advanced computational thinking in aotearoa

ACTivities .handbook

Starting points for practical learning and teaching

Produced for the Teaching and Learning Research Initiative project:
Advanced Computational Thinking in the New Zealand Digital Curriculum

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Contents

Kia ora fellow learner (teacher),

This ACTivities handbook offers practical starting points for learning and teaching Advanced Computational Thinking (ACT) in Aotearoa New Zealand. It is meant as a resource for teacher-learners to support their process of learning and teaching Advanced Computational Thinking (ACT).

Firstly, what is Computational Thinking (CT), and what do we mean by "Advanced" in ACT? For a definition of CT, check The New Zealand Curriculum and in particular the CT Progress Outcomes for years 1 to 13: technology.tki.org.nz/Technology-in-the-NZC. The A in ACT is not used here to indicate a more high-tech, complex, or difficult level of computer programming. Rather, advanced here refers to a more progressive, alternative, and forward-looking way of understanding CT, from the very first steps in early childhood to the professional practices in technology areas. As you proceed through this handbook, the key ACT principles and orientations should become clear. Suffice to say that ACT seeks a more creative, collaborative, embodied, community-oriented, and meaningful way of learning and practising Computational Thinking. Crucially, learners are free to ACTively figure out what ACT is for them.

The handbook presents a set of ACT concepts as starting points for learners to experience. Over recent years we have developed activities to find out about ACT and inspire you to come up with new ideas on your own. Initially, these activities use anything but the latest technological devices and systems, although you are welcome to extend them into activities with computers and other electronics. The activities in this handbook invite learners to use bodies, voices, and senses, the air, the junk of the school, stuff in the neighbourhood, and relationships with other beings as ways to experience and develop intuitions about ACT.

This handbook can be used by and with people with any age and level of knowledge. From those who have never interacted with the subject, to those who consider themselves experts in the field. The activities are free as in they only require your imagination and resourcefulness to gather and prepare the appropriate physical materials and resources.

Each of these activities was developed in connection to a particular ACT concept. We have put our ideas about how they relate to these concepts in a section at the end (pages 27–45). We encourage you to look at that section if you are feeling lost about what the links might be, or once you have completed the activities in order to build on them or extend them. We did this because (i) we realised that the activities stimulate learning over multiple concepts, and (ii) you will generate ideas about connections between activities and concepts that we did not think of. The more you get used to them, the further

you will develop your own ideas about computational thinking. These ideas will be a gift to you, and others.

Keep in mind that the design of the activities intentionally avoids prescribing the computational concepts at the beginning of an activity. This approach encourages learners to see and experience first with principles of computation. Experience first, explanation second. This also has the advantage of removing the digital device from the experience to avoid the ACT concepts becoming obscured by the functioning and limitations of devices.

There are some ideas for playing with the activities and concept prompts at the start of the Activities section. There are also some ACT cards and suggested activities towards the end.

We have also included an AI-generated story for you: *Are Mountains Computers?* Read it by yourself, with your friends or classmates, or use it as a lullaby… cut it up and rearrange it into a new and weird poem, story, or lesson plan… we are sure that you can find ways to play with it (find some ideas for using it in the Storytime section).

Ready? Well then, enjoy this GREAT warm up waiata by Sakamoto Shintaro and then head right in!
youtu.be/EY6sWifUbrI

A Note on Materials

These activities do not need many (if any) specific materials or tools, and can be done anywhere. You will be able to do them whether you are in the bush, in a rural school, home-schooling, in the city or suburbs, in a Modern, Flexible, or Innovative Learning Environment, in a traditional “single cell” classroom, roaming the streets, and so on. All materials can be found for free or very low cost.

When we suggest materials and tools for each activity you do not need to heed this suggestion! But they will probably be freely available in your general environment, or have a very low cost. We also provide “general properties”, ideas for substitutes, and ideas for where to find them easily and freely.

A great aspect of using stuff you can find freely in your environment is that you can spend the first part of the “lesson” exploring the area, knocking on doors, making new connections (and friends), crawling under decks, tipping out rubbish bins, and so on. This is a key part of developing your own local concepts of Advanced Computational Thinking.

You can find more ideas about finding what you need, anywhere, in the free book Distributed Resource Centre by Chris Berthelsen and Xin Cheng (supported by Mairangi Arts Centre) here: small-workshop.info/doc/drc.pdf

This guidebook has links to other stuff online as “extra resources” but, as we say in the trade, “No Internet? No Probz!”. Here is what you can do should you find yourself offline:

One person becomes the link
Another person reads the link out to them (the URL and the title)
The link-human then “acts out”, roleplays, or otherwise describes the online content in any way they feel like
The others enjoy the content provided by the link-human

(Optional Extra: Watch the actual content later and compare and discuss)
Otherwise, just leave it to your imagination and enjoy a no-internet link-life!

Note on “Generative Assessment”

We recommend taking a whole lot of photos while doing these activities. Usually we do not ask the participants to take the photos because we hope that they will focus on what they are doing with their bodies and all the other stuff. At the same time, you will always get surprising photos if you get someone else to take them.

Some time (a couple of days, a week) after the activity we will print out all the photos and spread them on some desks in the middle of the room or on the floor. We then all make “something” (e.g., collages, scrapbooks, documentation) with the photos and other ways of expressing ourselves (captions, poems, directions, diagrams, manuals, etc.) These could be one-page posters on paper or cardboard from the recycling bin, in handmade exercise books cobbled together from the junk of your school or general environment, or in a specific format to meet your organisational requirements.

Everyone will have a different way of doing this, and you will probably notice things about you and others that you didn’t realise before. Or things will acquire new meanings. In the process, new ideas for things to do and new ideas about Advanced Computational Thinking will probably bubble up. In such cases, how about shutting this book and following what the learners are doing?

Notes on Use

As we noted in the introduction, we've developed these activities so that they can be of equal use to total beginners and people with decades of experience. You can just dive into the activities in any order that suits you or take one or two of these tips to get started.

For a start, as noted in Materials you could walk around your general environment and collect everything that will be thrown in the landfill or "recycled" that you think might be useful. If you don't feel like doing this, try the next step.

Whatever you think your level of "understanding" or "competency" is, just pick an activity that looks fun and do it!

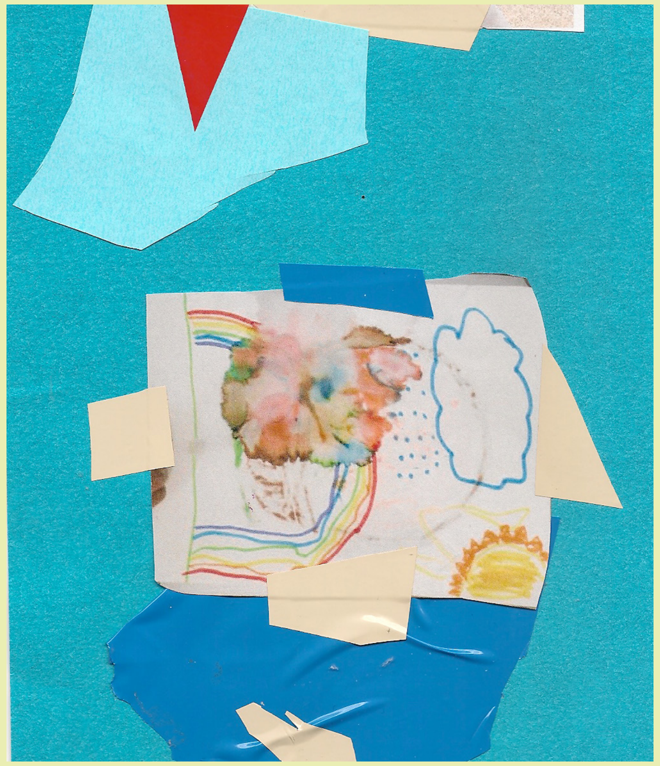
If you have some general ideas about computational thinking, then refer to the section 'Connecting the Activities with Advanced Computational Thinking' and see what links bubble up. That section explains the basic links that we developed the activities from. This might help if you have zero ideas (or want a quick way to explain) but it is definitely not necessary.

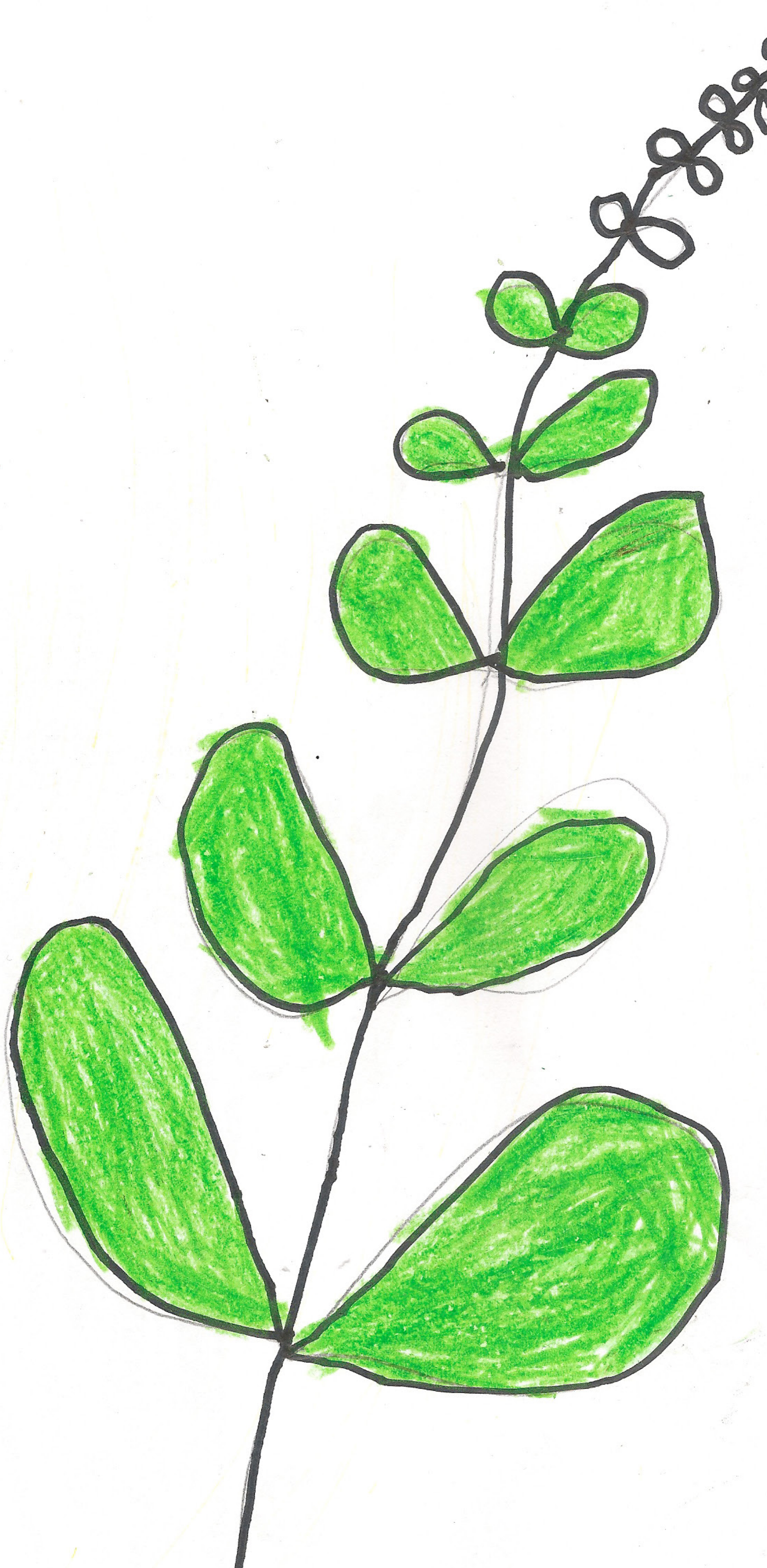
Print or write out the ACT cards. Take a card and walk around seeing how you can apply what is written on the card to the things around you, to the activities in the handbook or to the ACT concepts. See page 50 for more details.

A recommendation: Before you do anything, how about making a sound toy out of junk you find lying around your general environment, together, for example: youtu.be/AJnpcj22ujE (Chris Berthelsen's musical Junk Sculpture)

A PDF of this document, and a list of the links included in this handbook is available at advancedcomputationalthinking.org/handbook/links.php

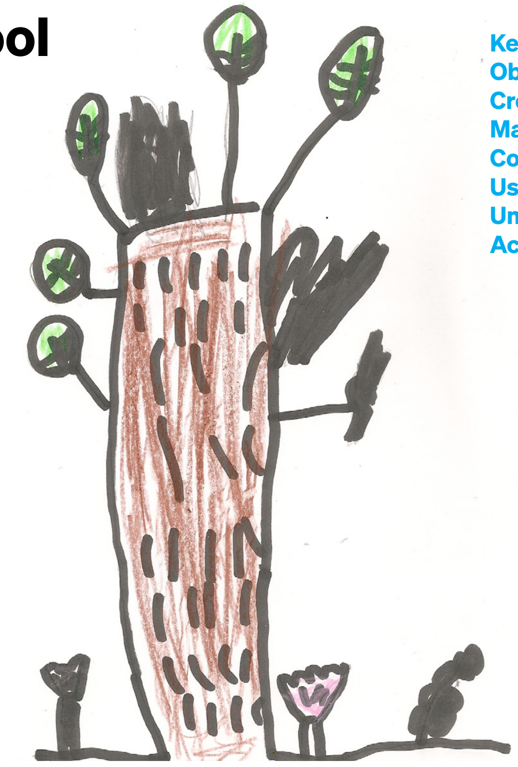
Activities, Extensions (Open Questions), Further Resources





Activity

"Mending" the School



Key Competencies:
Observing,
Creative thinking,
Managing self,
Contributing,
Using materials in creative ways,
Understanding,
Accepting imperfection

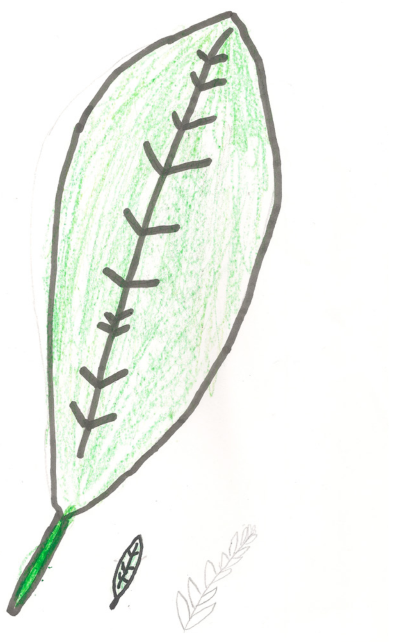
Groups roam different parts of the school with the materials gathered and find stuff they'd like to fix or improve in the school (cracks, stuff falling off, holes, wobbly seating) and try to fix, mend, or improve them. The actual "fix" is less important than the act of identifying and intervening. After a period of time, groups swap areas and roam, noticing the "bad job" that their predecessors did, and working on their own "fixes". And so on. It can be very interesting and often hilarious. And usually frustrating. Do not expect to ever fix anything, enjoy playing with and savouring uselessness and failure.

Added Bonus
Make up proposals to the principal, groundsperson, mayor, local MP, or any figure of authority to "fix", improve, or upgrade stuff. This can take several weeks and even include some preposterous and hilarious ideas. It is also very interesting, and can take you on a journey you never expected. Notice how trying to "fix" one thing might make more "problems" for you than you thought! And that does not mean it is a bad thing.

Materials:
Anything you can find freely in your general environment, usually from a rubbish or recycling bin. Some materials we have found useful are clay harvested from a local construction site or beach; bicycle inner tubes (ask for old inner tubes at your local bike shop), sticks, pebbles, orange peels, grass clippings, shoe laces and cardboard boxes.

Activity

"Mending" the School



Extension Activities/Open-Ended Questions
What does "fix" mean to you?
What might "break" when you are "fixing" something else?
Does "working well" always mean "not broken"?
What does "broken" mean to you? How did it "break"?
How do we determine that something is "broken" in the first place?
Can something become better when it "breaks"?
How do you relate and how do you feel about "broken" things? Why?
What does "function", "form" and "use" mean to you?

When you find something "broken", come up with as many ways as possible to fix it, say these out loud, write them down or draw them. i.e., There is a small crack in the ground, how could we fix it?
1. Make a sign pointing out the crack.
2. Fill it with clay/water/stones/poems/anything.
3. Make another crack next to it.
4. Make a map with all of the cracks in the general environment.

You may want to have a look at this website chindogu.com
Chindōgu is a Japanese concept that consists of inventing "unuseless" objects or solutions. These may seem absurd and funny at first glance, but upon closer inspection they actually point to deeper problems.
Here is an inspiring video youtu.be/c3fctmixsKE made in a West Africa post office in Ghana, showing how we can make music and create rhythm with just mundane activities. Use these techniques to make the boring tasks more interesting and fun.

Activity

Training your Teacher to Walk

Key Competencies:
Relating to others,
Using language, symbols, and texts,
Managing self.

Materials:
Anything. Learners can use a writing implement (e.g. pencil, clay, burnt stick, etc.) and writing surface (e.g. scrap paper, wall, concrete path, dust) to take notes if they need to.

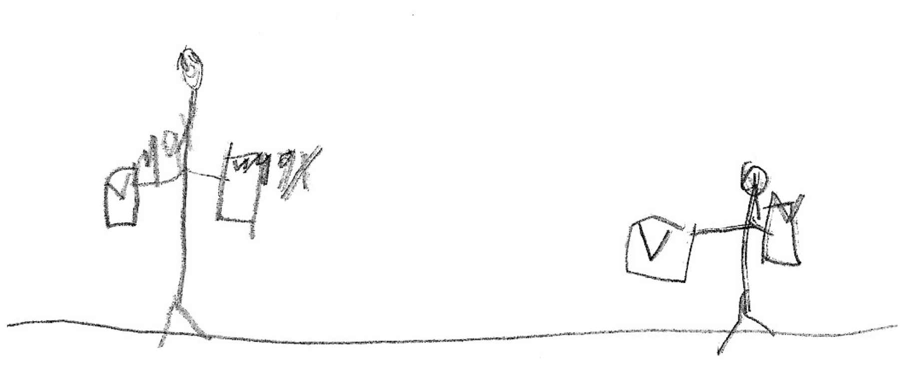
Ask your teacher or a volunteer to walk normally. Watch them very closely. Write down what each part of their body is doing in as much detail as possible. Analyse the steps ("instructions how to walk") and put them in some kind of order that makes sense. Now, try to train another person to walk using this training model (reading out your instructions). The person can be as pedantic as possible, meaning that they will only follow "literally" what they are told to do. This quickly becomes weird and hilarious.

Further Resources
Try these short videos for ideas on how movement creates character:
Let's bring back game characters to life using movement!
youtu.be/DeutKhta1Uo (3 minutes) How to run and walk like a Grand Theft Auto virtual Character
Dancing and moving as if you were a SIMS virtual character
youtube.com/shorts/sfdhWfRT_Y8 (1 Minute)

Depending on the learners, you may want to introduce the Butoh 舞踏; a style of dance. Originating in Japan after WWII, Butoh utilises pauses, slow motion and uncanny movements and involves unlearning the "civilised body" or how you might be accustomed to moving "normally". The "algorithms" behind these dances are quite complex:
Butoh - Piercing the Mask: Abandonment of the Self
youtu.be/a0_WlmDUSRk (54 Seconds)
Butoh Dance Performance in Japan youtu.be/9ms7MGs2Nh8 (3 minutes)
Demostración de danza Butoh - MNCM youtu.be/at5zyxgBXiU (2 minutes)

Activity

Training your Teacher to Walk



Extension Activities/Open-Ended Questions

Non-Human Meditation:

Watch something non-human (e.g. stray cat, stone, leaf, etc) for an amount of time (e.g. 15 minutes). Watch it very carefully and take a note every time something changes, they move, etc. Learners will end up with a list of instructions (training model). Next, train a person (or yourself) to act like that stray cat, stone, leaf, etc. Read out the instructions, quite slowly, kind of like a meditation, and they should follow the instructions as closely as possible. They will not immediately turn into a stray cat, but some of their movements and feelings will begin to resemble one.

Try this with other actions such as brushing teeth, eating a sandwich, etc.

15 minutes was the warm-up. Now try observing and "reverse-engineering" instructions for longer, say 30 minutes.

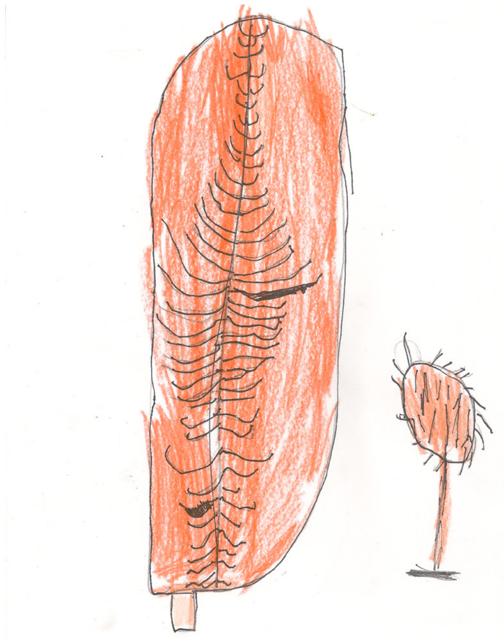
After receiving training through the Non-Human Meditation, learners close their eyes, relax and believe with every cell in their body that they have become a leaf, stone, stray cat etc. Ask them to repeat in their mind "I am a ______, I am a ______, I am a ______." Then silence their whole being. Encourage the learners to see how long they can stay as a _____. Ask them how it feels. Throughout the day whenever they are feeling tired or stressed out, they can close their eyes and become a _____.

Learners close their eyes and imagine they are inside a machine. Ask: How does that feel? What do you feel, smell, see, inside the machine?

Activity

Experiential Everyday Activities to Discover Hidden Biases

Key Competencies:
Thinking, Relating to others

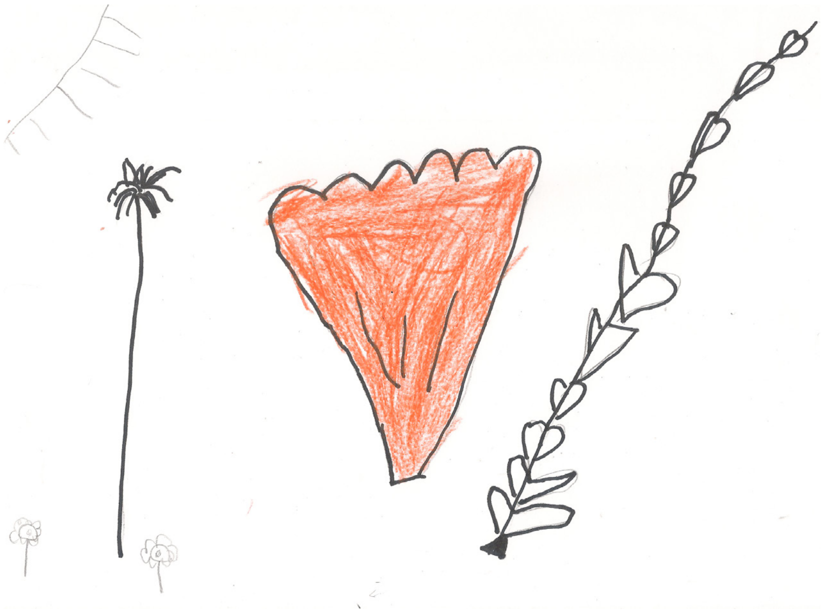


In this activity learners tie up a part of their body (e.g., tie up your hands into a fist so you can't use your hands or tie up one of your arms to your back). Now go around your daily activities and pay attention to the difficulties you try to do even simple tasks. Ask: What are the difficulties and biases designed into your everyday environment? (e.g. you won't be able to use a keyboard or touchscreen very well, if at all; it will be hard to lock the toilet door or tie your shoes). Invite learners to imagine ways to design things for their new bodies, based on the biases they have discovered (e.g. a keyboard with sticks coming high up off every key so people can easily press each letter). Now, talk about how the new things that have been designed would produce new difficulties and challenges for other bodies.

Materials:
Something you can tie up and/or modify parts of your body with. Examples include strips of old fabric, old bicycle inner tubes (available from bike shops), tī kōuka (cabbage tree) leaves, t-shirts and socks from the lost property bin, etc.

Activity

Experiential Everyday Activities to Discover Hidden Biases



Extension Activities/Open-Ended Questions
Investigate and/or imagine the form and perceptions of some other living (or nonliving) thing (e.g. cat, tree, spider, etc.) and explore your general environment imagining you are them and doing the above activity; i.e., If you were a spider would you be able to use a toilet designed for a human?

Pay attention to your senses.
Watch Pauline Oliveros talk about “The difference between hearing and listening” youtu.be/_QHfOuRrJB8 (11 min)

Group Discussion on Bias in Design
Discuss the following examples, which may or may not be “real”. You might want to do some research together to find out more: Seatbelts and crash test dummies were designed by males, based on male bodies. Kodak’s “Shirley Card” is a reference card that was used to check and balance the colours of photographs. It was of a white woman, which meant that “darker” tones were not paid much attention. What encouraged Kodak to pay more attention to darker tones was chocolate marketers who wanted better promo shots. A Chinese man in New Zealand couldn’t get his passport photo recognized in the online system because it said that his “eyes were closed” when actually they were open. You can find some more, we are sure.

Activity

Tinkerer’s Table

Key Competencies:
Relating to others,
Using language, symbols, and texts,
Asking questions,
Learning from and with others,
Kinesthetic learning

The tinkerer’s table is an unstructured activity using a rummage pile of random objects as an open invite for curiosity and participation. This pile can include anything, literally: rocks, packaging, fruit, broken tools and toys, leaves, keychains, spare computer parts, anything really. The more diverse the objects, the better. Combinations of familiar/uncommon and simple/complicated objects works well too. One way to conduct this tactile activity is to not give any instructions whatsoever to participants, and just encourage them to do whatever they want with the objects: touch, break things apart or put them together, anything is allowed. You can also encourage them to talk amongst themselves in an open-ended format. Once things warm up, conversations will get going.

Materials:
A bucket or more of “whatever” technology stuff you can find combined with other types of things, for example, broken parts of machines, remains of circuit boards, even stuff from a local “beach clean-up”, the rubbish bin in the “hard tech” room, the dumpster of a bicycle shop, stuff that your neighbour doesn’t need that has been sitting in their garage for ages.

Activity

Tinkerer's Table

Including some technology objects is a good way to introduce ACT in a soft and gentle way, by themselves and in contrast to other objects. Learners are free to ignore the technology but some will be drawn to it, sharing the space and conversation the objects draw out existing knowledge and share it amongst the table. The disorderly and messy appearance of the table creates a place that invites interaction. As the learners approach the table certain objects catch their eye and the hand follows, taking the object nearer for a closer look, an inner nod of recognition or closer examination whereby the learner begins to search for 'entry points' to the 'meaning' of the object. What does this do? Sometimes several objects are ordered by the learner to begin to resemble a 'thing' - the beginnings of making something which have not yet formed into a concrete idea but is a starting point for beginning a dialogue with materials.

Need Inspiration?
Watch Blair Somerville talk about tinkering: youtu.be/8NA6lX6OglY (5 min).
Or what about this "Tinkering Lab" at the Chicago Children's Museum? youtu.be/tFDFzB7m6Tg (5 min)
For a longer presentation and demos watch this from The Exploratorium: youtu.be/bfczjjXWnyk (28 min).
You might want to show this video during the activity Fresh Guacamole by PES youtu.be/dNJdJlwCF_Y (2 minutes) to get across the idea that you can make anything out of anything.
Ways of looking at discarded electronics as: The Dark Heart of Katamari Damacy youtu.be/mBaJsSuGeRs (9 minutes)
Japanese designer Oki Sato on his playful approach to design: youtu.be/c3TPbj2_Xjg (8 minutes)

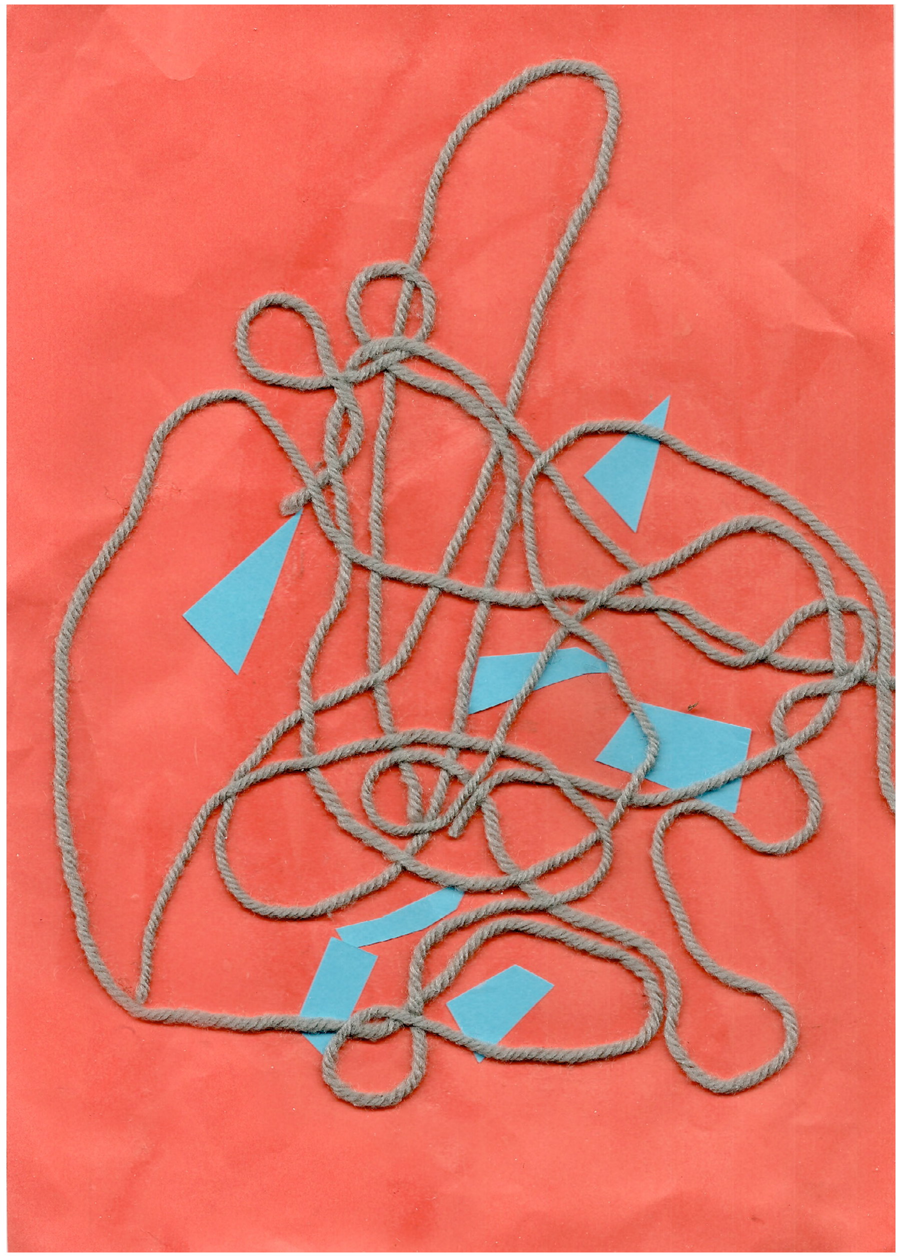
Activity

Tethered Walk (group organism/network)

Key Competencies:
Thinking,
Participating and collaborating

Materials:
Long strips of elastic-y material such as old bicycle innertubes (from the bicycle shop), stretchy fabric from old exercise (or other) clothes, broken rubber bands tied together, etc.

All participants use old bicycle innertube (or other stretchy material) cut into long, thin, strips to tie themselves together (hands, feet, tummies, whatever), with each person being connected to more than two others in a network-like system. They then roam around the school or neighbourhood. They may have a specific goal/destination which is set beforehand, or they may come up with their own goal/destinations as they roam.



Activity

Tethered Walk (group organism/network)

Extension Activities/Open-Ended Questions

If the group encounters another moving thing (e.g., plant, animal, mineral or fungi) (e.g., stray cat/dog going for a walk, plastic bag blowing around in the wind, branches of a tree) they can connect it to the network and follow its movements. Example 01: If you encounter someone walking their dog you could ask them whether they could connect their dog to the group. Now the dog leads the group around. Example 02: You encounter a plastic bag blowing in the wind, attach it to the network and the plastic bag now leads the group

Options: Allowed to communicate by speaking; Be prohibited from speaking but can use body language; Cannot communicate by speech or body language and just have to self-organise through movement.

Questions: What special intelligence does this group organism hold? How many languages can it speak? What sounds can it make? Does it know any songs or dances? Can it say words or sentences all at once? Explore curiosity and find out what the organism is capable of!

Further Resources

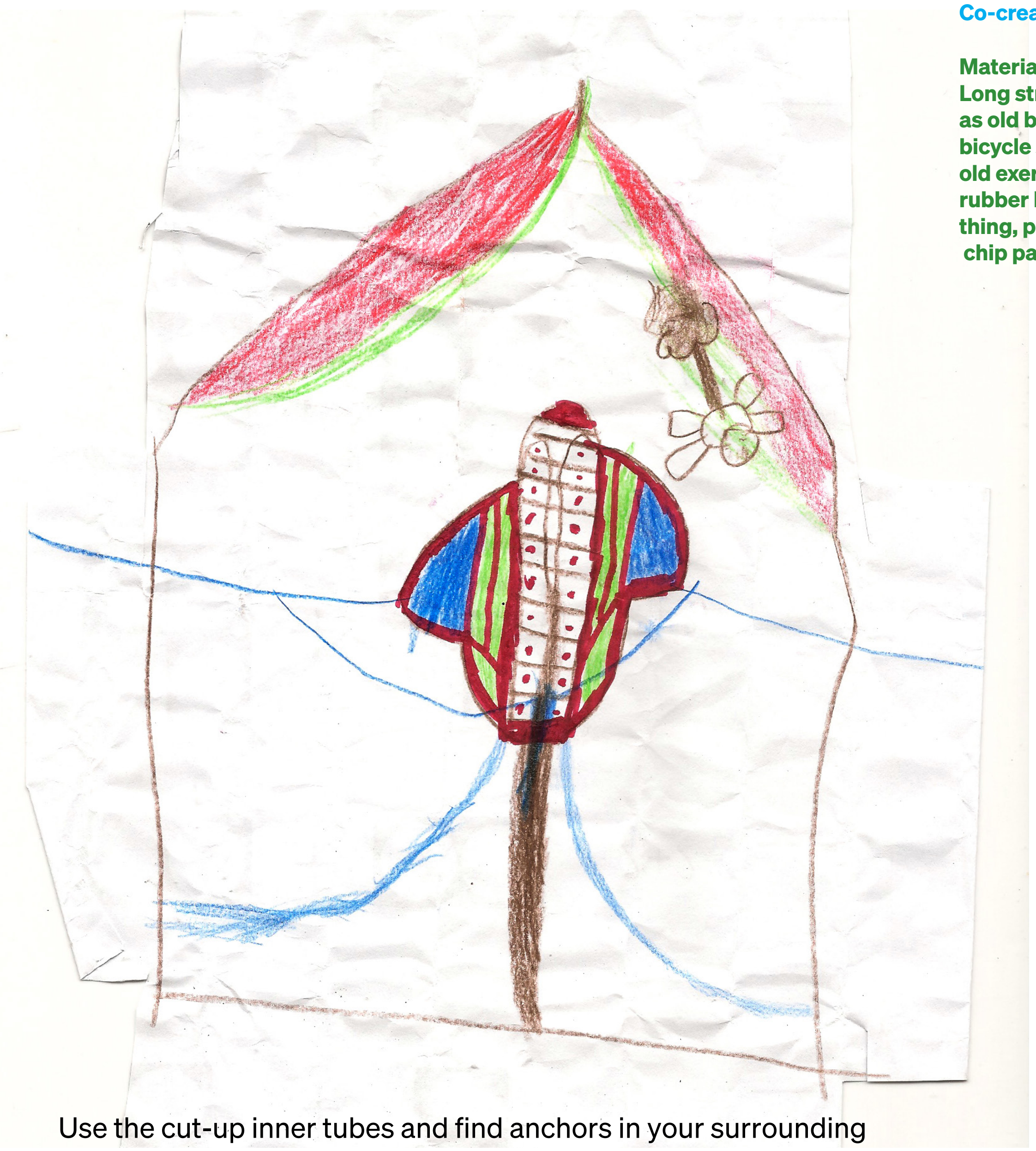
To help the exercise you may want to show this video of Self - Organising Drones youtu.be/Gcm--2u_XIY (18 Seconds) which in many ways mimics the movements of flocks of birds or schools of fish. You could also show this video of traffic in Vietnam youtu.be/1ZupwFOhjl4 to show your learners one way that complex decisions can be made by groups of individuals to move collectively.

Activity

Rubber Web/Soft Architecture

Key Competencies:
Thinking, Collaborating and Co-creating, Improvising

Materials:
Long strips of elastic-y material such as old bicycle innertubes (from the bicycle shop), stretchy fabric from old exercise (or other) clothes, broken rubber bands tied together, etc, anything, piece of wood, branch, chip packet.



Use the cut-up inner tubes and find anchors in your surrounding space to create a dynamic, changing architecture. Examples of anchors: table legs, human body, door handles, bottles of water. Experiment with different heights and movement dynamics, and sound-making potentials and attaching different objects to the web.

Depending on your learners you may want to start with this beautiful song about spiders / Pungawerewere by William Poutu youtu.be/9jLOG087-Tg (1 min)

Activity

“Fail” Choreography

Key Competencies:
Relating to others, using language, symbols, recreating. Making mistakes and recognising the potential of those ‘errors’ for making something ‘un-planned’, surprising or unexpected.

Materials: Your bodies.

When someone trips over, gets stuck when taking off their hoodie, misses an easy basketball shot, bumps into a chair, stumbles over a word, or any other common “fail” in everyday life don’t laugh or say, “good try, you’ll get it next time”, instead, turn it into choreography - a fun and/or beautiful dance/performance made from mistakes. The intention is to turn something ‘bad’ into something fun, enjoyable, interesting, new, or intriguing.

Some basic choreographic techniques that you can use include en.wikipedia.org/wiki/Choreography#Dance_choreography_techniques:

- Mirroring - facing each other and doing the same
- Retrograde - performing a sequence of moves in reverse order
- Canon - people performing the same move one after the other
- Levels - people higher and lower in a dance
- Shadowing - standing one behind the other and performing the same moves
- Unison - two or more people doing a range of moves at the same time

These movements can be characterised by dynamics: fast, slow, hard, soft, long, short, intermittent, aggressive, calm, etc.

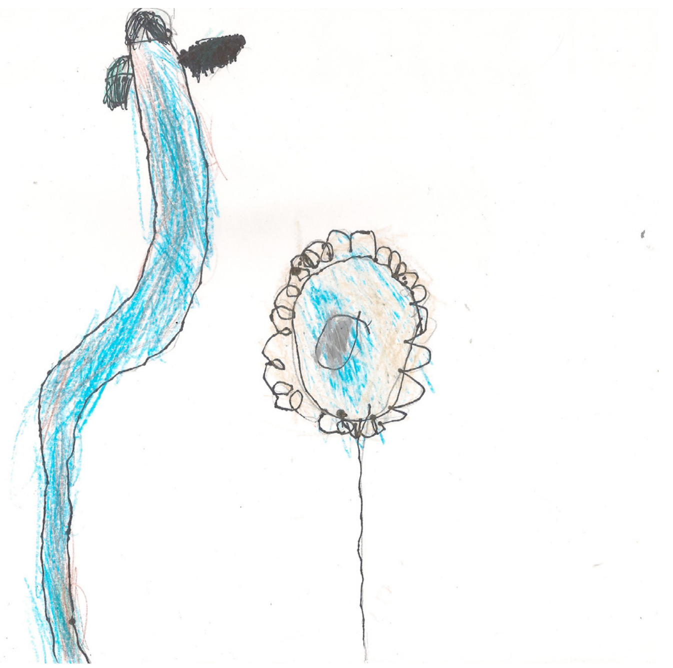
Try and imitate or recreate different ways of failing. For inspiration watch “How different ages slip” by Daniel LaBelle youtu.be/3YlofWNW8eY (1 Minute)

Activity

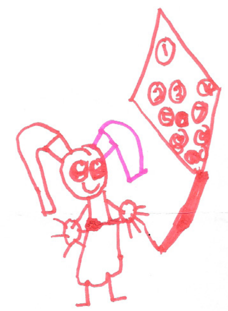
Draw and Describe

Key Competencies:
Using language, symbols, and texts.

Materials:
Scrap paper/cardboard and some writing implements.



Invite the learners to sit in a circle. Count how many people are in the circle and cut up enough pieces of paper (around half or one-fourth A4 size) so that each person has a little stack of pages equivalent to the total number of people sitting in the circle (e.g., 10 people in the circle = each person has 10 sheets of paper in front of them). Have every second person in the circle take the top piece of paper and write a description of something (anything) on it (e.g., a small house on the hill with the sun rising, my dad is leaving to work on a e-bike and my mother is cleaning leaves out of the gutters). Everyone else draw a picture on their top piece of paper.



After a minute or two everyone passes their description or drawing to the right. Now everyone takes a look at the drawing or description in front of them, if they have received a drawing, they translate it into description. If they have a description, they have to take that description and draw it. After some time they take the description or drawing that was received and put it at the BOTTOM of the pile of papers, and leave the latest description or drawing at the top.

Pass to the right and repeat - translating drawings into descriptions and descriptions into drawings. Pass to the right leaving ONLY the latest drawing or description at the top of the pile of paper. Continue all the way around the circle until everyone has their original pile of papers in front of them. Have each person spread out the whole story in order (description, drawing, description, drawing, description, drawing, description, drawing etc) notice the way that the details get (mis)translated with each iteration.

Activity

Draw and Describe

Extension Activities/Open-Ended Questions

How can you communicate to others without words? How long can you stay silent for? Can you share your silence with others?

Create a communal silence with others around you. How does that feel and sound?

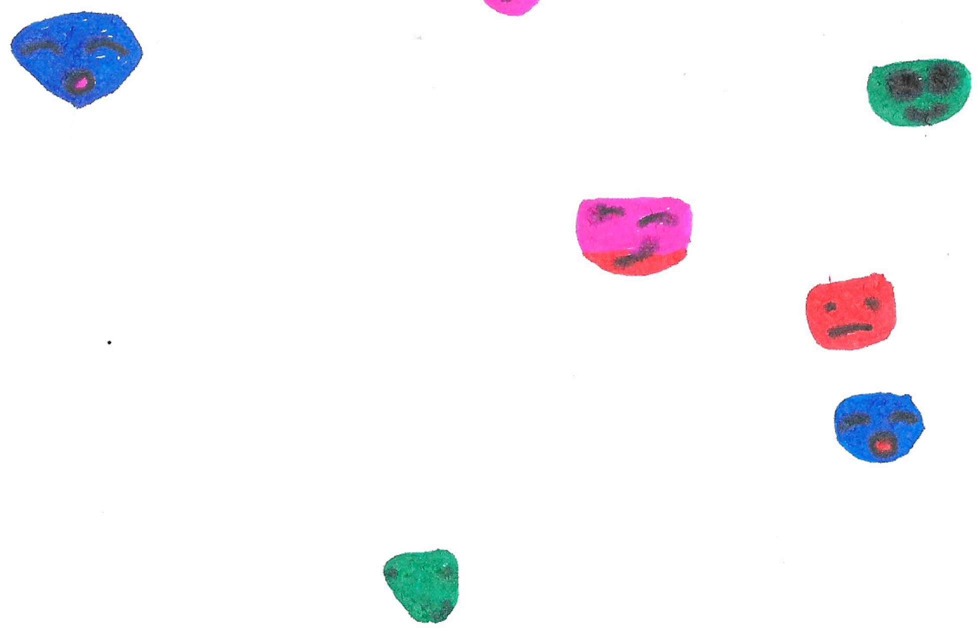
Try to accumulate some silence in you. Then, go and share the silence with others. What did you learn from this process?

Compare each other's silence in silent ways. What did you learn? How does that sound to you?

Activity

I am Becoming a Search Engine!

Key Competencies:
Relating to others, Managing self, Associative and critical thinking, Abstraction



The learners decide on a word/phrase and then gather keywords about it by asking a wide variety of people, including classmates, friends, the principal, groundskeeper, local shop owners, dogs, etc. e.g. "what word comes to mind when I say 'rice cracker' - round, white, crunchy, etc." They keep a record of all the words (on paper or simply committed to memory). They are now a specialised search engine for "rice cracker"! During the day, learners can experiment with yelling out "rice cracker" whenever someone says one of the words in their "database".

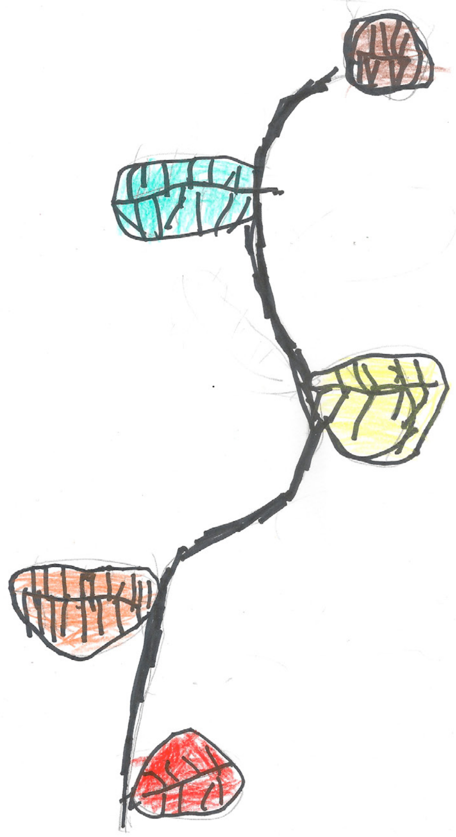
Decide on one person to be the search engine. Decide on a word/phrase and keep it secret from the search engine. Each participant comes up with one keyword. Participants say/pass on paper the keyword, one at a time, with the search engine providing a result after each word. e.g. keyword "round" - response "ball" - no!; keywords "round, white" - response "moon" etc... until the search engine returns what you are searching for. This process trains the search engine to return results with the keywords provided.

The learners can do the above with paper, vocally, and other ways that they are encouraged to invent.

Materials:
Scrap paper/cardboard and some writing implements, if you think they are required. You can do this activity without them.

Activity

I am Becoming a Search Engine!



Extension Activities/Open-Ended Questions

Treat everyone / anyone around you as a search engine, choose a topic and learn as many things as you can about it by asking anyone around to tell you what they know about that thing. e.g. grasshopper, cat, pebble, nose, earlobe

Your learners may start to feel as if they are computers – if so, try this video to stimulate further activities Jannie and Lyndon Robot Vending Machine | Stories with Good Moral Values
youtu.be/3wnzrKdje_Y (6 minutes)

Activity

Make Your Own Activity

The most fun and learn-able times can occur when we have diligently prepared materials and lesson plans for a session only to be stopped at the classroom door or beginning of one of the above activities (or any other plan) by a couple of curious learners who then rob us of our prepared materials and proceed to distribute it among the class before we have a chance to speak. Look for ways to plan for this unplanned and learner-led disruption.

In such times we open our hearts and minds to the universe and say “OK, what are you going to do with this stuff and why?”

Some ideas to help you:
Learners spend 30 minutes (or so) coming up with “a game”, “something interesting”, “something relaxing”, “a lesson” with the material they have. They spend time writing it down in some way (diagram, text, whatever). They share with each other. They try out each others’ activities.
Limit material choice. For example, only use bicycle innertube... or only corks, etc.
It is great that they have so many ideas, but also focus on how they can communicate their excitement to others.
After the first round, try “mashing up” the activities by pairing up individuals/groups and getting them to make a new activity based on both ideas.
Take it easy.
If the dynamic of the classroom feels like it may not be conducive to the openness and unpredictability of this approach to Advanced Computational Thinking, consider how this very activity can be introduced to support the learning community in recognising the barriers and boundaries that are in place.

This is the method of “Make Your Own Activity”

Connecting the Activities with Advanced Computational Thinking

The above activities were developed with the aim of providing intuitive ways to introduce and experience the sometimes complex concepts of Advanced Computational Thinking. The idea is that learners take part in fun activities which illustrate principles of computational thinking without using a computer. By experiencing these concepts first, learners will be much more receptive to building or identifying the connections to ACT. Better yet, everyone is also more likely to generate their own connections between what the activities felt like and what the ACT concepts feel like.

Here you can find activities listed in alphabetical order, with the connections to ACT concepts. The connections include observations, questions, and resources that provide extensions for the learners. These connections can be integrated and developed into modified versions of the activities, group conversations, or inquiry-led projects for a range of age groups and learning levels. The resources listed below can also be used for further research.

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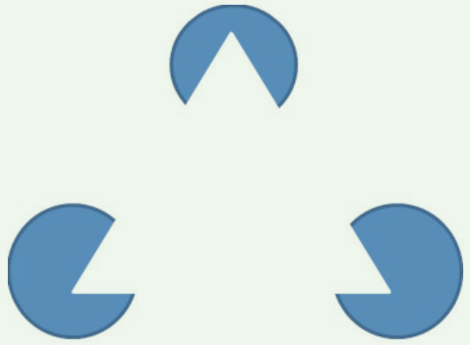
ACT concepts in Draw and Describe

In this activity learners are engaging with concepts of information, translation, learning, and communication. Here are some initial ideas and questions to spark conversation and further research:

- What is “information”? How is information different from knowledge? Who “owns” information? How does human thinking translate to computer thinking (and back)? What can be lost/gained in that process of translation or re-coding between human and machine? What happens with polysemic concepts (“Time flies like an arrow; fruit flies like a banana”)? Check out: “When Korean kid-bot meet American kid-bot for the first time” Hyunho & Carson EP1 youtu.be/r1gp8Qx5YPQ (4 min)
- What is thinking? Is the human brain an “information processing unit”? Yes? No? Why? What else is going on in your brain that may not be amenable/reducible to computer coding (yet or ever)? What about learning? Do machines learn like humans? “Why learning like humans is so difficult for machines” by Marcus Du Sautoy: youtu.be/7PV0HLdjACE (4 min)
- What role do precision and intuition play in information processing? A way to program the equivalent of “machine intuition” are Generative Adversarial Networks (GANs): youtu.be/kSLJriaOumA (6 min). GANs “learn” from training stimuli and work by identifying traits, but they do not build an explicit model (knowledge), hence they are called “unsupervised” learning. A different approach is “supervised” learning: when computers are fed the rules and seeded basic knowledge to grow. How do you conduct unsupervised and supervised learning yourself?
- Text and images are two different “languages” to represent and communicate information. In this activity people translated between drawings and words. What are the qualities of these languages and how may they affect how people think? Reflect on the differences between translating a written idea into a drawing, and vice-versa. What are the (real) possibilities of AI to translate text into images? Watch “The AI that creates any picture you want” by Vox: youtu.be/SVcsDDABEkM What differences did you notice in this activity between interpreting text and interpreting drawings?

• Text and images: which one is more precise, which one allows for more ambiguity and interpretations? When in life do we need accurate and very precise information? And when do we need information that is ambiguous and open to interpretation? How do computers handle information? How may the use of computers augment or limit the information we use in everyday life?

Look at this image made of a few lines and sliced circles:



What is going on here? Humans have no problems “seeing” here not only one but two triangles! But… the triangles are not explicit, we “complete” them which is a good example of how seeing is not a passive but a creative activity. Computers struggle with this type of information: if it is not explicitly declared or if it is not a pattern very similar to what they were trained to recognise, then computers are unable to process information that is very easy for humans to intuitively understand.

• Feeling more adventurous? How about coding a drawing robot? We like this one in particular: “Drunken Drawing Robot!” by skullbee because it’s relatively easy to make (no coding required!): instructables.com/Drunken-drawing-robot-. This is a bit more sophisticated: “Tinkering With LEGO: Art Machines” by tinkering-studio: instructables.com/Tinkering-With-LEGO-Art-Machines. Also, you can play “Finish the Drawing” by letting the robot draw a few squiggles and then using your imagination to complete the drawing.

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ACT concepts in Experiential Everyday Activities to Discover Hidden Biases

This activity brings to life ideas around “problem solving”, identifying needs, empathy, and techno-determinism. This is a useful activity to stimulate conversations about access to Computational Thinking and the cultural biases which exist around computers in general. Are certain groups excluded from learning computer sciences? Why is that? What are the obstacles which learners might face in their desire to know Computational Thinking and what can be done to ensure that everybody has equal opportunities to follow a career in computing? Is there a reason why computers are seen by some as more suited to a “particular type of person”?

• Algorithmic bias. How can human bias (racism, sexism, ableism) become encoded into computational systems? Programs are written by humans (usually male and young) and are trained on existing datasets. Therefore, programs can take on some of the traits and precedents to strengthen the status quo. For example, if companies have usually hired men, automation solutions to recruit new talent could be biased towards hiring more men than women. Watch this: “Algorithmic Bias and Fairness” youtu.be/gV0_raKR2UQ (11 min)

• Cultural and gender biases. Many artefacts have a visible cultural or gender bias - a mark which indicates the world view of the people who made the object. People are very diverse: we see this in all the various cultures of the world. Sometimes we forget that we are looking at these cultures through the ‘lens’ of our own culture. Things may seem ‘natural’ to us because they are familiar, but if you spend a few hours or days in a foreign culture, you start to realise how different the world looks to each society. Watch this talk by Caroline Criado Perez: “Why car design is killing women” youtu.be/7LQfu05i-80 (5 min)

• Many well-intended people imagine solutions to assist people who they perceive as lacking abilities or skills. By experiencing the world with a difficulty such as your hand tied, you can pay close attention to what is called a “deficit view” by reflecting on how “disabilities” are not problems that individual people have but problems that the world around them creates for them by limiting their lives. In other words, society causes disabilities, not individuals with different types and degrees of abilities. Can you decode products and artefacts around you? Who were they designed for and how are these characteristics of these products excluding other people? Empathy is often exaggerated: can we really understand how other people feel? What may be the limits to "wearing someone else's shoes" when we haven't had similar experiences ourselves? "Empathy and its Limits - Moralities of Everyday Life" youtu.be/hff3rqCAAF0

- Not every problem is amenable to technological solutions. This sounds like a simple enough and logical idea, and yet we see more and more people proposing technocratic solutions to complex social problems. They will use phrases like "We want to fix poverty" (or climate change, crime, etc.). A technocratic mindset believes that "if only we through enough technology" at a problem, it will be solved. This mindset leads well-intended people to create an app to solve recycling or to improve nutritious diets. We are not suggesting that technology can't help, of course it can. But, it's never enough. Look at problems around you and ask yourself (and others): How has technology addressed this problem? How may technology actually created or made worse this problem? What else would need to change in order to tackle this problem, other than a technological "fix"?

Further reading:
Invisible Women: Data Bias in a World Designed for Men
penguin.co.nz/books/invisible-women-9781784706289
Coded bias: codedbias.com/about
Combating unconscious bias in design: uxdesign.cc/combatting-unconscious-bias-in-design-bff4dfb013c3

Article on Deep Listening and Pauline Oliveros whitefungus.com/pauline-oliveros-freedom-through-music

Feeling ready to train your own AI? Give "Teachable Machine" a try teachablemachine.withgoogle.com where you can create a machine learning model without coding simply by training the program with a set of images or sounds. Try and embed some bias in your model (for example showing it only photographs of red apples and then seeing how it fails to recognise yellow apples) and then try to create a model that anticipates common biases (for example even today Google Images still shows mostly men when you search for "doctor").

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ACT concepts in "Fail" Choreography

In this activity participants improve their observation skills as they aim to replicate or emulate a behaviour. This connects to notions of glitches and errors, advantages and limits of precision, embodied thinking, and understanding.

- Glitches and errors can lead to new ideas. Have a look at "glitch art", or making art from (digital) errors: youtu.be/VjCn7Xc-5DQ (5 min)
- Computers are "precision machines": they are designed to give correct answers, to correctly store and process information, to solve problems, to find the correct information. And most of the time they do. But consider two possible scenarios:
  - Sometimes computers fail. Data are corrupted, programs have bugs, hard drives are scratched, screens break, electronics are fried. How do humans deal with computer failures? How could we anticipate and prevent failures? Watch "Types of Computer Failures" by Tim Hall: youtu.be/P5OhxdwVf2c (2 min)
  - Sometimes we *need* failure. A perfect world where everything works as programmed would be a boring and sad world. Many human inventions, art, and ideas in general stem from mistakes and flaws. Mistakes lead to learning. How could we cultivate and celebrate failures? How could we value errors? Watch this summary of "Aldous Huxley's Brave New World" youtu.be/raqVySPrDUE (10 min, adult guidance recommended)
- The philosophy that divides mind vs. body is called "dualism". Computers can lead some people to see the human brain as the hardware and the mind as the software. What may be the limitations of such thinking? How may it be possible to "think with our bodies"? How could our "minds" consist of our whole bodies, and even include our family, friends, and the environment around us? Watch this introduction to "Embodied Cognition": youtu.be/NDw_1UyNTKI (8 min)
- Humans can, through repetition, improve the way they understand something. In order to emulate or mimic a behaviour in this activity, we are led to looking at it closely and breaking it down to its more characteristic features. Can computers truly understand? Read "The Shallowness of Google Translate" by Douglas Hofstadter: theatlantic.com/technology/archive/2018/01/the-shallowness-of-google-translate/551570
- How about a collaborative artwork between you and a computer? Here is an example using some simple coding (includes code): instructables.com/Computer-Generated-Yarn-Art by GriffinC7. Feel free to adapt and change this activity.

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ACT concepts in Mending the School

This is an activity where participants get to apply concepts like debugging, function and use, repair, customisation.

- Debugging is a key activity in software development that can take up to two thirds of the total time spent in programming. ACT requires that learners adapt a mindset where they expect that coding may not work the first time, or it may work in unexpected ways. This requires a curious mindset to focus on the process, check our assumptions and expectations, and learn to deal with imperfection. In a world of social media, 'perfect' looking selfies and lifestyles, learning to accept mistakes and be resilient is a survival skill. As a spider once said to the future King of Scotland (Robert the Bruce) "Try, try again" - don't give up and don't expect it to work the first time.
- When things break down or malfunction, people pay attention. This can helps us pause and sharpen our curiosity to learn how things (are supposed to) work. Functional Analysis is how computer engineers study how machines (real and digital) work, and it can help to generate and evaluate ideas of how else they could work. A similar approach can be used to learn how people use stuff around them in their everyday lives, especially when people adapt and creatively repurpose or misuse things that were designed with a different intent. Look for instances all around you of things that have broken down and ask yourself and others whether people should repair or restore them, or perhaps they could repurpose, reinvent it?
- Parametrisation is a mouthful but it simply means that instead of some designers deciding for everyone how their everyday things (bicycles, software, etc) should look and work, they provide users with "parameters" that enable them to customise and personalise things by themselves. Perhaps someone wants their bicycle with a yellow frame and 14 speeds, and someone else wants theirs with a red frame and 7 speeds. Better yet, software can allow people to create their own worlds, as in games like Minecraft or Roblox where you can define and build what you like using the range of options available. What may designing parametric solutions be a more difficult task than designing fixed solutions? What problems may be caused by giving people too many options to choose?

- Tweaking or modding are very common activities in computer programming. Ask a professional programmer and chances are that they have never or very rarely started a project "from scratch". Instead, the most common starting point is code that already exists. This includes several ideas such as "versioning": with code being easy to modify or extend and then re-compile again, programmers know that every solution is always improvable. What version of you are you today? How may your future-self become a better version of your present-self? What part of your code will need "upgrading" as you grow? Has the code for your country or the world really "improved" over the last centuries and millenia, or is "progress" a myth?

Further Resources:

- youtu.be/fsF7enQY8uI. (Short video of robot with pen) Are you a robot? Can you prove you're not? Ask learners to try to convince others that they are not a robot, but in fact, a real human being.
- Find an AI chatbot online and ask it to help come up with suggestions for how to fix any of the things that you found were "broken" e.g., chai.ml -try a conversation with the chatbot app.
- Feeling more intrepid? Try this random project ideas generator: artideasgenerator.com/project.php.Better yet, create a simple random idea generator yourself using your own list of options, here's a tutorial using Excel: exceltip.com/excel-text-formulas/how-to-generate-random-text-values-in-excel.html (no coding needed)
- This hands-on project by The Unknown Chef teaches you how to "Upcycle a Hard Drive Into a Clock" and while you are at it, pay attention to how a hard drive (disk) looks like inside its casing: instructables.com/Upcycle-a-Hard-Drive-Into-a-Clock What else can you turn into a clock? A lamp? A decorative art piece?

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ACT concepts in Rubber Web/Soft Architecture

This activity explores ACT concepts of networks, improvisation, protocols, and emergence.

- Systems and networks allow computers to connect to other computers and share information or resources to extend their capacities. A network is formed by anchor points and links: in this activity the links where the elastic or string materials and the anchors could be table or chair legs, door handles, etc. A computer or a smartphone lose so much of their usefulness when there is 'no network', just an individual isolated device.
- How do computers and smartphones connect with each other? They use "protocols" or agreed-upon standards that they can issue and receive to communicate. What sort of "protocols" did participants develop and used during this activity? Perhaps part of these protocols were imposed by how the links were possible to attach to the nodes. Perhaps people initiated an action of tying up a link and someone else decided where to connect it at the other end. How did people decide? How was the construction of the network directed by personal vs group intentions? Did the group come up with some rules or ways to negotiate and decide what to build or how to play? Watch this intro to Network Protocols by "Eye on Tech": youtu.be/znljk-7ZuqI (2 min)
- Coordination can be "messy" but it can also lead to surprising outcomes beyond what any single person could have imagined, planned, or done alone. When things are created by many different small actions and their interactions, we call them "emergent results". Improvisation can lead to emergence, for example in how Jazz musicians interact with each other based upon some initial pattern. This is different than an orchestra where a conductor coordinates everyone. "Peer-to-Peer" or P2P networks use this same principle to create more decentralised and resilient communications that do not need a central coordinator (server). Did people notice instances of emergent behaviour in this activity? Watch youtu.be/s-Fs_Ucy_EU (3 min). This other video can also be useful to ask learners how they thought it could be made using a set of rules or algorithms for each element of the animation "Pipe Dream" youtu.be/hyClpKAIFyo (3 minutes)
- The creator of this robot-lamp, Riachi, says that it has a "soul": instructables.com/OiO-a-desk-lamp-that-has-a-soul You can embark on building this or simply watch the video and discuss with your friends whether you agree that OiO has a soul, and how might you create other objects that have or don't have a soul.

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ACT concepts in Tethered Walk

Tethered Walk introduces people to ACT concepts of networking, self-organisation, and decentralised control.

- This activity demonstrates the power of networks. Each node in the web is connected to the others and movement of one node may affect other nodes of the network. Connecting everyday objects to the web, is also known as the Internet-of-Things (IoT). In IoT architectures, everyday objects like furniture, lamps, and cars become "smart" meaning they are equipped with sensors (cameras, temperature, sound) and they can communicate with each other to activate or change the way they work. A classic example of home automation is curtains that close and open depending on how bright is outside, or your fridge sending a request to purchase milk or other food when you are running low. But, what could go wrong if we automate everyday activities like these? What does "smart" mean and how may smart IoT homes and cities cause more problems than they solve? Watch this scene of Wall-e to spark conversation: youtu.be/s-kdRdzxdZQ (3 min)
- Computers become more powerful and useful by connecting to other computers or resources, such as databases. In this way many specialised nodes in the network can work together and learn from each other. This power is also available for humans: we can think and act through a network, rather than doing everything individually. For example, we may see the world through specific collections of information, beliefs, affiliations, friends and ancestors. Networks support our ideas and thoughts and are equally important in computing where combined processing power can produce far more complex results. The Rubber Web activity demonstrates to learners the interconnections of actions, thoughts, and ideas. Watch Marc Samet introduce networks: youtu.be/eM1KaaTez0A (3 min)
- Swarm intelligence refers to the collective intelligence displayed by groups, think of an ant colony and how it can be a marvel of engineering and logistics, despite each individual ant having very simple capacities. Or termites, bees, and human societies. These groups often combine centralised with decentralised control strategies. Centralised control means that a single individual or an elite tell others what to do, and decentralised control means that every individual decides what to do based just on local information and local interactions with other individuals.

Ant foraging is an example of decentralised work: each scout ant moves around and when they find a food source they release a pheromone that other ants detect and this is how they form lines from and to the nest supplying it with food. Gorillas organise differently: they live in social groups that are highly centralised where a leader calls the shots.

- Self-organisation can show highly synchronised and complex behaviour by aggregating a few and very simple rules for each individual. Birds and fish do this to navigate long distances and for protection from predators. There is no "boss" bird or fish in the group: each individual just follows three simple rules: align your direction of movement with those around you, stay close to them, and keep some distance to avoid crashing. This is a strategy used in computer systems too: instead of programming where every 3D model should be in an animated movie scene, start by placing them at random and let them figure out how to form a swarm that looks realistic. Watch some examples:
- Drones that sync and swarm youtu.be/Db6aiSa4soU (3 minutes)
- Biggest drone display ever! - Guinness World Records youtu.be/44KvHwRHb3A (2 minutes)
- A Minimalistic 3D Self-Organized UAV Flocking Approach for Desert Exploration youtu.be/o8bphtbPCaA (4 minutes)
- Flocking simulations jumpoffboids.netlify.app
- Boids is an artificial life program, developed by Craig Reynolds in 1986, which simulates the flocking behaviour of birds: red3d.com/cwr/boids
- There are several mailbox alert systems but here is a simple one by Stannickel that only requires a few parts: instructables.com/Mailbox-Signal-System.

If you feel more adventurous, you can try one of the several Arduino-based mailbox notifiers or other "smart" DIY solutions.

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ACT concepts in Tinkerer's Table

Tinkerer's Table include playful making and hands-on inquiry, functional analysis, object-oriented design, components and assemblies, and "upcycling".

- This activity can be seen as generating an "object oriented" dialogue. In computing, object-oriented programming (OOP) refers to "chunks" of computer code and data (objects) that can be re-used in different parts of a program. This is achieved by initially defining the object in abstract terms and then instantiating it multiple times more concretely. For example, if a program will draw chairs, tables, and lamps, then code can be defined to draw "furniture", so that it is way easier to draw any piece of furniture by simply adding the details of a chair or a table. In this activity, people often imagine ways of sorting or categorising objects, even finding new connections and "is-a-type-of" relationships. Watch this 7 min introduction: youtu.be/xoL6WvCARJY
- Components form assemblies. Humans are good at decomposing the world around us: the ancient Greeks thought of an "atom" as the smallest unit of matter and these days we continue to inspect subatomic particles in search of "the essence" of life and things. This quest for components has been very useful to understand the world (science) and to create solutions (technology) all around us. Alas, reductionism has an ugly underbelly: people can assume that "the essence" of something must reside somewhere in its components. What happens when you disassemble an artefact? Where is the "essence" of an umbrella? Of a car? Of a pair of scissors? Alternatively, how may organisation help us understand things rather than only focusing on their components? Watch Knolling, Organization, Backwards Planning, and Executive Functioning: youtu.be/XzbKkg59ENw (3 min)

- Upcycling is like recycling but way cooler. In recycling, a lot of energy is used to reprocess materials so they can be used again, and sometimes these can degrade. But in upcycling things are transformed to make even better new things. Watch this entertaining video on "Clever Ways to Upcycle Everything Around You" youtu.be/fGqfWvm4TnQ (13 min). When it comes to coding, it is advisable to copy, recycle, and upcycle code as long as you use this approach to keep learning. Watch "I Feel Like I'm Just Copying Code" youtu.be/5F45DWsLceg (3 min)

Further resources you can use for reflecting on the activity

- Introduction to Modular Design youtu.be/20JP8w6_nVA (2 minutes)
- Modular Design youtu.be/DuK4dKH0zOA (9 minutes)
- Examined Life: Philosophy is in the Streets youtu.be/j_K_79O21hk (10 minutes) Featuring: Cornel West, Avital Ronell, Peter Singer, Kwame Anthony Appiah, Martha Nussbaum, Michael Hardt, Slavoj Zizek, Judith Butler and Sunaura Taylor.
- Introduction To Structured Programming youtu.be/TmtyFcLWXwo (6 minutes)

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ACT concepts in Training your Teacher to Walk

Training your Teacher to Walk include decomposition and algorithmic thinking.

- Machines can do very "smart" things, but in some ways they are actually not that clever, they simply follow instructions we give them. And instructions must be very precise before you get good results. Therefore, we need to tell machines very complete and very precise instructions. And a significant challenge is that things that seem intuitive and simple to humans, can be very difficult for machines to do, like walking. Walking is actually very complex when you break it down into all of its steps. Turns out walking is more like "controlled falling forward" and each person has a unique way of walking too. The "Peanut Butter & Jelly Sandwich" activity can be a fun and useful way to learn problem decomposition: youtu.be/Hr4TG0zr-6c (5 min).
- Creating simple instructions for someone or something to follow, such as 'how to walk', is like designing an algorithm. This video introduces algorithms to small children: "What is an Algorithm" youtu.be/Da5TOXCwLSg (1 minute) and this one by David J. Malan is suitable for older children: youtu.be/6hfOvs8pY1k (5 min).
- All robot behaviour is based on algorithms. Watch this "Robot learns to open doors by splitting the task into three easy steps": youtu.be/URmDJP-LUVo (1 min). Other robots such as "Atlas" by Boston Dynamics can appear highly capable youtu.be/tF4DML7FIWk (1 min) but it's important to remember that such videos are highly choreographed and these well-planned demos take place under highly controlled conditions. These robots would struggle considerably and often fail if they had to operate in unpredictable environments and in interaction with humans. How do humans learn how to walk in mud, over grass, with different gaits, wearing any shoes, uphill, up and down slippery stairs and ramps, etc.? Part of the answer is "failure", toddlers fall all the time, until they perfect walking. Another part of the answer is proprioception, or the human sensory capacity to feel and control the body integrating information from muscles, tendons, and skin. Which, of course, will be hard if ever possible to build artificially. Watch this 1 min video: youtu.be/PMm7G0il5oc

- Virtual Creatures that were evolved by algorithms and learned to walk and swim by themselves: Karl Sims - Evolved Virtual Creatures, Evolution Simulation, 1994 youtu.be/JBgG_VSP7f8 (4 minutes)
- If you feel brave, you can build a robot like this one by Randofo: instructables.com/Simple-Bots-Hopscotch and then come up with games such as children mimicking how the robot moves. Also try mimicking or building this “Robotic Rat” by 14-year-old David Galindo: instructables.com/Robotic-Rat Can you tweak the code or the rat to change how it walks?

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ACT concepts in I am Becoming a Search Engine!

I am Becoming a Search Engine! include abstraction, memory, and categorisation

- Keywords can be defined by abstraction and by association. Abstraction could lead us from “rice cracker” to “food” because crackers are a-type-of food. Association could lead us from “rice cracker” to “cheese” because we may normally eat cheese with crackers. In the activity, people will identify more typical and more atypical keywords, and it will be up to each person becoming the “search engine” to decide what keywords are acceptable or not to refer to a concept. Is “price” a good keyword for “rice cracker” or is it too general? And what about “disgusting”? In some ways, the person who makes these decisions has a type of power over others who conduct the search process. After all, he or she decides how words and ideas are connected and made accessible to people. This is what happens when we use real search engines: why do you think some results come up first? However, “relevance” is calculated, you can bet there are commercial and even political and ideological criteria at play.
- How do we create and use categories in everyday life? How are things organized in supermarkets, pharmacies, libraries, in our pantry and fridge? What is gained and what is lost by defining/using one way of organising things vs another?
- How do we define things? Let’s take an example: The dictionary defines a “die” as “a small cube of plastic, ivory, bone, or wood, marked on each side with one to six spots, usually used in pairs in games of chance or in gambling”. And yet, dice can also be made from other materials, they can have more than six sides, have icons rather than numbers, and be spheric rather than cubic.
- For humans it can be easy to “stretch” and update our definitions of everyday things and ideas. But this is really hard for computers. This is because in order to achieve the precision and explicitness required to design algorithms, we need to settle on definitions and it becomes hard or even impossible to change at “run time” without the program breaking down.

- Have fun with this “Human-Powered Computer” by John Maeda: johnmaeda.medium.com/whats-a-human-powered-computer-14997285111
- An important “side effect” of becoming a search engine is that people will likely learn new facts, new information, and may think more deeply about their everyday. For example, people may or may not be aware that “rice crackers” originated in East Asia about twenty centuries ago, that in Japanese they are called “senbei”, that they can be baked or fried, and that the variety of rice crackers these days expands from baby food to otsumami or snacks usually enjoyed with alcoholic drinks.
- This “How to Make a Octohedron Platonic Solid Die” by Eye Poker shows you how to create an eight-sided die: instructables.com/How-to-make-a-Octohedron-Platonic-Solid-or-an-Eigh and you could tweak this one to create a digital die: “Micro:bit Memory Game” by maaikeEHB: instructables.com/Microbit-Memory-Game

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ACT concepts in Make your own Activity

Make your own Activity is open-ended and can connect to any ACT concept.

- Making your own activity has direct parallels to computer programming: you can extend, adapt, and hack other activities to create something new.
- Do make sure that your new activity has some links to ACT. These connections can be “retroactive” when you find them after creating the activity, or they can be “generative” when you start with an ACT concept and create an activity to bring it to life. Check some of the videos below as candidate ACT concepts to inspire you:
  * “Fauxtomation”: youtu.be/-CKPHpGuvJA (8 min) refers to “false automation”
  * “Is Everything in Crypto a Scam?” youtu.be/PB5OPthU75o (23 min)
  * Computational Thinking basics: youtu.be/SVVB5RQfYxk (3 min)
  * “The Turing test: Can a computer pass for a human?” youtu.be/3wLqsRLvV-c (4 min)
  * “How the Youtube Algorithm Works in 2022” blog.hootsuite.com/how-the-youtube-algorithm-works
  * “Jaron Lanier: Delete your social media accounts” youtu.be/iwQYvbKsyeY (19 min)
  * Tim Berners-Lee: “The next Web of open, linked data” youtu.be/OM6XIlCm_qo (16 min)
  * “AI and the Gartner Hype Cycle” youtu.be/XJ476O86hbU (5 min)
  * “The ethical dilemma of self-driving cars” by Patrick Lin is an excellent discussion on the ethics of AI youtu.be/ixIoDYVfKA0 (4 min)
  * The Boltzmann brain paradox - Fabio Pacucci youtu.be/OpohbXB_JZU (6 min)
  * What is Cloud Computing? youtu.be/mxT233EdY5c (3 min)
  * Inside a Google data center youtu.be/XZmGGAbHqa0 (5 min)
  * What is the world wide web? - Twila Camp youtu.be/J8hzJxb0rpc (4 min)
  * Facebook A.I. Robots shut down after creating their own language youtu.be/QaoDXYYtgK0 (3 min)
- Gather inspiration from these Instructables:
  * “Carrot Piano” by jimbob1996: instructables.com/Carrot-Piano-A-MaKey-MaKey-Project
  * “Guitar Hero: Guitar W/ Strings” by elliott-hoving instructables.com/Guitar-Hero-Guitar-w-Strings-MaKey-MaKey
  * “Crack the Code Game, Arduino Based Puzzle Box” by thediylife: instructables.com/Crack-the-Code-Game-Arduino-Based-Puzzle-Box
  * “Enraging Mico Zen Garden” by ChristophF1: instructables.com/Enraging-Mico-Zen-Garden-With-Arduino

Bonus! Storytime!

Are Mountains Computers?

Are Mountains Computers?
Have you ever looked at mountains and wondered what they were like if you were on the inside? What if you could go inside a mountain and see all the electrical wires, all the circuitry, all the chips and electronic devices that are deep inside of it? Would you be able to tell that it was a machine or would it just look like an old mountain?

How do they look like in person?
In person, mountains look even more impressive and beautiful than they do in pictures. They are often much larger than they seem in photos, and their rocky surfaces are textured and interesting to explore. Hiking through a mountain range is an unforgettable experience, and one that everyone should try at least once.

How are they similar to computers?
Mountains and computers have a lot in common. Both are large, complex systems that require a lot of energy to function. They also have a lot of moving parts that must work together in order for the system to function properly.

Like computers, mountains are also constantly changing and evolving. The weather, the amount of daylight, and the seasons all affect how a mountain looks and functions. Just as there are different types of computer systems, there are also different types of mountains. Some are tall and pointy, while others are short and round.

Just as computers can be used for good or bad, mountains can also be a source of beauty or destruction. A mountain can be a place of refuge during a storm, or it can be the cause of one. It all depends on how it is being used.

How can thinking happen outside of the head or even outside of the body?

One of the things that computers do is process information. They take data in, compare it to other data, and then make a decision based on that. In a way, you could say that mountains are like giant computers. They take in all kinds of data from the environment around them – things like temperature, moisture, wind speed, and so on. And then they use that data to make decisions about things like where to grow new trees or how to hold onto the soil.

But mountains aren't just big computers; they're also huge storehouses of information. Every year, mountainsides erode a little bit and all of that erosion material ends up at the bottom of the mountain. Over time, this can form huge layers of sedimentary rock – and within those layers are often found fossils of plants and animals that lived long ago. So in a sense, you could say that mountains are like giant libraries, full of information about the Earth's history.

And finally, mountains are also places where people can go to find peace and quiet. In our fast-paced, modern world, it can be hard to find time to just sit and think. But when you're surrounded

What are some weird things that happen on a mountain that might be similar to what happens inside a computer?

We all know that computers are complex machines, but did you know that mountains are pretty similar? Just like a computer, a mountain can experience a variety of strange and wonderful things. Here are just a few:

1. A mountain can have an "avalanche" of rocks and debris. This is similar to how a computer can have a sudden surge of activity that causes it to freeze up.

2. A mountain can be struck by lightning. This is similar to how a computer can be hit by a power surge.

3. A mountain can erupt, sending lava and ash into the air. This is similar to how a computer can "melt down" if it overheats.

4. A mountain can slowly erode over time. This is similar to how a computer can gradually slow down as it accumulates dust and other debris.

Weird things happen on mountains all the time. For example, rocks fall and avalanches happen. These things are similar to what happens inside a computer. In a computer, data is constantly being read and written. This data is stored in memory chips. When these chips are full, they need to be cleared so that new data can be written to them. This is similar to how rocks fall off a mountain and make room for new rocks to grow.

ACT cards

If you are feeling stuck for ideas or how the activities relate to the computational thinking concepts you can print off and cut these cards out or make your own.

Take these cards out for a walk, seeing how you can apply what is written on the card to the things around you, to the activities in the pamphlet or to the ACT concepts. Use these to "randomise" your thinking and to make connections between different ideas, the more varied the better.

e.g.
You come across a meadow and you are holding the "Big Data" card. How are these two things related?
You are holding the "Is this a computer?" card and come across a snail.
You are in a bus, the Sky Tower, or a farm shed and find yourself holding the "What is a human body?" card.
You are swimming in the ocean and remember the "Is this a keyboard" card.
You are at your school assembly and draw the "Is my principal a chatbot" card from your pocket.
Whenever someone tells/asks you to do something you reply with the "Why do you recommend it?" card.

and so on, FOREVER.

ACT cards

Decision making algorithms	Big data	Coded Bias	Are you the Internet?	What is the Internet?	'Why' and 'Why not'
Debugging	Generative Adversarial Networks	Glitch art	Non-Human Meditation	Is this a computer?	Butoh
Distributed systems (Being a computer)	Am I a computer?	Am I online?	Why is this broken?	Are you a human?	What is a human body? What is not?
'If' _____ then _____	Keywords	Is this a keyboard?	Is this broken?	Are you a robot?	Am I turning into a search engine?
Random access memory	Hard Drive	Self organising systems	Mending the School	Hard drive	Loops
Machine learning	Plan Well?	Chatbot	Webcam	Random access memory	Speakers
What is «wire»	Who are you?	I am a computer program?	Am I a robot?	Maybe my friend is a chatbot	Error
I think my principal may be a chatbot	What «self» is «self-organising» ?	Translate	Am I a drone?	Generative Adversarial Network	Why do you recommend it?

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Students at Epsom Normal School, Auckland, 2021 (In the spirit of this handbook, most of the drawings were recovered from the rubbish bin.)

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TEACHING & LEARNING RESEARCH INITIATIVE
NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU

advanced computational thinking in aotearoa

ACTivities handbook

Starting points for practical learning and teaching