

## DATALOGGING BASICS

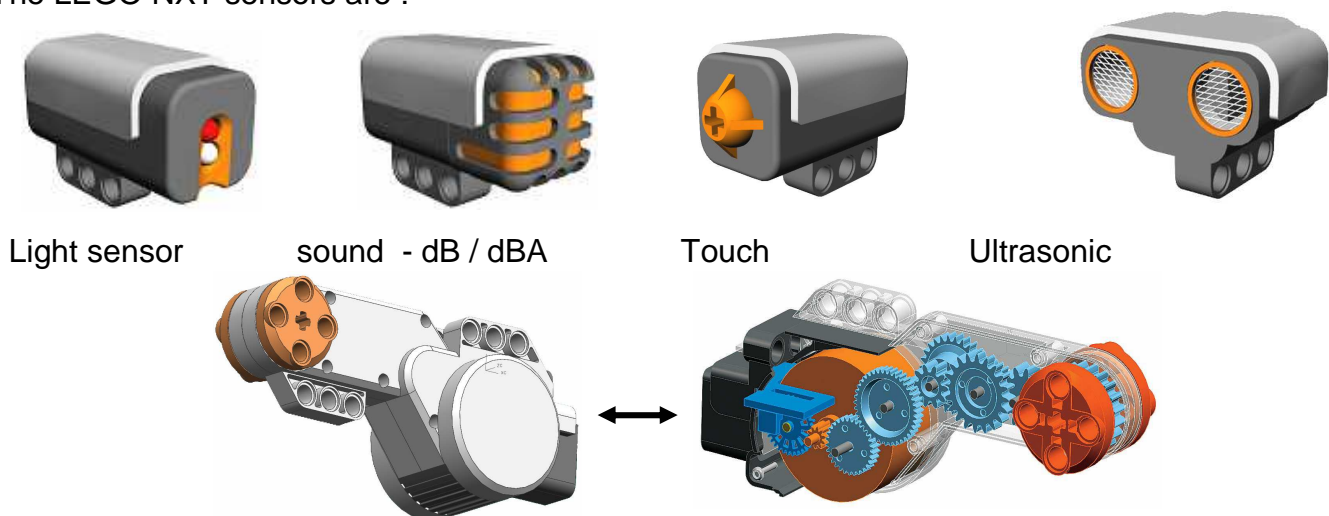
### WHAT IS A DATALOGGER?

A datalogger is - an electronic device that takes measurements from the environment / situation; stores the information and is able to provide the information back in a format that you can analyse, manipulate, apply calculations to, show as graphs and figures etc. This sometimes involves uploading into a computer. Datalogger samples- LEGO MINDSTORMS Education, Vernier, Texas Instruments, Tain etc.

Manual dataloggers – require human operators and manual recording of the data obtained, they include standard thermometers, tyre air pressure gauges, tick lists, etc.

A sensor is the direct interface between the datalogging device, it's software and the "condition" that you wish to obtain data about . Some sensors are integrated into the datalogging device eg: Alcohol Breathalyzer; others can be detached and are separate to the "datalogger" itself

The LEGO NXT sensors are :



The NXT motors act as outputs but they are also inputs ( sensors) as they have in-built rotation / degrees sensors based on the degrees of rotation ( 360° on a circle) of the axle inserted into the motor

**The NXT brick is the datalogging device, it holds your datalogging programs and the collected data. Sensors are plugged into INPUT ports 1 / 2 / 3 / 4 (Motors are plugged in on output ports for degrees/ rotation datalogging / feedback)**



## **Benefits**

1. Dataloggers are usually automatic once you have set them and can be run for long periods of time without human supervision.
2. With most dataloggers the user has the ability to change a range of measurement parameters, this gives the user great flexibility.
3. The sample frequency can be set to an extremely fast rate of sampling, faster than a human could take.
4. Dataloggers can be calibrated for a specific experiment / situation and are usually extremely accurate ( removes the human “variable”) .
5. Because electronic dataloggers store information they offer great flexibility for analyzing the figures, such as exporting to Excel etc.
6. Dataloggers offer the ability to log several sensors at once , relationship of data can be seen easily.
7. Dataloggers provide the user with an easy way to see the results of an experiment.
8. Analyzing data relies heavily on Mathematical skills.

## WHAT DOES A DATALOGGER NEED TO KNOW ?

### 1 WHAT

sensor do I wish to use?

### 2 WHERE

is the sensor plugged in ( input port)

### 3 HOW OFTEN

the samples\*

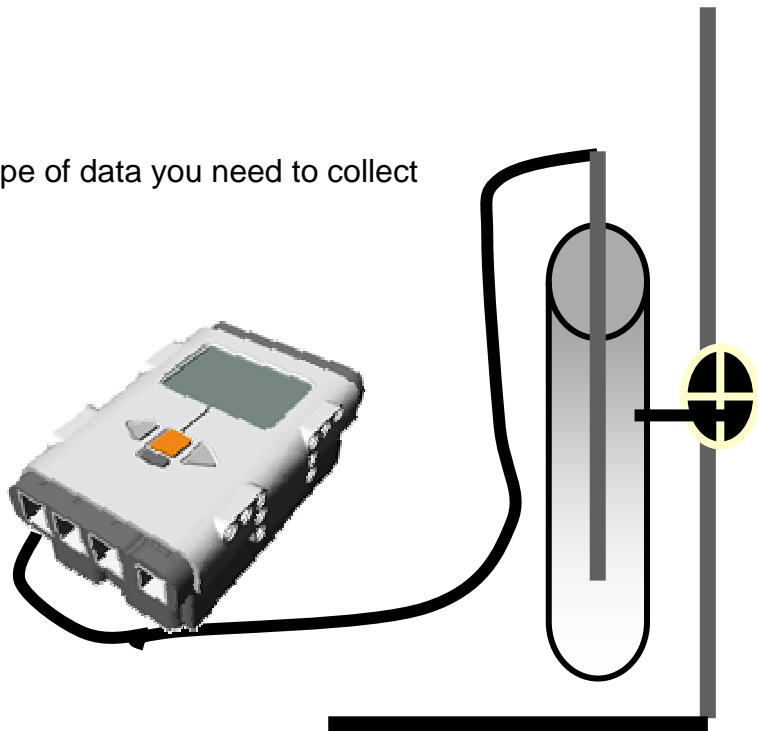
interval – how often do you want to take the sample? Time between

### 4 HOW LONG

Duration - at how many / till when / do you want to take the sample.

## Experiments

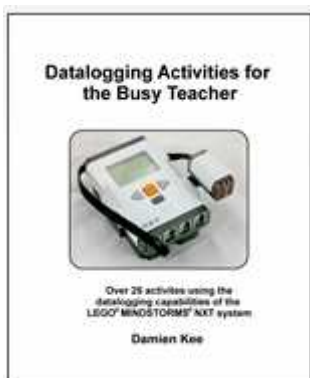
Think about your experiment and the type of data you need to collect



## The Method

1. Prepare the NXT brick – battery charged ( or transformer plugged in for long duration) , re set the shut- down time.
2. Design your experiment method, set up equipment.
3. **Write a data logging program on the computer using the NXTg software in**
4. Down load the program into the NXT brick
5. Plug in the appropriate sensor/s.
6. Run the program on the NXT whilst conducting the experiment
7. UP-LOAD your data from the NXT brick back into the computer using the Infra Red tower
8. Make a prediction, Analyse your data , take a screenshot , copy log file into Excel and conduct graph comparisons etc.

## Activities :



### From \* “Datalogging Activities For the Busy Teacher “ By Damien Kee

1. Touch sensor - Response time experiments : How many presses per second, Audio & touch response. Voting machine – 2 sensors
2. Sound sensor - Bouncing Ball
3. Light Sensor – Sun glasses
4. Ultrasonic – How tall are people walking through the door? How many

Bouncing NXT, Pendulum NXT

5. Rotation – Distance

Pointing at objects ( arrow attached to wheel)- order of pointing

Secret code- 26 letters 13.85 degrees apart . A = 0

\*Available form Moore Educational : <http://www.mooreed.com.au>

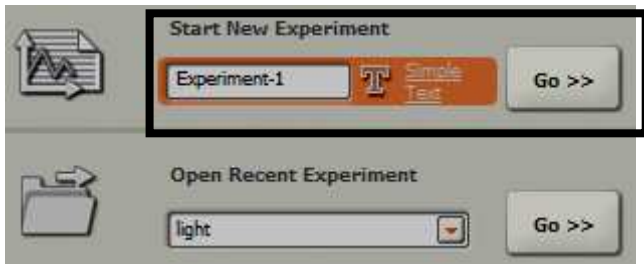
# Straight Datalogging With NXT

Click this icon in the top left of the NXT screen to open the datalogging



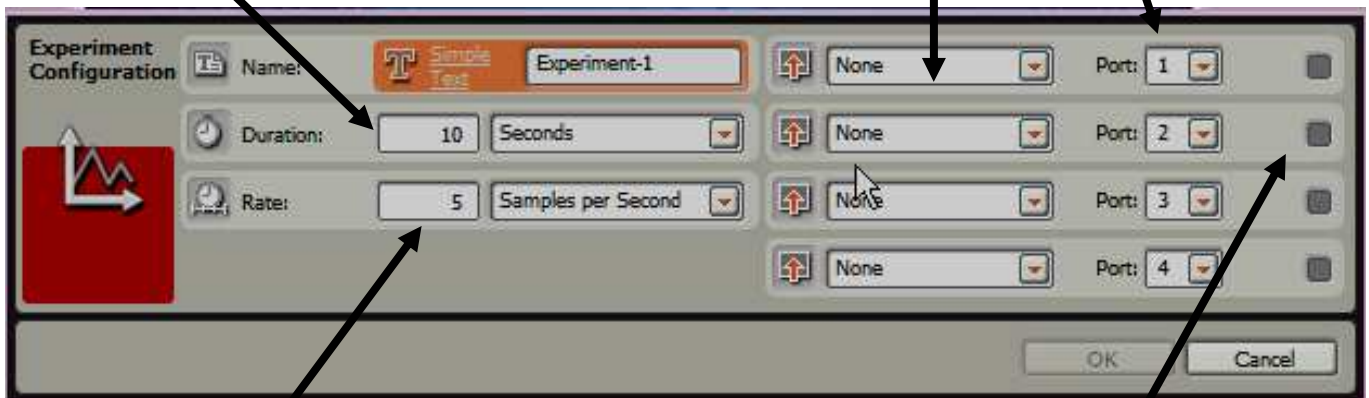
screen

Name your experiment and click GO to create a new experiment



Duration- how long to datalog for

Which sensor & what port?



Rate – how many samples per second

graph colour

## DOWNLOAD YOUR PROGRAM

Turn the NXT brick on, make sure the sensors are plugged in on the nominated ports.

Plug the USB cord into the NXT brick

DOWNLOAD the datalogging program into the NXT brick by clicking the DOWNLOAD TO NXT button on the datalogging screen.

Disconnect the USB lead from the NXT brick



**RUN THE PROGRAM :** Find the program in MY FILES ( in square in the centre of the screen ) , select using the orange button



Software Files >  
Select with orange button

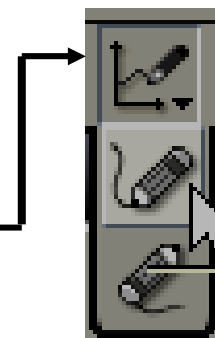


Then locate and select your datalogging program. Pres the orange button to select , then again to run it.

The screen will indicate when the program has ceased to run.

## PREDICT RESULTS

Before uploading the data set you may like to draw a prediction line on your graph using the **prediction tool on the menu bar**:



## UPLOAD THE CAPTURED DATA

You now have to upload the data into the computer to be shown as a graph.

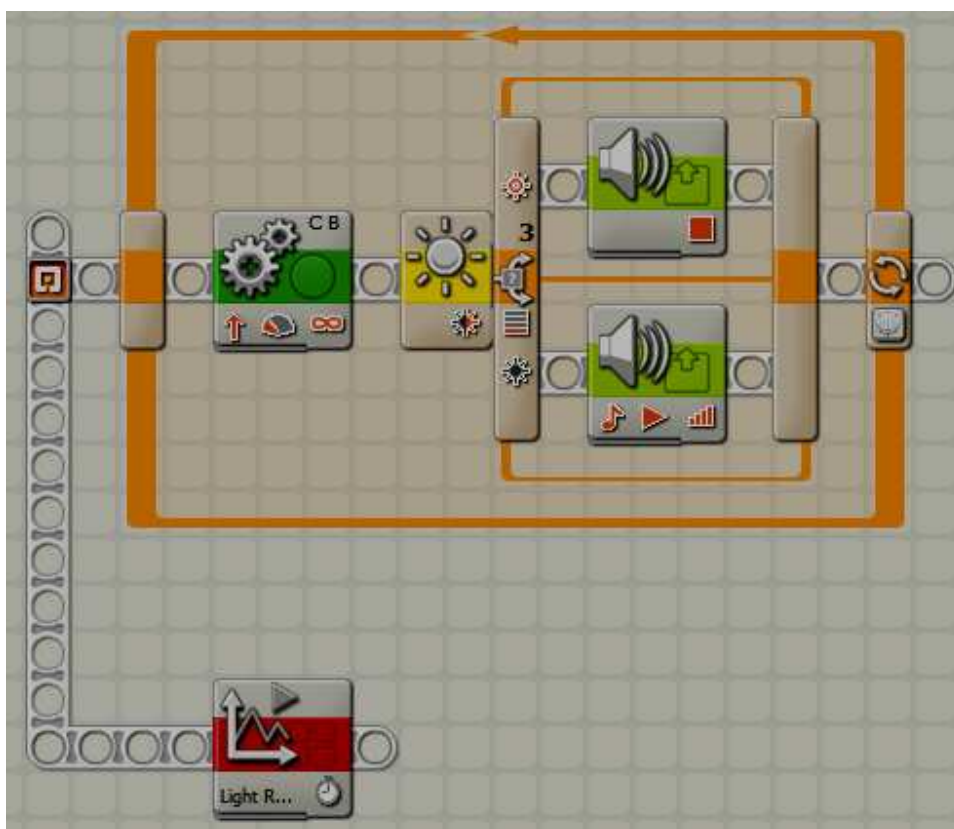
Connect the USB lead to the NXT brick again.

Click the UPLOAD FROM NXT button on the datalogging screen and your data will upload onto the screen



## ALTERNATIVE – DATALOGGING ROBOT

The illustration below shows a datalogging robot. It datalogs the light and sound sensors for 10 seconds at a rate of 3 per second while also moving forward slowly and playing a tone for .3 of a second if the light sensor “sees” light >40 , this also runs for 10 seconds. You need to take care not to contradict your datalogging and robotic commands to the robot



## ANALYSE THE DATA

You can have a closer look at the data collected at various points on the graph by using the tools on the menu bar :

Undo   Redo   Delete   Zoom   Pan   Predict   Analysis   Annotation

**ZOOM tool** →

Get a closer look at the data

Zoom in and out / reset

**Analysis Tool** →

**Point analysis**

**Section Analysis**

Screenshot

Light in this room

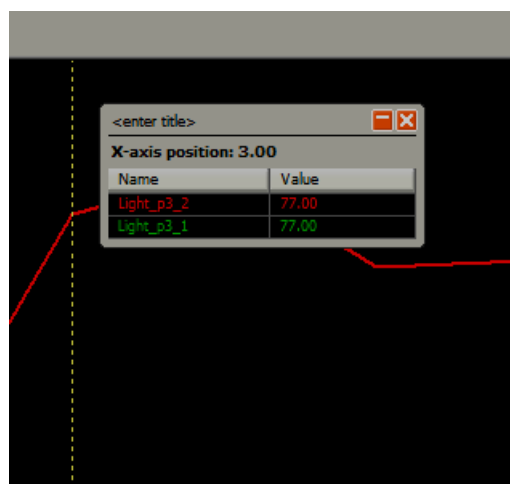
Brightest spot near the window  
darkest - inside the cupboards

Mouse click a point on your graph

**Point analysis** inserts a label on the screen and a numeric analysis of the data in the range

<light>			
Start: 4.00		End: 6.00	
Name	Min	Max	Mean
Light_p3_2	69.00	83.00	74.00
Light_p3_1	69.00	83.00	74.00

Show Linear Fit



When data is uploaded you will see the data information in the left lower window:

Start Time	0.00	1.00	2.00	3.00	4.00	5.00
23/11/2009 1:30 PM	36.00	32.00	37.00	77.00	83.00	69.00
23/11/2009 1:30 PM	36.00	32.00	37.00	77.00	83.00	69.00

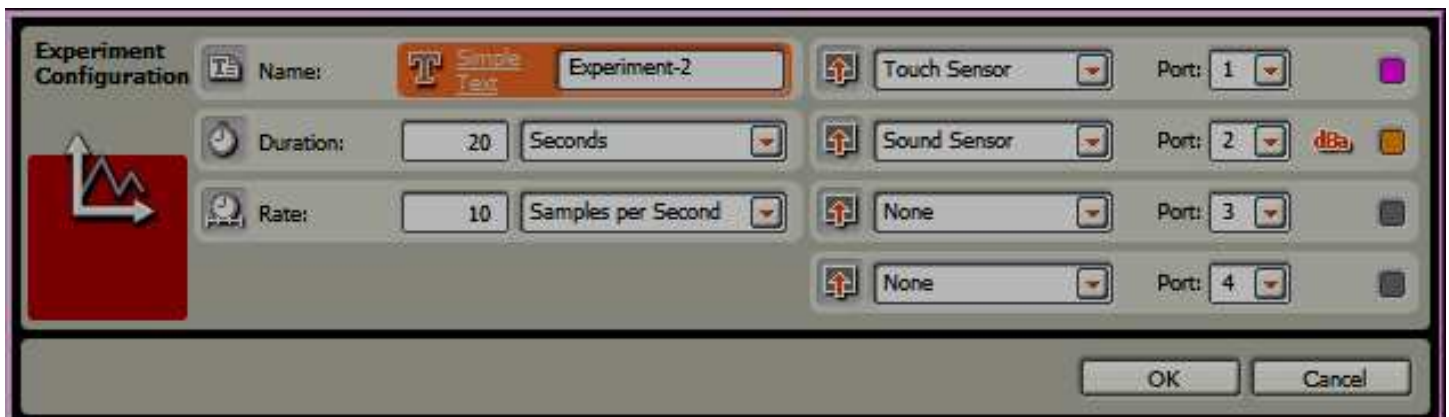
```
Light_1_2.log - Notepad
File Edit Format View Help
Sync data      3341788123
Sdata  3_Light sensor_on
Time   Light Sensor
0      36
1000   32
2000   37
3002   77
4000   83
5000   69
6003   70
7003   100
8003   35
9003   51
10000  40
```

The uploaded data is also saved in a LOG FILE , this is a text file ( Windows Notepad) where the data can be copied and pasted into EXCEL to analyse the data further and create more detailed & overlaid graphs for comparisons

### EXPERIMENT 1 – REACTION TIME

Plug in Touch sensor on input port 1, Sound sensor on input port 2  
Click FILE → NEW

Set the experiment parameters as :



## EXPERIMENTS 2 – 5

Can you work out what you need to log for these experiments?

Equipment ; Assorted sunglasses,

Assorted balls

Whistle

Motors, axles and wheels, Template from book

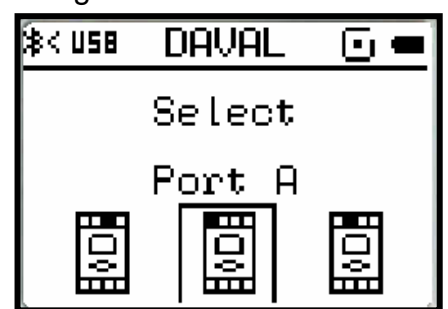
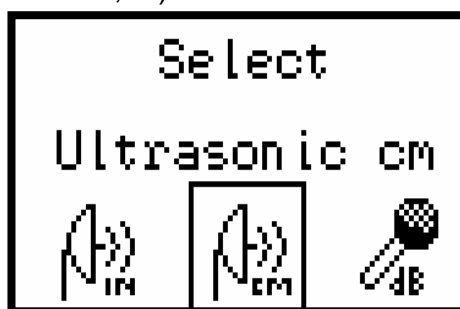
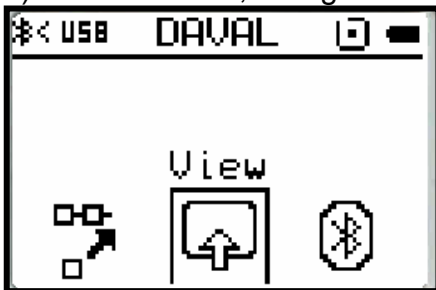
## OTHER CONSIDERATIONS WITH LEGO® MINDSTORMS Education

1. Set the NXT brick so that it doesn't shut down automatically before the experiment is completed- DEFAULT SHUT DOWN TIME FOR THE NXT in the NXT window
2. Make sure that you don't exceed the NXT bricks memory, too many sensors at once, long duration with extremely fast sampling rate will tend to do this
3. Decide what experiment you wish to do and what equipment and sensors you need
4. Load the datalogging programs into the NXT brick before the class to speed things up or for a mobile lab
5. NXT can datalog at up to 100 samples per second .
6. You can also use NXT g programming to incorporate datalogging into a robot in a similar manner to the Mars Pathfinder / Phoenix



ALSO USE VIEW ON THE NXT to see sensor readings ( doesn't log data )

1) Scroll to VIEW, orange button to select, 2) Scroll to select sensor, orange button to select



3) Scroll to plug in port , orange button to select. Zero reading using orange button ( degrees)