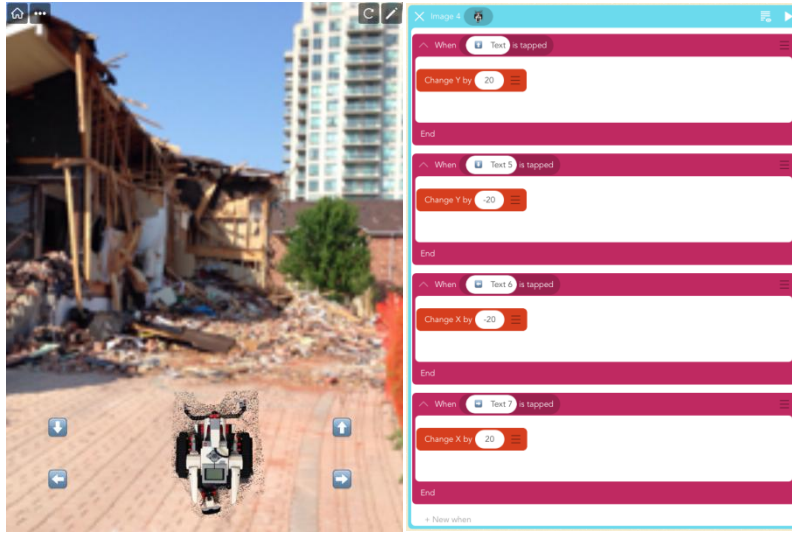


Name of the program : Pétrole vert : <https://c.gethopscotch.com/p/xkoe2bv hv>

Name of the program : Molecule de pétrole : <https://c.gethopscotch.com/p/xkodbivia>

Timing will be critical to avoid global warming and its impact on our society. There are increasing storms that destroy homes and require a lot of equipment, including robot scouts that allow you to go into the rubble without endangering the life of the firefighters. We are already afraid of the Syrian refugees who have to move because of the lack of water that caused a lack growth of their agriculture.

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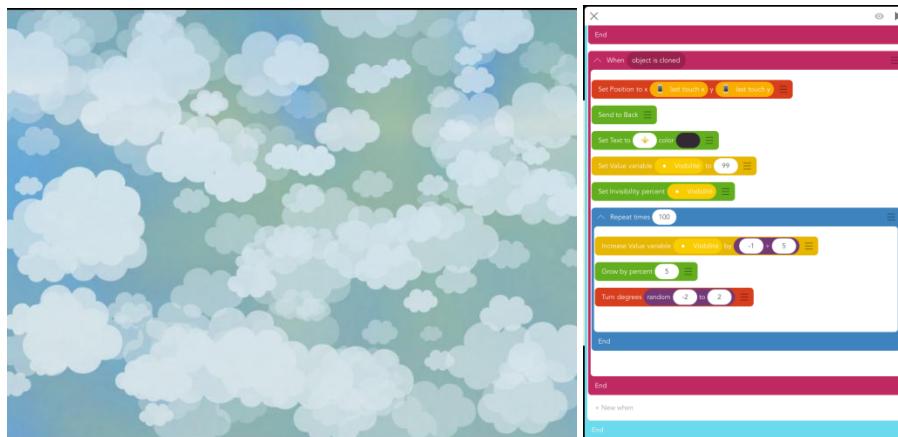


Name of the programme: Robot à la rescousse

<https://c.gethopscotch.com/p/ydfkpwqn3>

By 2014, 19 million people from 100 different countries had to be displaced due to natural disasters. In the middle of this century, when we get closer to the established limit of global warming and storms will be more frequent and stronger and the water level of the ocean will increase, where will climate refugees go? Estimates of climate refugees around 2050 are 25 million. Others estimate that 1 billion people will have to flee by the middle of the 21st century.

Wagner and Weitzman (2015) discuss the economic consequences of global warming in their book *Climate Shock*. They favor the technologies that solve the problem we have, the excess CO₂ in the atmosphere. One of the problems with this solution, including green oil, is that technology up to date, it very expensive to set up.

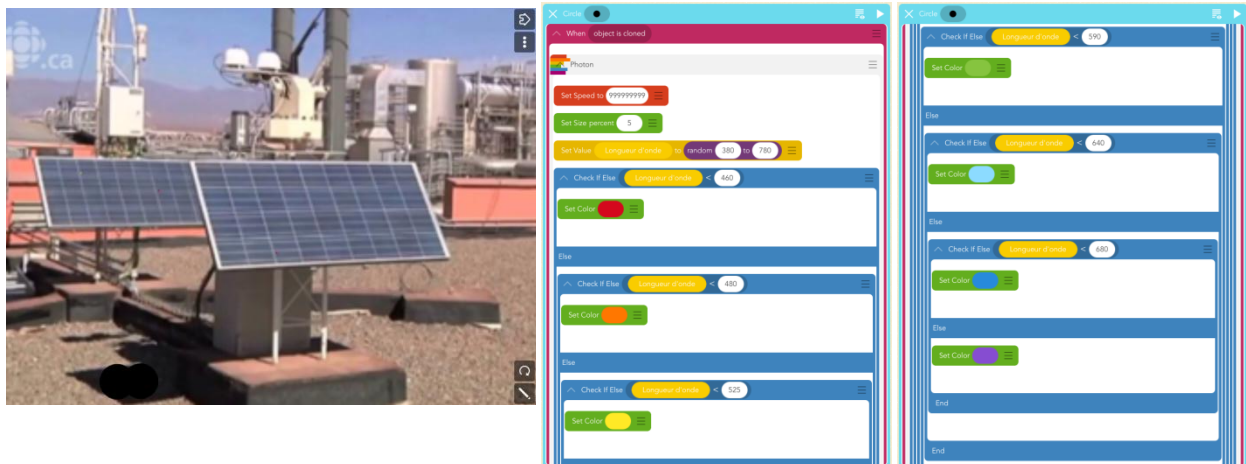


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Name of the program : Géo-ingénierie <https://c.gethopscotch.com/p/ycnvysxv4>

They offer another solution, geo-engineering, which could give us a little more time to put other solutions in place. It consists, roughly speaking, to put sunglasses on our atmosphere. Geo-engineering does not solve the effect of climate change. It only masks the symptoms. The idea is to put sulfur in the atmosphere in order to reflect the sunlight, giving the surface of the Earth a chance to cool down. This technology would simulate volcanic eruptions that inject sulfur into the stratosphere, reducing the amount of sun entering the atmosphere. Sulfur would be injected into the atmosphere using balloons. This is not an interesting solution and does not solve the cause of global warming. This is only a possible solution if we can not cooperate finding another solution before the middle of the 21st century.

Morocco gives the example of a very innovative solution to the problem of global warming. They started the first phase of the biggest solar power plant to supply electricity to the population (Découverte, 2016). Once completed, the Noor solar plant will have the power of a nuclear power plant. In this example, photons of visible light can be seen deposited on the solar panels. The color of the photons has been programmed with the wavelengths of each color.



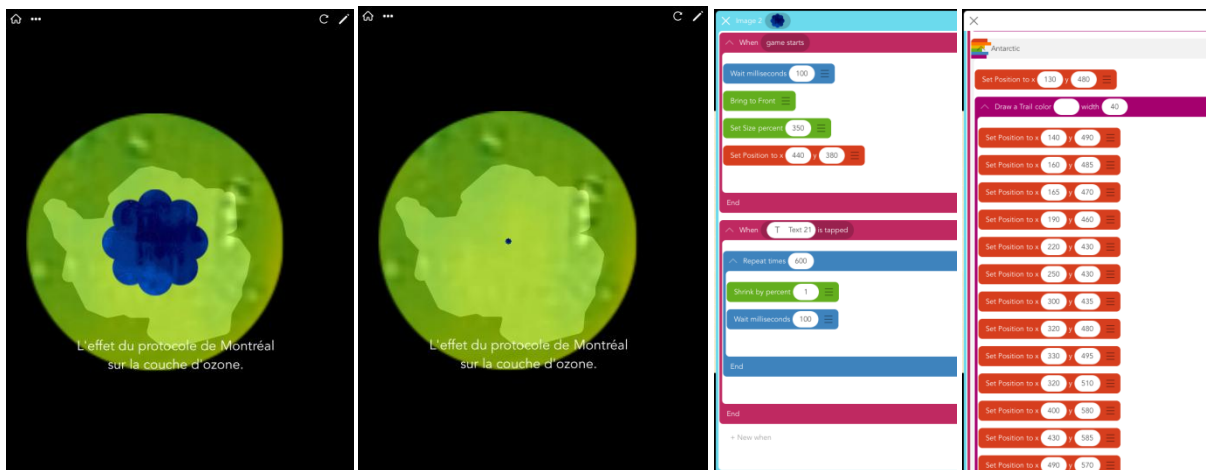
Name of the program : Noor Projet Solaire <https://c.gethopscotch.com/p/yf3sccjzq>

Next challenge

What struck me the most by reading the book "Most Likely To Succeed" is the mention of the creativity test that NASA uses to select their engineers and scientists. They also gave this test to children and adults. 98% of 5-year-olds are creative geniuses. There are 30% of 10-year-olds, 12% of 15-year-olds and only 2% of adults are creative geniuses. Tony Wagner also says that we live in an innovative economy. We must give our students the chance to keep and develop these qualities of creative genius.

By following the Genius Hour model, all students have the chance to participate in a project with technology, one hour a week and create something that they care about.

The Montreal Protocol has been successful in eliminating the need to protect the Earth's ozone layer.



Name of the program: Effet du protocole de Montréal

<https://c.gethopscotch.com/p/ybffhqwe4>

With the ratification of the Paris Climate Accord, our next challenge is to find ways to do the same, and find solutions to climate change. These solutions inevitably pass through programming and we must give all our children the chance to innovate and participate in this great challenge.

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