

1- Create an Innovator's culture with Hopscotch

Environmental educators, are very clear about how precious is our home, planet Earth. We work towards ensuring this remains a priority, in the face of the current climate crisis. The question arises, how can we solve our current problems related to climate change? I think we need to create a culture where we can train our students, where students can develop innovative ideas with the goal of preserving our planet. Since we live in a technological world, being able to solve our problems with technological tools like coding with Hopscotch is fundamental.

2- What problems do you think require our attention?

We talk to our students. We ask questions. We read. We experience. We discuss the news. We focus on important issues. President Obama, Prime Minister Justin Trudeau are in agreement. "Climate change is not something that's happening in the future. It is causing hardship now. Climate change is real and we need to act now." We discuss the cause of mega-storms and the effect on our home, cities, farm land.

3- We have Syrian students now in our classes. They came to Canada as refugees from a civil war. Did you know that crop failure due to climate change helped trigger the Syrian Civil War? No water, no crop. No infrastructure to bring water to the field, no crop. This was reported in the proceedings of the National Academy of Science.

4- We bond with what we experience. We take students to the zoo to discover and bond with animals from all over the world. The polar bears, the symbol of climate change, are losing their habitat. Ice is melting and they have less time and less ice surface to use for hunting. They go hungry.

5- Thankfully, the entire world agreed to do something about it in the Paris accord of 2015. We are going to reduce our carbon emissions to make sure the global temperature does not rise more than 2 degrees Celsius. Perhaps identifying the source of the greenhouse gases might be helpful. They come in large part from producing electricity, from agriculture and industry.

- 6- Why learn coding? The tools we need to solve climate change are made with code. Environment-friendly transportation is made with code. Environment monitoring tools are made with code. Solar panels, energy distribution centers, farming equipment are made with code. Everything we use is made with code, yet we do not teach our students how to code. Would you want to **give all your students**: the boys, the girls, the poor, the people of color, the disadvantaged, the struggling to the gifted, the opportunity to find employment and solve the most pressing issues we face?
- 7- Hopscotch was invented to create mathematics students would love. Hopscotch is a free app that works on the iPad. It won several awards for its excellence. It allows students to learn easily the thinking behind computer science and engineering. It could be as easy as sliding a block to the work area to draw a line or as complicated as developing sophisticated algorithm to made an invention. The app can be used from grade 3 to grade 10.
- 8- Students usually get introduced to coding with the Hour of code. For one hour, students can code whatever they want. They are able to do amazing creations. To integrate coding in the classroom, with 15 iPads for the entire school, Genius Hour is a good model. For one hour, perhaps once a week, students can code to create something amazing that interest them. It is the model Google use with their employee. For a day, their employee can work on something that interest them and will benefit the company. We can set a task, to develop something that interest you that will help the environment.
- 9- The work opportunities for students who know how to code is tremendous. Here are the statistics. In mathematics, science and technology area, 60 % of the jobs are for computing jobs, for people who know how to code. And if we look at the number of computer science graduates, only 2% will have the necessary education to be able to work in this area. And among those qualified, only 27% are women. Why is it so? It is not in the curriculum? Google polls further indicate that most parents want their children to learn coding but most principals do not offer coding in their school. Is it not important?

- 10- I modeled my classroom after Tony Wagner. You can hear him speak on the TED channel, and the WISE channel from QATAR. It was introduced to me by the STAO, the Science Teacher's Association of Ontario. My classroom becomes a place where students learn through play. Coding with Hopscotch is quite fun, for example. Not only can students create video games, they play their **own** video games when finished. Students become passionate about their learning. Questions are open-ended. Students have a choice of activities and a choice of their level of involvement. With this choice, students become quite invested and passionate **because** their learning becomes personal. Students know we are learning from the best sources, that they create very significant work that can be shared with the online community. The learning becomes purposeful and students become quite creative.
- 11- In addition to meeting the science and environment expectations of the curriculum, we are meeting the mathematics expectations when we use Hopscotch. The thinking expectations, the mathematical processes like problem solving, reasoning, reflecting, connecting, representing and communicating are most use when we use Hopscotch.
- 12- In addition, we can meet several expectations in number sense and numeration, geometry and spatial sense and patterning and algebra.
- 13- Many students and teachers think it is difficult to learn math and code. Would you believe it is easy? It is. With a fixed mindset, we believe that skills cannot be developed. I.e. Math and coding is not for me. With a Growth mindset, we believe that our skills and intelligence can be developed with persistence and effort. Students with a growth mindset are the ones who will be successful. We need to train our students to have a Growth mindset. We encourage their EFFORT.
- 14- Computational thinking is the name for the thinking behind coding. It is a subset of critical thinking. All of you know that thinking can be introduced in all areas of the curriculum
- 15- Under the previous Canadian government, like the Harper government, Canada was projected to the world as a country with resources. We have oil and we have gas for sale. The new liberal government under Justin Trudeau, wants to change this image to an image of Canada as a green country. We are developing infrastructures to create a new green economy. We can develop and improve the efficiency and cost of green technology such as solar panels. For example, with a molten salt reactor, the solar panels can provide electricity for 70,000 homes and this energy is 100% renewable. (The blocks you see is the Hopscotch code required to draw the solar panels on the iPad.)

- 16- We have a vision with a green goal. Instead of only producing petroleum from the dinosaur era, we can research the production of green petroleum. For instance, by farming microalgae, fed by carbon dioxide, we can produce oxygen, and biomass very quickly that can be used to make petroleum. This process removes CO₂ from the atmosphere. The resulting green petroleum is very similar to fossil petroleum and can be used to fly airplanes.
- 17- In grade 5, students might not be able to be real engineer but we create the environment where they learn the process of creation, the process of innovation for a green future. Instead of playing violent video games, we can create a culture where students write green video games. With only 3 lines of code, we animate a program and create a video game. The solar impulse 2 succeeded to go around the world with only the energy from the sun. Students can develop the tools to be an engineer and create a video game about this.
- 18- If your passion is biomimicry, making innovations by observing nature, we can start developing new products based on our observation of nature. For instance, by observing the dynamics of schools of fish, we can improve the efficiency of windmills. The windmills you see in this program actually MOVE and TURN. It is just fascinating for a young child. And we model what engineers actually do.
- 19- There will be a learning curve, in the same way that athletes do not become Olympic ready overnight. They need to practice and learn as they go. You see here examples of structure collecting energy from the sea and an Hydroelectric dam.
- 20- As in real life, creating large projects requires many people in many fields. Hopscotch projects can also be created by several people. Students can build upon other programs that have been written and shared on the Hopscotch community using ideas discussed in the classroom. Here we have the Jason 3 satellite that collect information about the oceans. Some of its functions are controlled remotely.
- 21- Hopscotch can be learned in a few minutes. Students as young as grade 3 can code **simple projects** with just **one line of code**. The Hopscotch code can be very simple for beginners, to quite **complex** for the gifted students. Students have a choice of questions and projects. Here we see a publicity for sustainable development in a city. There is also a project about making toys from recycled objects to protect the Earth. The wheels of the robot are programmed to turn the same way gears do. Students can write very simple to very complex programs that reflect all types of ideas.

- 22- When choosing your topics, choose something that you and your students are passionate about. We created several programs around helping the environment. In this example, after listening to the radio program quirks and quarks, students can ask questions and ponder how to build what they are learning about. There is another energy source that could be build. It works like fireworks and is used to power rocket fuel: the metal-air burner. Research is being done to investigate how this type of fuel could be used to power our cities.
- 23- Scientists are also studying how geoengineering could be used to modify global systems to address climate change by interfering with sunlight. The idea is to deploy balloons in the stratosphere filled with sulphur. The sulfur will reflect the sunlight for a while, giving a chance to the Earth to cool down. The argument for this type of project is that it occurs naturally when volcanoes erupt and inject vast amounts of dust and sulphur in the atmosphere.
- 24- Students are able to create real products that are shared with an authentic audience on the Hopscotch community. For example, as in architecture, we can build new types of green housing. Here we have a building that is producing algae. The biomass extracted could be used for heating. There is also the house with the solar panels.
- 25- The more involved the projects are, the better networking becomes. We can network by looking at ideas online or by listening to the best science programs. We can network with the Hopscotch community by looking at what others have. For example, if we search TRAIN on the app, several ideas of programs will appear. The students can incorporate several different ideas into a new program. In this example, we are reminded of the dangers of transporting petroleum by train by the train accident in Lac Megantic.
- 26- Students can participate in the Hopscotch community by sharing their own projects with other Hopscotchers. When they share a project, the Hopscotch app provides assessment for learning. It shares other ideas of projects that are in the same range of difficulty that the student can try in the future. Here we see a new type of water filter: a nanofilter. The nanofilter can desalinate ocean water without the use of petroleum. The filter lets water go through and blocks salt molecules as they are bigger than water particles. There is no need for evaporation and large use of energy.

- 27- Students learn to make a difference in the world by following and learning from **people** who make a difference in the world. Students can work at school but also at home. There are several video that teaches students how to code. Learning does not come entirely from the teacher. Intrinsically motivated students can code beyond their grade level and investigate nuclear energy. There is high level math behind drawing an atom with moving electrons. Fission is currently used in current nuclear reactors. Perhaps nuclear fusion can be used in the future to create energy. Germany is currently building this type of reactors.
- 28- Curious students could also investigate nanotechnology. At the nano level, particles have different properties. For example, a sheet of carbon one atom-wide rolled in a tube is very hard and resistant. If we use nanotechnology, the solar panels become very thin , strong and malleable.
- 29- Imaginative students can create new house designs like these floating houses. In case of rising sea level, houses close to the shore do not need to be on solid ground, they can float, rising and going down with the water level. This type of project can help residents close to the shore line.
- 30- Students learn all the time. They can observe the aquaponics class aquarium with its fish and plants and code at home. OR they can code in the classroom what they have learned with their parents while visiting an aquarium or outdoor center. Learning happens all the time. Hopscotch works without Internet 24/7 and the Hopscotch **community** is available throughout the whole world, where there is Internet, 24/7.
- 31- Coding is so fun, students don't realize they are learning math. In this 3 lines of code that allows the drawing of part of the biodigester. They learn some algebra with the use of variables. They can discuss the shapes they have drawn, the angles. The biodigester is transforming manure into carbon dioxide and methane.
- 32- Students could make a difference in the world by sharing their ideas on website. Students can design their own website or use a template from the large selection of template available on the Hopscotch app. The website is shared on the Hopscotch community. The Hopscotch link to the website (or program) can be shared via email or social media. Hopscotch programs are developed on the iPad but they can be used on other phones or computers with the link.
- 33- How do we develop systems cartoon.

34- There is an entire life cycle involved in designing products and systems. Computer science is not only learning how to code. We need to understand the problem. Students can use social media or google for that. We need to analyse and discuss the problem. With technology, it can be done with Padlet. Students can also discuss the design of the system they have in mind with an organizer app like Popplet. Coding is done with Hopscotch. Documentation and explanation of what was created can be done with ExplainEverything. Finally, for the promotion and sharing the idea with others, students can use an app like Prezi or a blogging platform like Kidblog. It is not necessary to do all steps for every Hopscotch program but it might be worthwhile doing the entire process for the best projects.

35- Hopscotch changes the nature of homework. The app contains all the best research practices regarding homework. The homework is short, or as long as the interest of the child. It does not burden the teacher. It is not too easy or too difficult. It involves the family since parents would encourage their child in that direction by purchasing an iPad and providing moral support. It is an excellent use of technology since it emulates what real engineers do. It gives an opportunity to correct social and economic inequities by giving all students the opportunity to learn a new profession. It is a different way of learning for students with learning difficulties, gifted or disengaged students. The app and the culture encourages students to find a new passion and to become independent innovators. A Hopscotch homework makes sense. Students are making innovations instead of filling out worksheets. The app provides many forms of help and resources for students. I find it quite remarkable.

36- What is the best way to learn?

37- If you are not sure how to link coding to the curriculum, this manual can help. It is available online.

