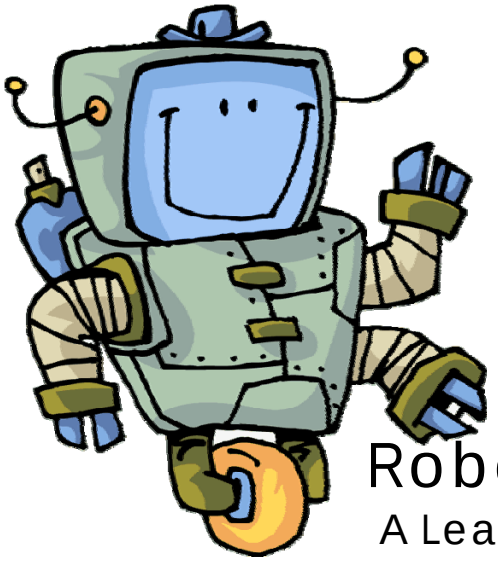

Robotics in Kindergarten

A Learning and Evaluation Situation for Preschool Education

Created by
Christiane Dufour, Educational Consultant, LEARN

This LES and all its related resources are available on line at
http://www.learnquebec.ca/project-and-learning-situations

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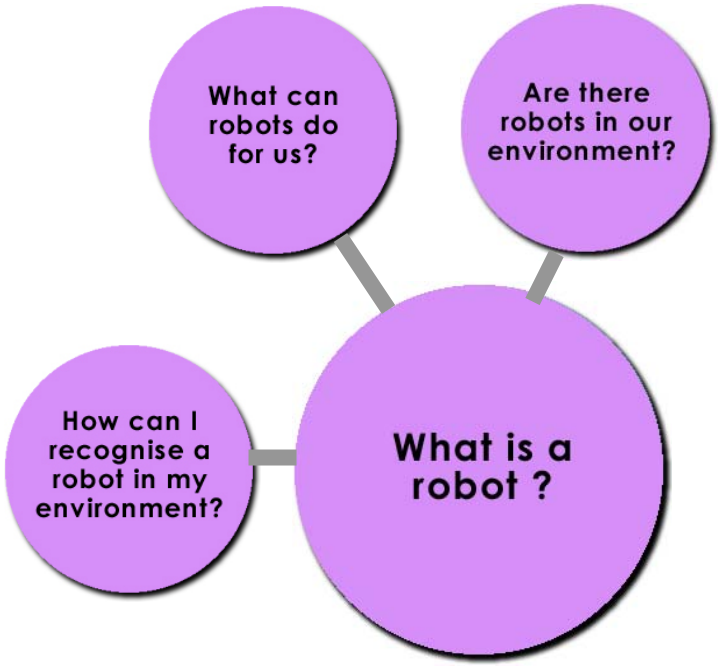
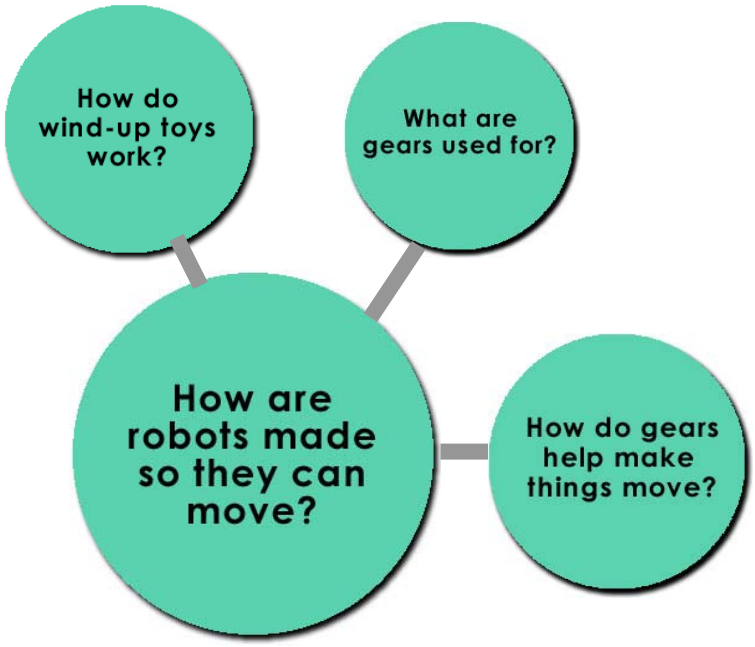
Resource icons used

Indicates a video is available on the Learn web site and listed in the resources at the end of this LES.

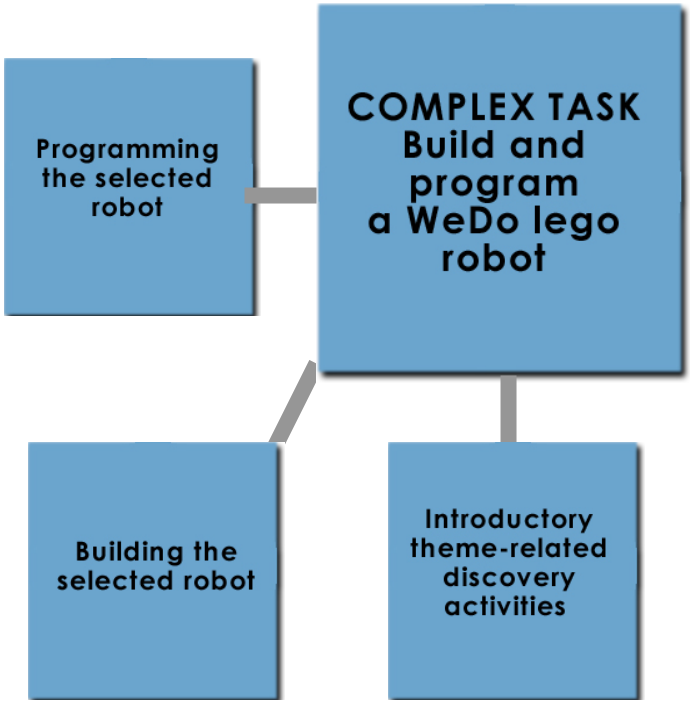
Indicates a document you can print is available on the LEARN web site and listed in the resources at the end of this LES. All documents listed are available via:
http://www.learnquebec.ca/robotics

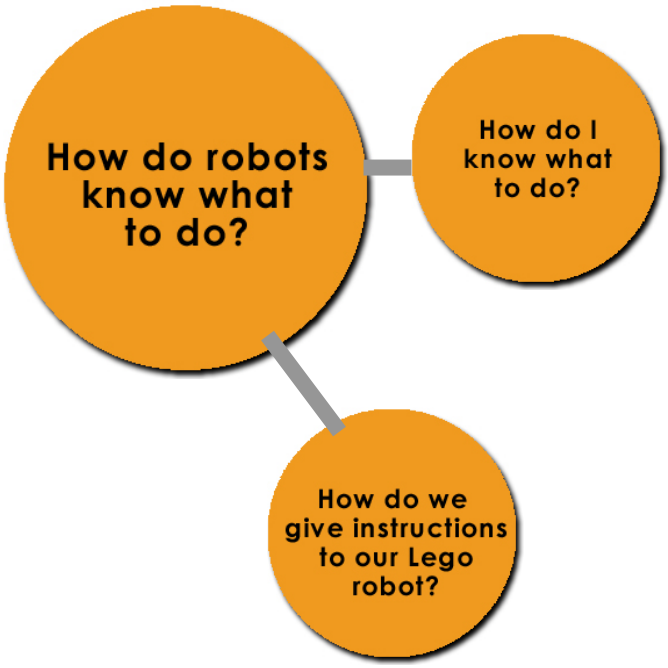
OVERVIEW





Do we need robots
or
do robots need us?





Focus of this LES

- Explore the interdependence between robots and humans
- Provide a rich environment that stimulates reading and writing behaviours through a variety of means both visual, and digital.
- Provide a technological discovery environment in which the students can, through play and interaction with others, observe, anticipate and experiment.
- Encourage autonomy, and critical, creative thinking.
- Provide an environment that offers a real challenge.
- Encourage trial and error to explore and solve problems

Essential Knowledge

What will students learn need to learn to carry out the complex task?

- Science and technology: observation and manipulation of objects, attempting to find explanations and consequences.
- Actions associated with emergent writing when writing programming sentence with pictograms.
- Concepts related to language in the context of reading plans and writing programming sentences with pictograms.
- Mathematics: sorting, measuring, counting, and naming shapes.

Targeted Competencies

C4- To communicate using the resources of language

- To show interest in communication
- To understand a message
- To produce a message

C5- To construct his/her understanding of the world

- To show interest and curiosity concerning the arts, history, geography, mathematics, science and technology
- To exercise thinking in a variety of contexts
- To organise information
- To describe his/her learnings

C6- To complete an activity or project

- To become involved in the project or activity, drawing on his/her resources
- To show tenacity in carrying out the project or activity
- To show satisfaction with the project or activity
- To transmit the results of the project or activity

Note: other competencies could be targeted depending on how the activities are structured and supported, and on what you choose to focus on and document.

Project Timeline

Teachers who have done this LES suggest that it should be done in spring to allow for student maturation and autonomy. It could be done over a 3 to 4 week period.

Complex Task

To build and program a robot that can interact with its environment.

Hooks

The projects the children take part in arise from their interests, games, experiences or imagination.

Ideally then interest in robots and the questions that they raise should come from the children. Stay alert for their stories that may involve objects that have robotic characteristics: smart coffee-makers that start at a designated time, the car that parks itself, the toaster that senses when the toast is ready, the automated milking machines in the barns of some of our communities, etc. Guided questioning in these situations can lead the children to understand that these are actually robots that sense and react to their environment. Other hooks can include:

1- Placing a variety of books on the theme of robots in the reading corner and engaging in a discussion about them.
2- Many children may already have see the movie "Wall-E". Excerpts are available here, some of which contain little "teachable" moments (Like "Wall-E's treasure" and "Foreign Contaminant" at which we can stop and ask the children questions: http://adisney.go.com/disneyvideos/animatedfilms/wall-e/flash_site.html?deeplink=Video

Robot-specific Hooks

There are 12 robot models to choose from. To introduce the model and its theme, you could create whole group introductory activities or provide a variety of theme related centers while robot building and programming is taking place. For example, animal behaviour (for the animal related themes), music and rhythm, geography, sports, etc.

Inquiry Paths

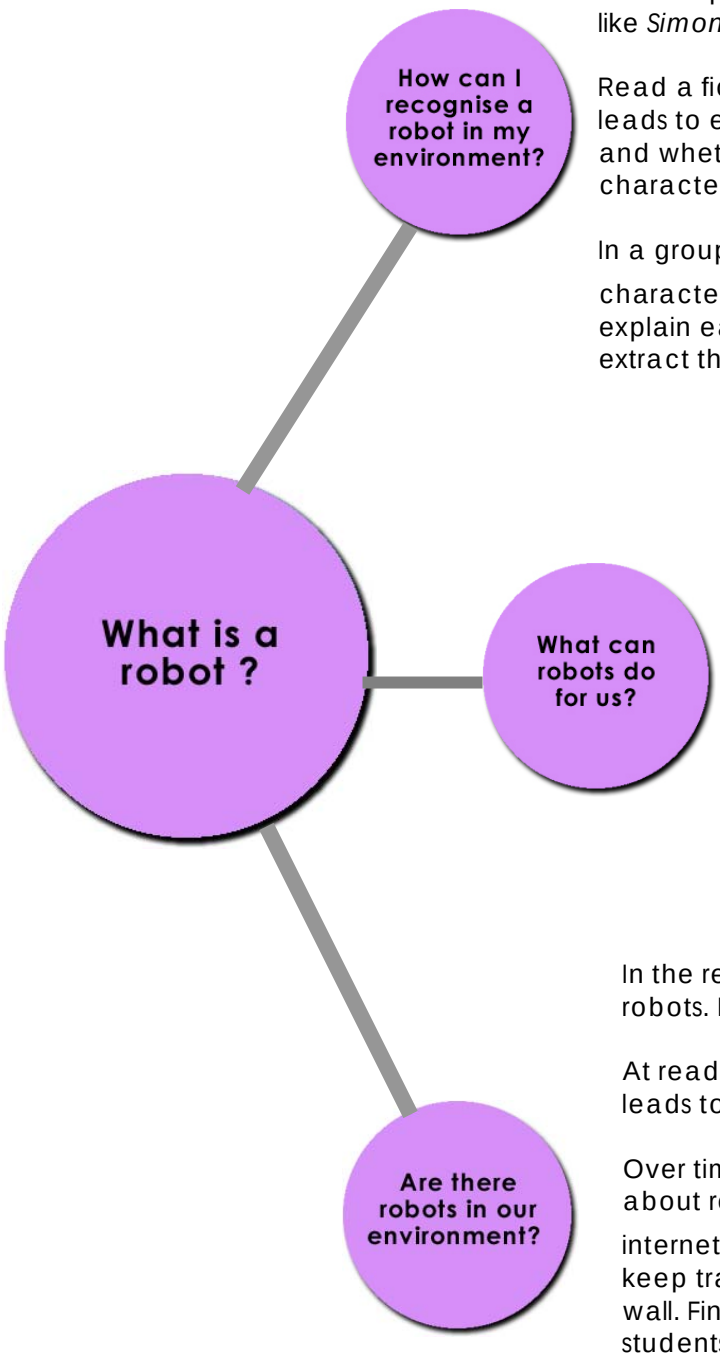
The first three inquiries paths in this LES need not be taken in any specific order. There are several possible ways they can be implemented: some elements can be dealt with as whole class activities, some can be done in small groups while others can be set up as exploration and discovery centers. Select or adapt the activities that are best adapted to your specific learning focus.

The complex task comes last, but can also be implemented in a variety of ways, gradually over time.

Evaluation-Observation

At each step of the process, a focus of evaluation is suggested. Use the Kindergarten Education Program to help you create an evaluation-observation grid. You can also use the Kindergarten Development Profile to help identify typical observable behaviours if needed. Available at: http://www.learnquebec.ca/kindergarten-development-profile

Learning activities



Ask the question "How do robots move". Play movement games like *Simon Says*, while moving like a robot.

Read a fiction book involving robots. Engage in a discussion that leads to explore how a robot is different from a person or an animal and whether a robot is always humanoid looking. Collect the characteristics they name.

In a group, sort pictures of objects with or without robotics characteristics, into 2 groups: ***Robot – Not Robot.*** The children explain each of their choice. From their collected explanations, extract the characteristics required for something to be a robot.

Students ask themselves: *If I made a robot, what would I want it to do?* Individually they draw their robot and someone scribes their description.

Create a *Robot Building Center*: provide recycled materials, including technology, mechanical parts, Lego, or blocks. Or make it a *Career Center* by providing costumes and tools to build robots. The students describe the steps in the **This is How I Did It** organiser. They present their process to the class.

In the reading corner, put out books and magazines that deal with robots. Include fiction and non fiction books.

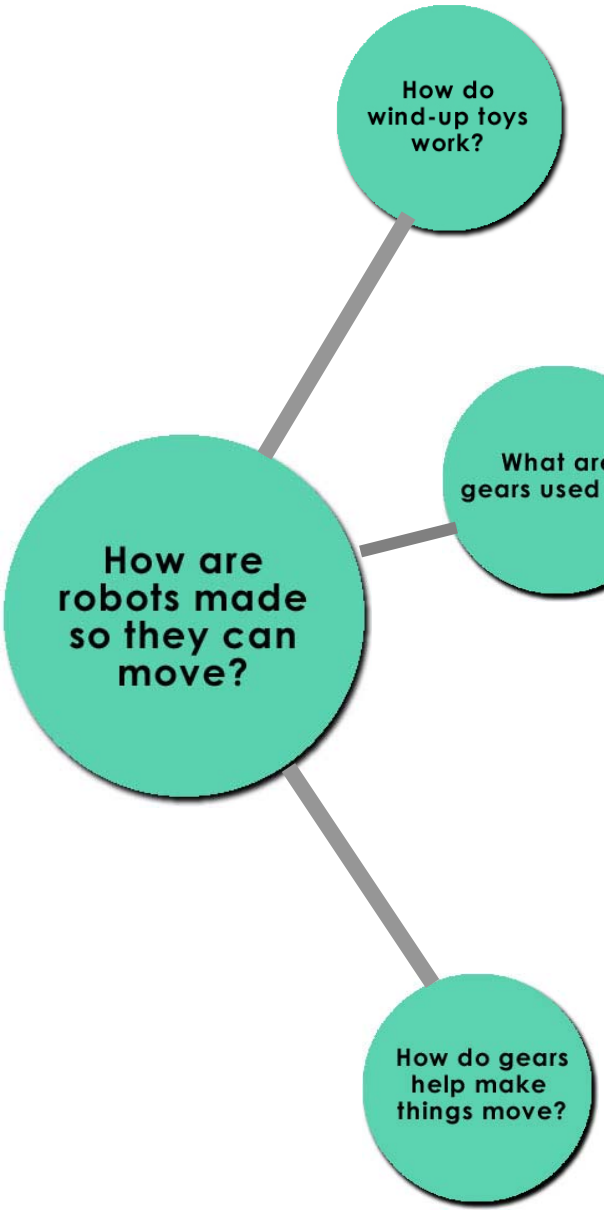
At reading time, read a fiction book. Engage in a discussion that leads to question whether or not there are robots in our lives?

Over time, students collect information from a variety of sources about real robots: non-fiction books, magazines, people, and internet. They use a **My Research Organiser** to take notes and keep track of their discoveries. Then they create an information wall. Find a place outside the class to post the "wall" so that students can interact with others to explain what they have learned.

Focus of Evaluation: C5 - TO CONSTRUCT HIS/HER UNDERSTANDING OF THE WORLD

- Demonstrates interest, curiosity and a desire to learn
- Uses pertinent information to learn
- Describes the process and strategies used in learning

Learning activities



Provide a variety of wind-up toys (from the dollar store) to play with. Question the students about what they think makes them work. The students explain in their own words how they imagine it.

Provide tools to take wind-up toys or wind-up clocks apart to "test their hypotheses" (their guesses). Use open-ended questions to help them explain to you what they observe and talk about what they are seeing (they might notice the gears and springs). *If you are unfamiliar with the topic, you can learn about gears, pulleys and springs in Appendix 1*

After having presented a variety of gears (in objects, pictures or videos) challenge the children to find gears in their environment (through observation, asking adults, or in books and magazines. Collect their findings (at show and tell) and post the drawing they make or pictures they find.

Create a museum area where mechanical objects or gear parts can be showcased. Think of music boxes, wind-up toys, bicycle gears, clocks, etc.

Provide gear games like *Kid K'nex* in a free-play center. Observe and question to help the children wonder how movement is transmitted from one gear to another. There are 3 aspects they could discover: how they connect (touch), the direction of their respective movements and rotation speed relative to size. Discoveries are presented to the group. *If you are unfamiliar with the topic, you can learn about gears, pulleys and springs in Appendix 1*

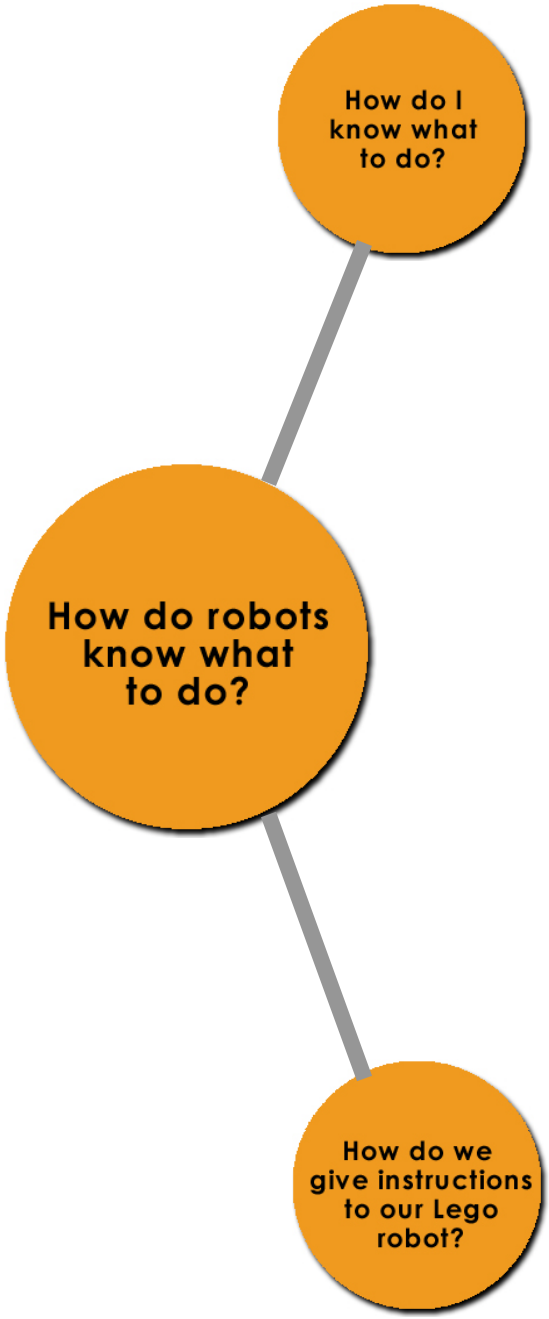
Provide construction sets that can be used to build mechanical structures with moving parts using gears, levers, pulleys, connected with rubber bands, toy airplanes powered by rubber band, etc. (They might take the explorations in different directions and discover they can use an inclined plane to power a wheeled vehicle, or wind in a sail, etc)

When they are ready to build their first robot, in small groups, ask them to find all the gear parts in the Lego Kit. They could draw what each looks like and indicate how many there are of each kind (there are 5). Make connections with prior learning above.

Focus of Evaluation: C5 - TO CONSTRUCT HIS/HER UNDERSTANDING OF THE WORLD

- Demonstrates thinking in a variety of contexts: interacts with his/her environment
- Describes the process and strategies used in Learning: recognises what he/she has learned

Learning activities



Design and build a robot "puppet" with recycled materials including technology parts. Make the robots available in the puppet play center. During play, when the occasion arises, plant a reflection seed by asking how the robot knows what it has to do since it's not alive. Help bring out the concept that it requires instructions.

In teams of two, play a "human" programming game where 1 player gives instructions while the other pretends being a robot. Use the paper **Game Console.** Also see

Play a variety of "*Do as I say*" games such *as Simon Says*. Build up from giving one instruction at a time to a string of instructions. Ask the children to take the role of leaders. When an instruction is not followed as expected, help them reflect on the cause, ex. Were the instructions clear? (This is the beginning of learning to "debug" a program)

Put up a visual instruction board for some activities. Post a sequence of visual instructions for selected activities thus creating visual sentences like the ones that will be used to program the WeDo robots.

Show the images of the main programming icons for the students to discover their function. Provide the correct vocabulary. (Use **IWB**)

To familiarize the students with the icons, provide plasticised versions of the **programming icons** to play *Match the card* games. The corresponding name of the icon could be written on the flip side of each card.

Focus of Evaluation: C4 – TO COMMUNICATE USING THE RESOURCES OF LANGUAGE
C5 – TO CONSTRUCT HIS/HER UNDERSTANDING OF THE WORLD

- Shows interest in communication: interest in oral communication
- Demonstrates understanding of the message: in oral and written communications
- Demonstrates thinking in a variety of contexts: interacts with his/her environment

Learning activities

Introductory theme-related discovery activities

Set up a sorting table where the pieces will be sorted according to categories the children choose. Have them explain their sorting criteria. See if they can locate all the types of gears.

Play an "I spy with my little eye" game to teach the vocabulary of the pieces and the names of their shapes.

Building the selected robot

Before building, the students take out and set aside only the required pieces for the model.

In small teams (2 or 3), they use the plans provided to build the selected robot. While one team builds with the help of an adult, the others are engaged in center activities. The teams can rotate: each team reads and builds a page or two until the robot is complete.

Programming the selected robot

Preliminary work: demonstrate how to use the programming interface and review the programming icons. To begin, the students put aside, on the work space, those icons that will be used. (**IWB**)

PREDICT – OBSERVE – DEBUG: In small teams, they solve each of the **5 challenges** that are provided for each robot. They use the plasticised pictograms to "write out" the solution. They predict what will happen. They transfer the solution to the computer screen and observe how the robot behaves. If it's not as they expected, they modify their program until it does what is required.

They imagine a challenge of their own and program the robot to do it. Suggest they make it into a story. Provide time to present the stories and programs to the class. (**IWB**)

With one Robot kit per class, teams can take turns to program all 5 challenges provided. After which the robot can be provided in a center where the children can create their own challenges.

Reflection

During circle time, bring back the notes taken at the beginning of the project (What is a robot?) Initiate an exchange on the topic "What do I know now that I didn't know before?" Using the **Reflecting on Robotics** or **My Reflection** organiser they explain what the project was about, how much they enjoyed it and what they now know (or know how to do). Throughout the project as a whole, there might be moments when the **I am Proud of Myself** organiser would also be appropriate.

Focus of Evaluation: **C4 – TO COMMUNICATE USING THE RESOURCES OF LANGUAGE**
C6 – TO COMPLETE AN ACTIVITY OR PROJECT

- Shows interest in communication: interest in information and communications technology.
- Demonstrates understanding of the message: in oral and written communications
- Uses his/her resources in carrying out the activity or project.
- Perseveres in carrying out the activity or project
- States learnings acquired and difficulties encountered
- Expresses satisfaction with the activity or project

Suggested Graphic Organisers

These graphic organisers are available *on the LEARN Kindergarten Website*
www.learnquebec.ca/documents/20181/99909/RoboticsGraphicOrganizers.zip

- This is how I did it (4)
- This is how I did it (6)
- My research organiser
- Making predictions
- Reflecting on robotics
- I am proud of myself
- My reflection

Support documents and tools for teachers

All the documents below are available on the LEARN Kindergarten Website
http://www.learnquebec.ca/robotics
Videos showing class management ideas and suggestions for activities are also available there.

Documents

- Robot – Not Robot images
- Robot-Not Robot signs
- Programming console for the Instruct a Human game
- Building Robots with WeDo Plans
- Programming challenges associated with each plan
- Lexicon of part names
- The backgrounds and their associated numbers
- The sounds and their associated number
- The vocabulary of the WeDo programming icons
- The WeDo Programming icons - small and large

Evaluation: Kindergarten Development Profile observation grid.

- Competency 4 - Communicates Using the Resources of Language
- Competency 5 - Constructs his/her Understanding of the World
- Competency 6 - Completes an Activity or Project

Videos: Before you Start - Laying the Groundwork

- Instruct the Robot
- Discovering gears
- Prepare to read plans
- Video clips illustrating a variety of classroom situations
- Instruct a Robot

Books and songs

Fiction books

- Funny Faces Rusty Robot by Jo Rigg ISBN-13: 978-0312498917
- Hello Robots by Bob Staake ISBN-10: 0670059056
- Little Robots: Ragged Bears by Michael Brownlow ISBN-13: 978-1929927050
- Me and My Robot (All Aboard Reading) by Tracey West ISBN-13: 978-0448428956
- My Robot (Green Light Readers Level 2) by Eve Bunting and Dagmar Fehlau ISBN-13: 978-0448428956

- Nova's Ark: David Kirk's Nova the Robot by David Kirk ISBN-13: 978-0448438160
- Nova's Ark: Twinkle Twinkle, Little Hedgehog: David Kirk's Nova the Robot ISBN-13: 978-0448438184
- R. Robot Saves Lunch by R. Nicholas Kuszyk ISBN-13: 978-0399247576
- Ricky Ricotta's Mighty Robot Collection (Books 1-4) by Dav Pilkey and Martin Ontiveros ISBN-13: 978-0439435222
- Robot by Jan Pienkowski ISBN: 0-440-07459-2
- Robot Dreams Sara Varon ISBN-10: 1596431083
- Robot Rampage! (Backyardigans Ready-to-Read) by Jodie Shepherd ISBN-13: 978-1416990130
- Robot Zot! Jon Scieszka ISBN-10: 1416963944
- Robot Riot! (Schooling Around!) by Andy Griffiths ISBN-13: 978-0439926201
- The Robot and the Bluebird by David Lucas ISBN-13: 978-0374363307
- The Trouble with Sisters and Robots by Steve Gritton ISBN-13: 978-0807580905

Non Fiction Books

- Robot (DK Eyewitness Books) by Roger Francis Bridgman ISBN-13: 978-0756602543
- Robots by Clive Gifford and Frank Picini ISBN-13: 978-1416964148
- Robotics (Life in the Future) by Mark Beyer ISBN-13: 978-0516240077
- Military Robots (High Interest Books) by Steve White ISBN-13: 978-0531187081
- How to Draw Robots and Aliens (Kid Kits) by Janet Cook, Judy Tatchell, Kuo Kang Chen, and Mary Forster ISBN-13: 978-1601301864
- Robots!: Draw Your Own Androids, Cyborgs & Fighting Bots by Jay Stephens ISBN-13: 978-1579909376

Songs

- Aiken Drum (modified to reflect this curriculum unit
- Slipper Sam
- Play the song "Baby Elephant Walk" by Henry Mancini. Have the children move to the music like they are robots
- I'm a Color Robot - http://www.youtube.com/watch?v=9l_0sb9ZRel
- Sam the Robot Man by Movement Songs Children Love – Themes & Variation ISBN : 1-894096-40-1

Appendix 1: resources

Find out about Gears and Clock

These videos are not directly meant for the students but rather to help you learn more about the topic in order to help you question the students in their process of discovery. You may want to show elements without the sound and have an open discussion of what they see.

- Gear Basics
  http://www.youtube.com/watch?v=odpsm3ybPsA

- Clocks
  http://www.youtube.com/watch?gl=CA&hl=en&v=M8ZEJTNW3OM
  Note: the movie "Hugo" shows many clock gear mechanisms up close in a wonderful child centered context.

Elements to be attentive to

These are elements of knowledge and understanding that YOU have. Do not expect the children to provide correct answers. They are meant to help you direct their attention and elicit their explanations while providing further opportunities for questioning and hypothesising, i.e, what would happen if...

How does a wind-up toy work?

- Springs: what is their role? How do the work? How they connected to the wind-up key?
- Gears: how are they connected? To each other? To what moving parts. To the spring? They should discover that they need to touch each other and the moving parts to work.
- Sometimes gears are not in direct contact but are connected by a chain, as in a bicycle.

What kinds of things around use use gears?

- Electronic devices with no moving parts do not use gears.
- Gears will be found when there is a mechanical aspect to the object even if its energy source is electric rather than wind-up (mechanical)
- Some gears are obvious as in bicycles; others are hidden from view, like the gears that make the car wheels turn.

Why do gears come in different sizes?

- The direction of rotation from one to the next. An assembly of gears can change the direction of the movement. Can they guess which way a gear is going to turn based on its position in the set?
- The speed of rotation when gears are the same size and are of different sizes. (A gear that has ½ the number of teeth as it's connected neighbour will turn 2 times as fast)
- Some gears lie flat next to each other, others can be at angles and so can transmit motion in a completely different plane (that's how the axel in our cars transmit motion to our wheels!)
- Using a small gear to move large ones provide a mechanical advantage, i.e. you need very little force to turn the little wheel, even if it is connected to a very large one. (see http://www.youtube.com/watch?v=odpsm3ybPsA). It's unlikely that the children can discover this with the classroom materials unless having experienced it in some home context, for example, in winching up a boat, or having observed a manual lock.