



TechXellent



Training



Solutions

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“Experience is learning, everything else is information”^①

“Victorian Essential Learning Standards”^②

a framework for whole school curriculum planning

Themes based on robots and/or mechanical systems can be used to address these areas of the VELs.

Physical, Personal and Social Learning

- Health and Physical Education
- **Interpersonal Development**
- **Personal Learning**
- Civics and Citizenship

Discipline-based Learning

- The Arts
- English and Languages Other Than English
- The Humanities (Economics, Geography and History)
- **Mathematics**
- **Science**

Interdisciplinary Learning

- **Communication**
- **Design, Creativity and Technology**
- **Information and Communications Technology**
- **Thinking**

TRANSFERENCE

Fundamental to the Essential Learning Standards is the **integrated focus on the three strands to develop deep understanding in learners which can be transferred to new and different circumstances.**

CONTEXT

Focusing on **more complex, contextualised demonstrations of what has been learned, rather than a number of smaller, disconnected tasks;**

.....applying the knowledge in ways appropriate to context, rather than merely exercising one's memory; retrieving important aspects of knowledge with a degree of automaticity (autonomously?); and approaching new situations in flexible ways

SCIENCE

The most fundamental goal for science education is to stimulate, respond to and nourish such curiosity, wonder and questioning.

All students need to appreciate the significance of science for the long-term future of our society.

Science at work

This dimension focuses on students experiencing and researching how people work with and through science.

Students learn to be curious and to use scientific understanding and processes to find answers to their questions. “

② The Above Extracted entirely from :

① This quote attributed to Ian Maud, Teacher and RoboCup Junior Chairman, St Paul's Grammar, Warragul .

SOME DEFINITIONS

MACHINE - APPARATUS FOR APPLYING MECHANICAL POWER, having several parts each with a definite function.

MECHANICAL- OF MACHINES OR MECHANISMS

MECHANISM- SYSTEM OF MUTUALLY ADAPTED PARTS WORKING TOGETHER

WHAT IS A SYSTEM ?

- Complex whole
- Set of connected things or parts
- Organised body of material or immaterial (information, music etc) things
- Several items arranged to work together

ASSUMES –

- Organised sequence of progression
- Predictable outcome / result
- A degree of control of the whole / components
- Something happens as a result of some input
- Some change takes place - increased speed, power, direction, location of effect,
- That there is some identifiable purpose

The most common mechanical systems are :

WHEELS , AXLES , PULLEYS , LEVERS , GEARS

These all interact and perform according to various laws and principals of physics (science - force, movement, friction etc.)

These principals are repeatable, measurable and predictable and affect us in everything we do .

Physics is not just a set of mathematical formulas that have no useful relationship to the real world.

Applications of physics in our life – Car design and new materials, solving crimes, how we do our work, efficiency , space exploration, moving house, playing sports

QUESTIONS

Does a system have to be motorised to be called a system?

Is a spoon resting on a table a system ? What about if it is in my hand?

Is a single gear wheel alone a system ?

Teaching Principals (for beginners)

Q- How does this affect me ?

- **SO WHAT ! CARE FACTOR** – For a student to connect to learning the teaching content needs to be relevant and interesting to the students life right now, you can re-visit and build skills and understanding over time.

Q – What types of learners are in your class, weaknesses & strong points?

- The teaching technique needs to cater for various learning styles.
- The content needs to be conveyed at an appropriate level of complexity.

Q – What has gone before? Previous learning and experiences

- Build understanding – what do I know right now? What more do I need to know? What have I learned from my experience/ research/ experimenting?

For those without a science /physics background

Moving in the Physical World

The relationship between Mass, Force and Acceleration

Quote taken from –

<http://www.qrg.northwestern.edu/projects/vss/docs/Propulsion/2-every-action-has-an-equal-and-opposite.html>

“Every Action has an Equal and Opposite Reaction- The bigger the push, the bigger the push back. That's why cannons and guns recoil.”

What is a Force?

Quote taken from –

<http://science.howstuffworks.com/fpte2.htm>

Force causes **acceleration**. If you apply a force to a toy car (for example, by pushing on it with your hand), it will start to move. This may sound simple, but it is a very important fact. The movement of the car is governed by **Isaac Newton's Second Law**, which forms the foundation for classical mechanics. Newton's Second Law states that the *acceleration (a) of an object is directly proportional to the force (F) applied, and inversely proportional to the object's mass (m)*. That is, the more force you apply to an object, the greater the rate of acceleration; and the more mass the object has, the lower the rate of acceleration. Newton's Second Law is usually summarized in equation form:

$$a = F/m, \text{ or } F = ma$$

MASS

Quote taken from –

<http://science.howstuffworks.com/fpte1.htm>

“Generally, **mass** is defined as *the measure of how much matter an object or body contains* -- the total number of subatomic particles (electrons, protons and neutrons) in the object. If you multiply your mass by the pull of Earth's [gravity](#), you get your weight. So if your body weight is fluctuating, because of eating or [exercising](#), it is actually the number of [atoms](#) that is changing.”

“Your body's mass on the moon is the same as its mass on Earth, because the number of atoms is the same. The Earth's gravitational pull, on the other hand, decreases as you move farther away from the Earth. Therefore, you can lose weight by changing your elevation, but your mass remains the same. You can also lose weight by living on the moon, but again, your mass is the same.

Mass is important for calculating how quickly things accelerate when we apply a force to them. “

What is Work?

<http://science.howstuffworks.com/fpte6.htm>

“Work is simply the *application of a force over a distance*, with one catch -- the distance only counts if it is in the direction of the force you apply. Lifting a weight from the ground and putting it on a shelf is a good example of work. The force is equal to the weight of the object, and the distance is equal to the height of the shelf. If the weight were in another room, and you had to pick it up and walk across the room before you put it on the shelf, you didn't do any more work than if the weight were sitting on the ground directly beneath the shelf. It may have felt like you did more work, but while you were walking with the weight you moved horizontally, while the force from the weight was vertical. “

ENERGY & POWER

<http://science.howstuffworks.com/fpte8.htm>

“Energy is a *measure of how long we can sustain the output of power*, or how much work we can do. Power is the rate at which we do the work.

<http://science.howstuffworks.com/fpte7.htm>

Power is a measure of how quickly work can be done. Using a lever, you may be able to generate 200 ft-lb of torque. But could you spin that lever 3,000 times per minute? That is exactly what your car engine does.”

POTENTIAL ENERGY

Potential energy is *waiting to be converted into power*. [Gasoline](#) in a fuel tank, food in your stomach, a compressed spring, and a weight hanging from a tree are all examples of potential energy.

INERTIA

Quote taken from –

<http://www.wisegeek.com/what-is-inertia.htm>

“Inertia is the idea that an object keeps moving unless acted upon by an outside force. Much of the initial work written about inertia was done by Isaac Newton in the 17th century and became known as his first law of [physics](#). It is one of the basic principles of physics and has a number of real-life applications, as it helps to explain much of why objects behave the way they do.

The idea of inertia is quite simple. Inertia is the principle that is that an object will tend to keep moving at a certain speed and direction unless something else acts to change it. That external force could be almost anything. Friction is a common external force that can change the speed and direction of a moving object. Many other objects can also affect motion, however, from [gravity](#) of the earth's pull to another person. The key idea is that an object will keep moving (or stay still) unless something else influences it otherwise. “

GRAVITY

Quote taken from –

<http://www.wisegeek.com/what-is-gravity.htm>

“Gravity is an attractive force between objects. Most people are familiar with gravity as the reason behind things staying on the Earth's surface, or "what goes up, must come down," but gravity actually has much vaster significance. Gravity is responsible for the formation of our Earth and all other planets and for the movement of all heavenly bodies. It is gravity that makes our planet revolve around the Sun, and the Moon revolve around the Earth.”

TORQUE

Quote taken from –

<http://science.howstuffworks.com/fpte4.htm>

“Torque is a force that tends to rotate or turn things. You generate a torque any time you apply a force using a wrench. “

Other recommended references

<http://www.qrg.northwestern.edu/projects/vss/docs/Propulsion/2-what-is-inertia.html>

<http://science.howstuffworks.com/fpte10.htm>

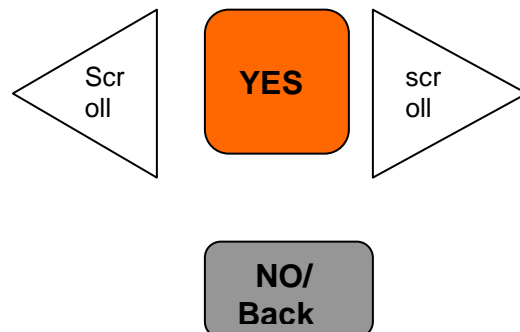
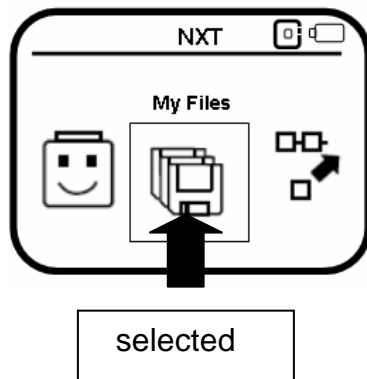
Mechanical systems I have met today ?

What man-made items have I used/ seen today that move?	What mechanical systems do I think these items incorporated?	What forces were acting? (forward motion, gravity, inertia etc)



Space Age Robots Activities.

The NXT DEFAULT screen



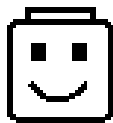
ROBOT BASICS

An output **DOES** something (Motors , lamps , sounds, graphics)

An in-put **TELLS US SOMETHING** (sensor / datalogger)

A robot must be told what is plugged in and where it is

TRY ME



Try-Touch



Try-Sound



Try-Ultrasonic



Try-Light



TRY TOUCH

What is the input ?(told the robot something)

What are the outputs? (What did the robot do?)

TRY SOUND

What is the input ?(told the robot something)

What are the outputs? (What did the robot do?)

TRY ULTRASONIC

What is the input ?(told the robot something)

What is the output? (What did the robot do?)

TRY LIGHT

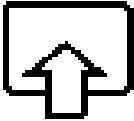
What is the input ?(told the robot something)

What is the output? (What did the robot do?)

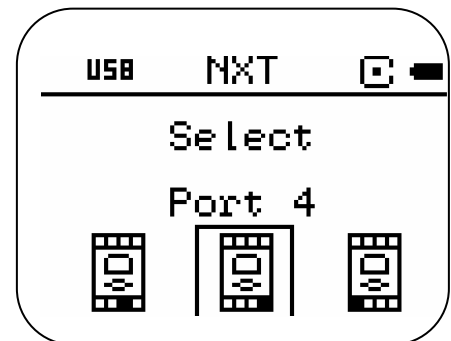
READING SENSORS

Why do programmers have to take sensor readings?
 Will one reading suffice?

VIEW

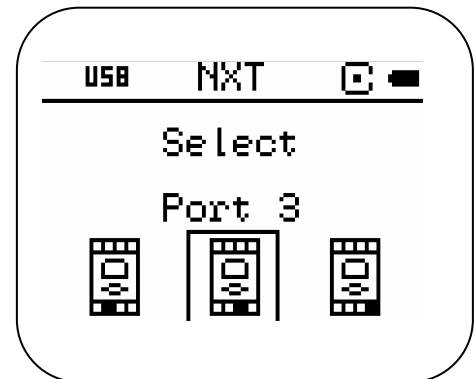


Ultrasonic cm
 Port 4



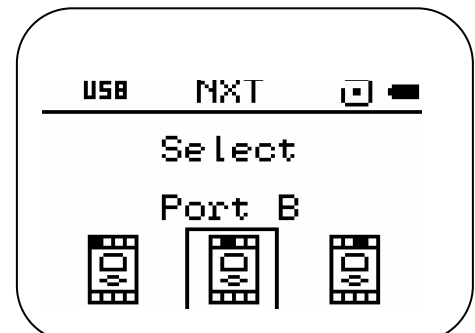
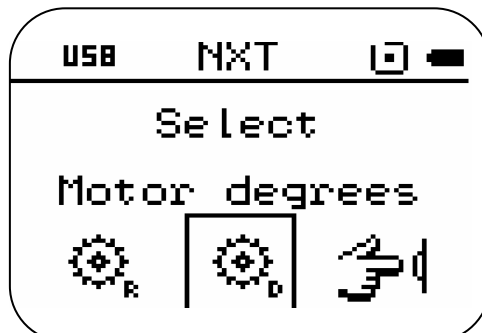
What don't we know about the Ultrasonic sensor?
 What is the maximum range?
 What is the sensors field of view? (peripheral vision?)

Reflected Light
 Port 3

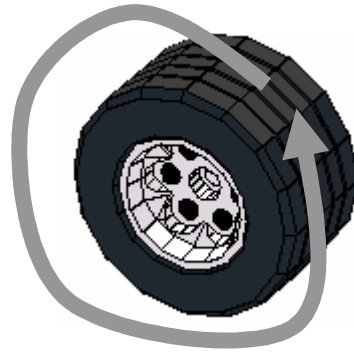
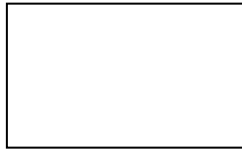
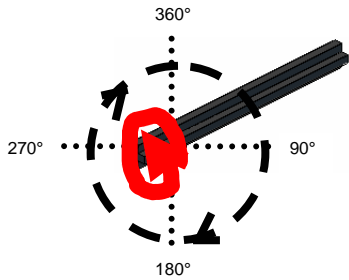


Dark reading
 Light reading

Motor Degrees
 Port B



What is the circumference of the tyre?



Mathematically, how can we express this ?

1 axle rotation = 360° = 1 rotation of the wheel =

Consider creating an Excel spreadsheet to calculate distances:degrees automatically.

My Files



These are programs I have written on the computer and downloaded into the NXT robot

Run the programs and :

1. Say in words what you observed – What did the robot do?
Be exact - How did the robot do it? (input & output, port)
2. Quantify – proof, measurements
3. Is this an unusual result or can we repeat the experiment (fair testing) Number of samples
4. Can we make up a rule ? Physics? Has someone already done this?
5. Can we predict results
6. In everyday living where do I see this “rule” happening?

Programs 1 and 1B –

Run : 1 Fwd till dark OR 1B Fwd till dark_low

OR Program 2 (or 2B) -Tyres off / On

Run : 1 Fwd till light OR 1B Fwd till light_low

Program 3 – Low power robot

Is Speed the same as Power?

Ramp Climb – low power

Drag a weigh

Program 4

Is Speed the same as Power?

Ramp Climb – High power

Drag a weight

Program 5

5_DEGREES_LOW_PWR

Rotational Power to Linear

Low power - rotate 580 degrees – will the power level influence the distance travelled?

How far will the robot travel?

Program 6

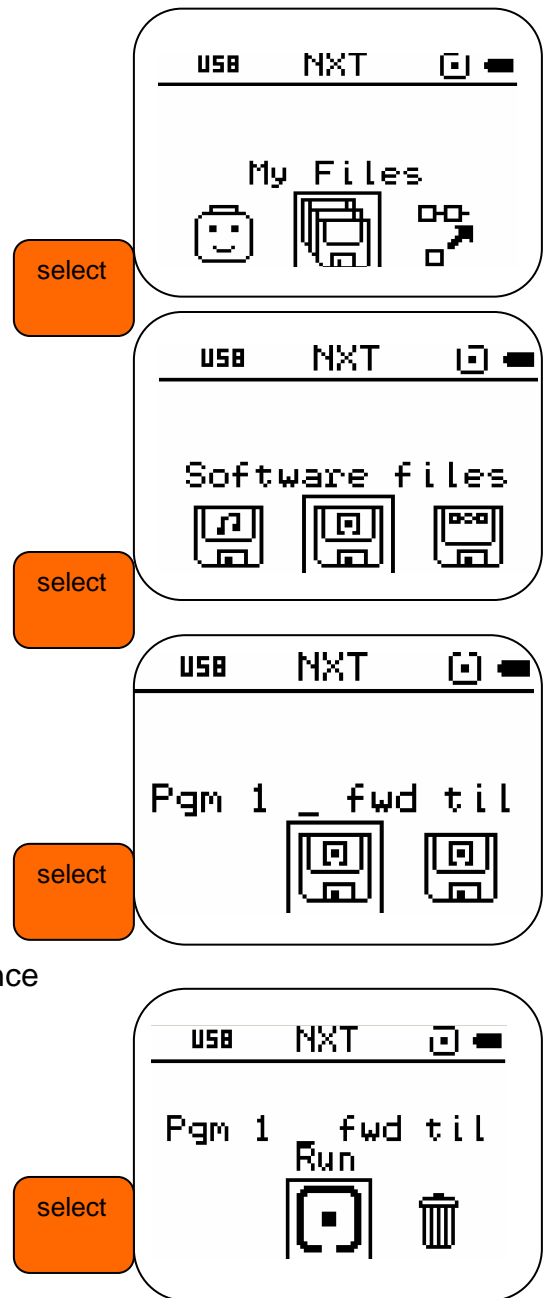
6_DEGREES_HIGH_PWR

Rotational Power to Linear

High power - rotate 580 degrees – will the power level influence the distance travelled?

How far will the robot travel?

What physical modifications to the robot will result in a different distance traveled when the axle rotates 580 degrees?



Our Test revealed that for one full rotation of the axle (360 degrees) the robot moved 18cm (180mm)
So, how far does a robot with tyres circumference of 180mm travel per 1 degree of axle rotation?
Divide 180mm by 360 degrees = 0.50mm per degree. We will use this formula in our table. Namely , Number of degrees multiplied by 0.50mm
This translates to a ration of 1 :0.50
OR for every degree of rotation the wheel travels 0.50mm

.....

How can I apply this in schools?

Use concrete materials like LEGO to investigate real life principals and situations.

Make sure that the equipment / materials you use aid the learning that you want to focus on rather than side issues – difficulty of construction, joining , inappropriate materials.

Verbalise , summarise, write it down.