Mighty Machines to Little Lego
Investigating Sustainable Forestry with Lego Mindstorm Robots

Big Task

The unit involves learners working in teams to build and program a robot which simulates the machines used during sustainable logging operations.

The learners are challenged to build a robot which can navigate a course and can collect trees suitable for logging, while leaving trees that must be left growing to ensure sustainable forestry practices.

Learners will communicate their design through a poster and the robots will be tested in a competition format to determine the most successful design.

Rationale

This unit of work shows the benefits and principles of sustainable reforestation through situational outdoor learning which is reinforced by a robotic simulation. It aims to provide an engaging and meaningful engineering project to S3 learners. It has been built around the Third and Fourth Levels of Curriculum for Excellence to create a STEM orientated unit for Broad General Education. The unit draws on influences from Design Technology, Science and Maths resulting in a fully integrated interdisciplinary project.

This unit of work will allow learners to develop skills in programming and robotics systems. This will occur through a design challenge within the context of sustainable forestry and the impact of forestry on the environment. The unit will involve using an outdoor setting to heighten the learning experience and inform learner's design decisions.

Utilising a design challenge approach to the unit provides a grounded sense of realism and context to the project allowing the learning experience to be more authentic to the learners and ultimately more meaningful.

Learners will aim to complete a 'Big Task' by the end of the unit with their learning scaffolded by a series of 'Small Tasks' through the unit, encouraging them to develop and refine the skills and knowledge necessary to the completion of the big task.

The big task will involve more independent design decisions and autonomy by the learners with the teacher acting more as a facilitator during the building of the robot. In this way learners are able to take ownership of their own learning and apply their newly-gained skills to the project through their own creative designerly thinking.

This unit comprises of six 'sessions' of work focussed around learners gaining knowledge and understanding of some of Earth's resources and the need for responsible use of them through sustainable forestry practices. The vehicle for this learning is the learners participating in a STEM design challenge to design, build and programme a robotic tree harvester to mimic the function of a full scale tree harvester, a fantastic example of large scale engineering in the industrial world. The learner's robots will simulate the harvesters on a very basic level but through creating them learners will experience the full design process from research to testing before competing in a competitive obstacle course to assess how well the challenge has been met.

Outline Plan

Session 1 - Introduction and Preparation
Watch video clips of logging machines in action and introduce sustainable forestry.

Learners complete basic risk assessments to be aware of health and safety. Any equipment learners must bring is explained (eg waterproof clothing and cameras)

Session 2 - Outdoor Visit
Learners discuss tree types, tree health and sustainable forestry.

Learners investigate the land conditions of their site and begin to think about design issues their robot would encounter. Learners perform experiments, take photos and gather evidence of conditions.

Session 3 - Research and Experimentation.
Learners gain knowledge of movement and mechanisms through both theory and practical tasks.

In teams learners use LEGO pieces to begin to construct moving components. Learners will develop an understanding of gears, sensors, axles

Session 4 - Build Phase
In teams learners construct their LEGO robot. They choose the sensors and motors they need to complete the challenge by applying their previous knowledge.

Components will be assigned a cost and teams will be given a budget and must not exceed it

Session 5 - Programming Phase
Learners will develop an understanding of basic programming using flowcharts and the LEGO Mindstorm system to complete small skill building tasks before creating their own program.

Teams will test and refine their robots ready for competition. Teams will also create a poster to communicate their ideas and design.

Session 6 - Competition
Learners display their posters and compete to complete the course. Points are awarded for completion, time and trees collected. Points are lost if the robot gathers the wrong trees.

The winners of the challenge will be the team that create both a good robot and a good poster.

Harvesters and Forwarders are large scale machinery that can be used for sustainable forestry.
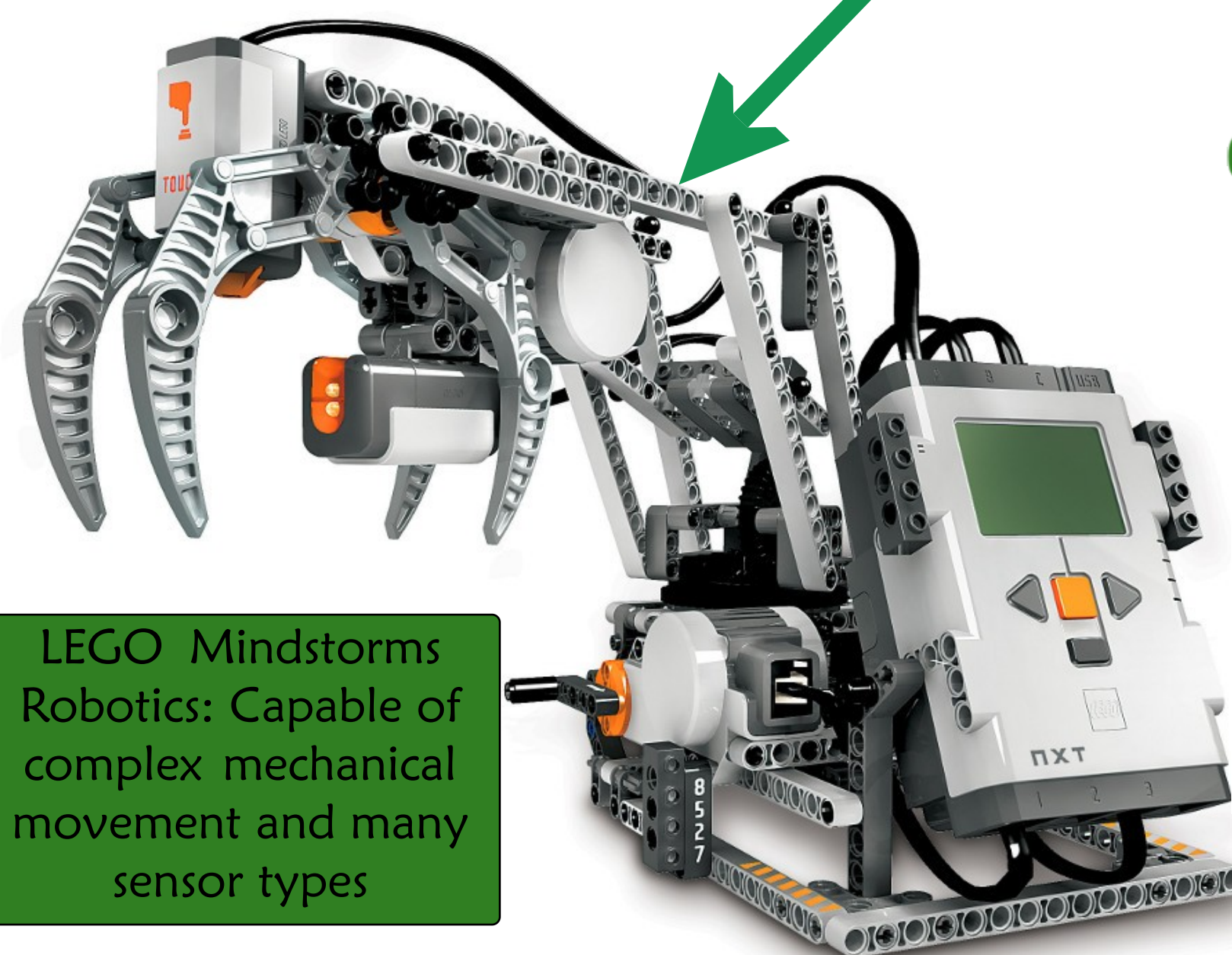
LEGO Mindstorms Robotics: Capable of complex mechanical movement and many sensor types

Experiences and Outcomes / Skills for Life

- HWB 4-16a
- LIT 4-02a
- LIT
- LIT 4-26a
- 4-29a
- MNU 4-01a
- MNU 3-09a
- MNU 4-11a
- SCN 4-09a
- TCH 4-01a
- TCH 3-02a
- TCH 4-09a
- TCH 4-12b
- TCH 3-14a

Skills:
- Creativity
- Logic, reasoning
- Inventive
- Inquiry
- Problem Solving
- Investigation