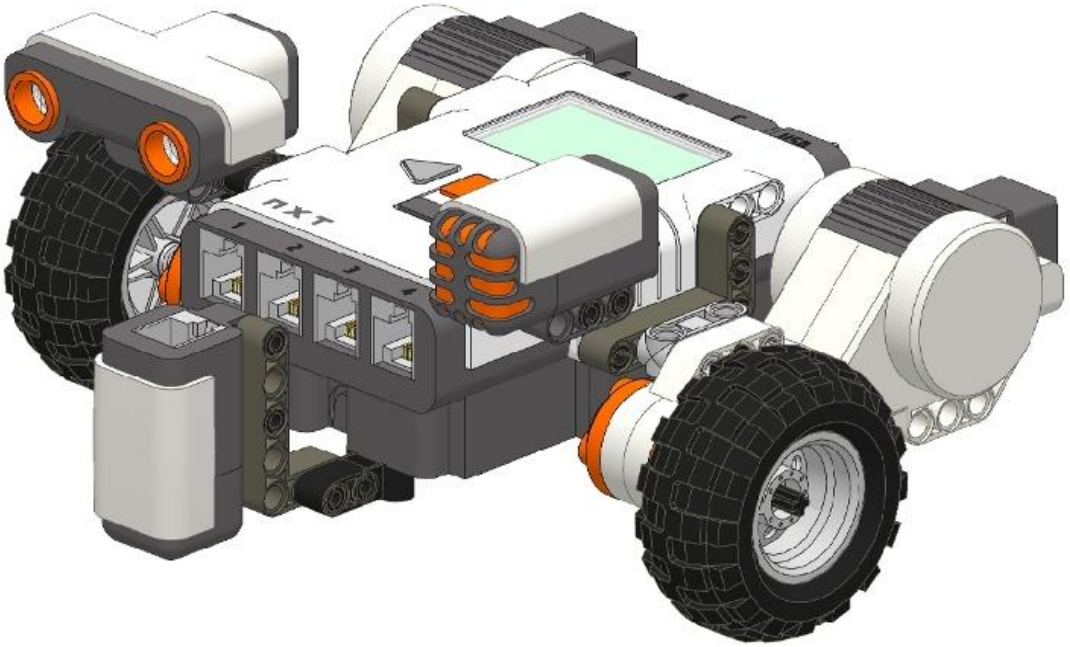
Student Worksheets for Classroom Activities for the Busy Teacher: NXT



Teacher Resource Book
available from

www.damienkee.com/books

Student Worksheet – What is a Robot?

When you hear the word 'robot' some famous movie robots spring to mind. Robots in real life however are not yet up to the standard of their movie counterparts.

Robots are becoming more prevalent in today's society. There are used in high level applications such as space exploration right through to commercial vacuuming robots found in everyday households. You are required to do a research assignment on robotics in general and to focus on one robot in particular.

Robots come in many different shapes and sizes and are often tailored to meet a particular need or action.

Assessment

Create a report on robotics. Your teacher will tell you the format of the report. The following questions will need to be addressed in your work.

- What is a robot?
- Why do we have robots?
- Name some different types of robots?
- What are the main components of a robot?
- Where did the term 'Robot' come from?

Pick one robot and elaborate on it. You must have your robot choice approved by your teacher before you start your research. You will need to include the following information in your report:

Sensors - What information does it take in? (e.g. Sound, distance etc)

Software - What does it do? (e.g. Vacuum floors, explore space)

Mechanical - What materials is it made out of? How does it move? (e.g. motors, arms and metal frames)

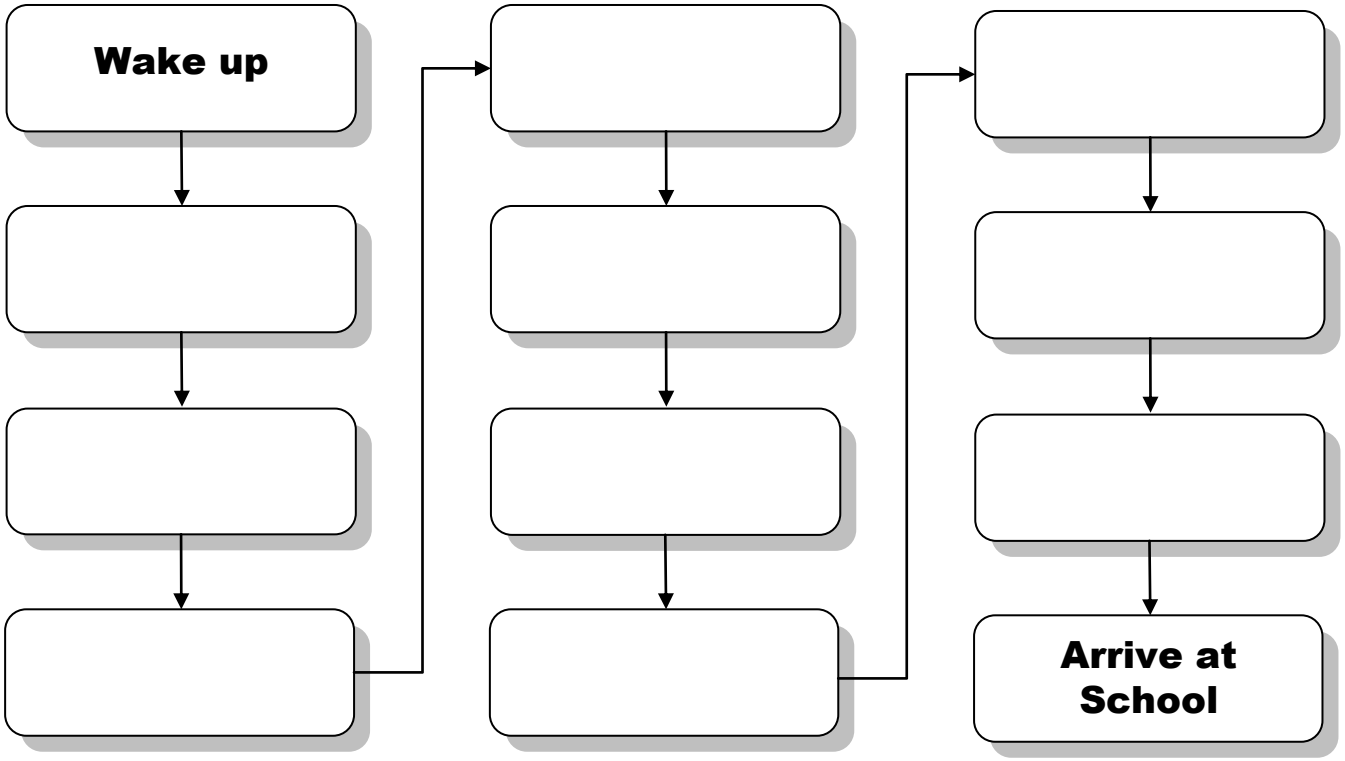
Robot Chosen _____ Due Date_____

Presentation Type_____ Page / Slide limit_____

Student Worksheet - Flowcharting

All robots need to have programs to make them run. The easiest way to start a program is to firstly have a plan. This plan consists of a flowchart of small steps that make up the entire program. Each step is simple enough that the robot can perform it without too much effort.

Task: Using the blank flowchart below, plan out your daily morning routine, from when you wake up until you get to school.



Student Worksheet – DomaBot Basics

Group Name_____ Group Members_____

Overview: NASA is in the market for a new planetary rover to explore the recently discover planet NXTopia. You are required to design and construct a robot that is capable of following a set of commands to explore the planet's surface. Before the robot is deployed, it must be extensively tested to ensure it will perform as expected. You can't fly a technician to NXTopia to reboot the robot!

Before we send our robot into space, we must first test it thoroughly here on earth. Run the following experiments and observe how your robot behaves. Do not move to the next experiment until your teacher has seen your current experiment.

Drive Forward for 90° of the wheels
How far did your robot travel? _____

Drive Forward for 0.25 rotations of the wheels
How far did your robot travel? _____

What is the circumference of the robots wheel?
(hint: you will need to measure the diameter of the wheel) _____

How far will the robot drive if the wheels turn 3 rotations? _____

Program your robot to move 3 rotations and measure how far it goes.
Does it go as far as you expected?

Drive Forward 540° slow, then 540° back as fast as possible

Turn the robot around 180°
What happened? How far did your robot turn if you type in 180°? _____

How much Duration does the wheel need for the robot to turn 180°?
(hint: keep experimenting until it is perfect!) _____

Drive forward for 500mm (OR 20 inches), turn around 180° and drive back to where you started

How much duration do you need to go forward 500mm (20 inches)?

(hint: Have a look at the circumference of your wheel,
this will tell you how far your robot goes in 1 rotation) _____

Make your robot drive in a 'figure of 8'

(hint: draw a diagram first in the space below before you start programming. Don't forget to mark your starting point!)

Student Worksheet – How far?

Group Name_____ Group Members_____

Overview: In the initial construction of the robot the travelling characteristics are required. After characterising the properties, NASA have asked that you use your data to make predictions about the distance your robot will travel given specific time constraints.

Your group will be assigned a random power level to be assessed. Power Level Assigned _____

For this experiment you will need to measure how far the robot travels for different time values (eg. 1 second, 2 seconds, 3.5 seconds etc). The more data you gather, the more accurate your graph will be.

Plot the results either on the graph below or in a graphing software package.

(Hint: you will need to know the smallest and largest times you tested for, as well as the smallest and largest distances so that you can determine the horizontal and vertical axis scales)

Once you have plotted your data, can you see a relationship between the time taken and the distance travelled?

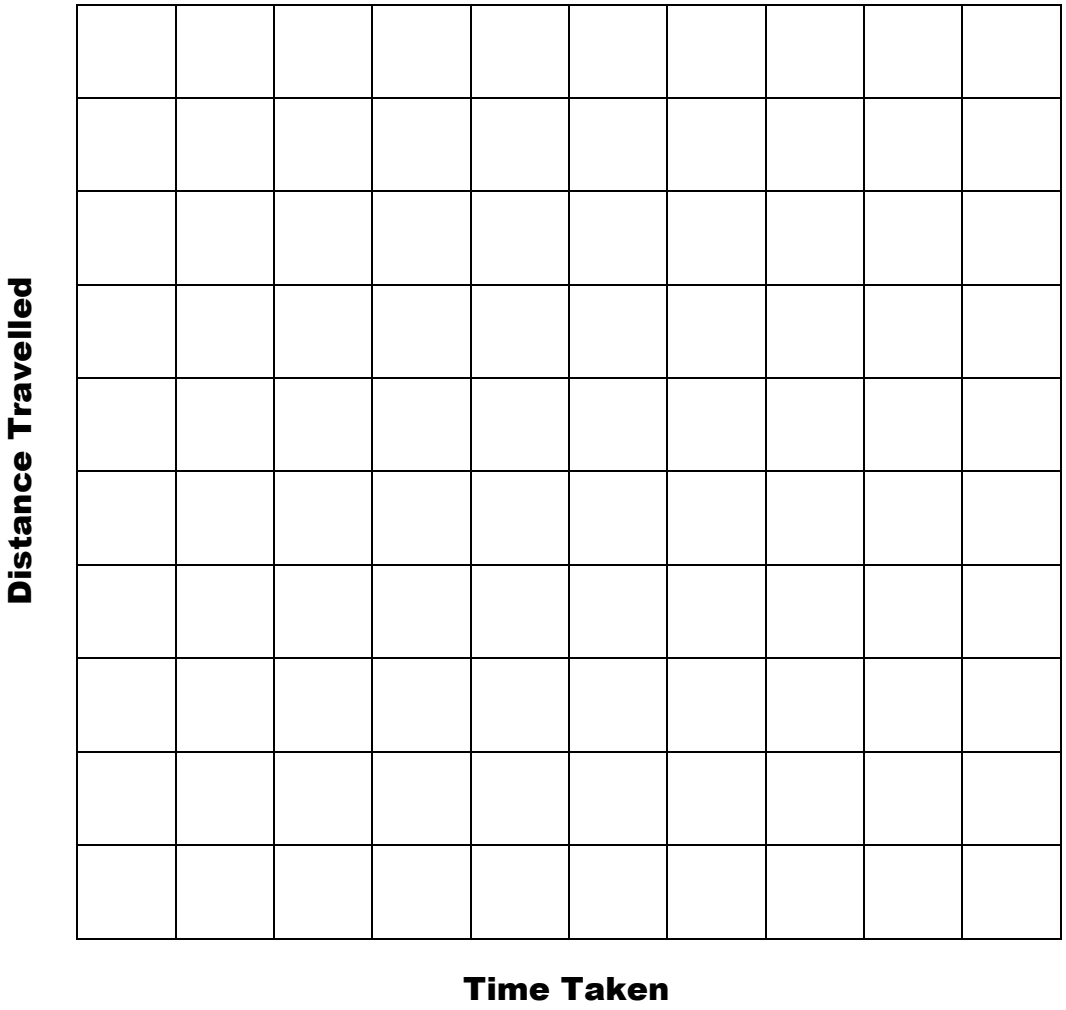
By looking at the graph, can you determine how many seconds your robot would need to travel exactly 30com (12 inches)? _____ seconds

How about 1.5m (59 inches)? _____ seconds

Your teacher will assign you a test distance. How long does your robot need to travel this particular distance?

Test Distance = _____ Time required = _____ seconds

Distance Travelled vs Time Taken



Student Worksheet – How fast?

Group Name_____ Group Members_____

Overview: To accurately be able to command the robot, you need to understand how fast it can go and what properties may change its performance. NASA have requested a detailed report, supported by data that you have gathered from your robot.

Make your robot drive forward for 5 rotations at 50% power

How long did it take to go 5 rotations? _____ sec

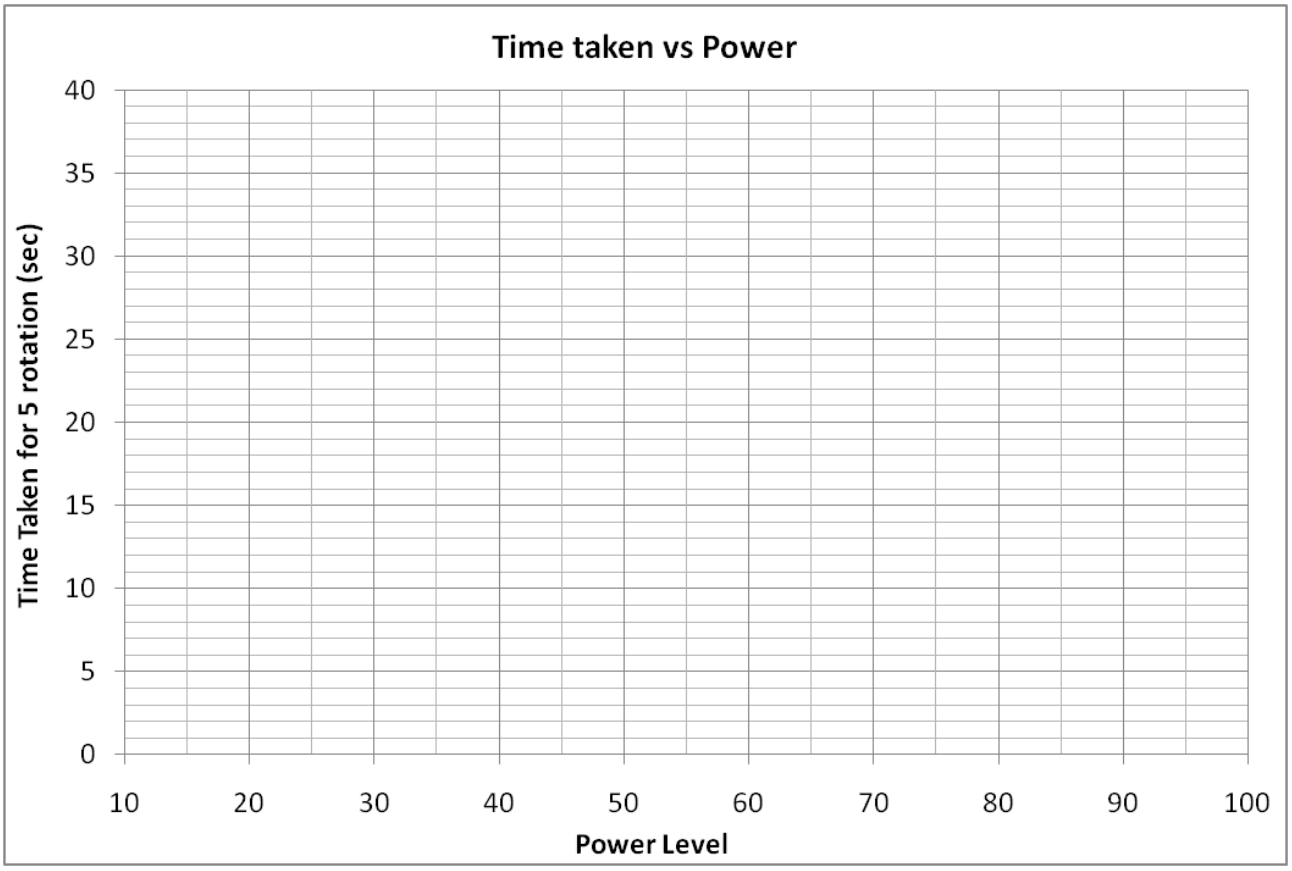
What about 10% power? _____ sec

70% power? _____ sec

Fill in the time taken to complete 5 rotations on this table and plot your average on the graph

Power Level (%)	Run 1	Run 2	Run 3	Run 4	Run 5	Average
10						
20						
30						
40						
50						
60						
70						
80						
90						
100						

Draw a line of best fit through the data you have taken.



Based on this data, make a prediction as to how long it will take to do 5 rotations at 65% power. _____ seconds

Mark your prediction on your graph in a different colour. Program your robot and see what happens. How close were you?

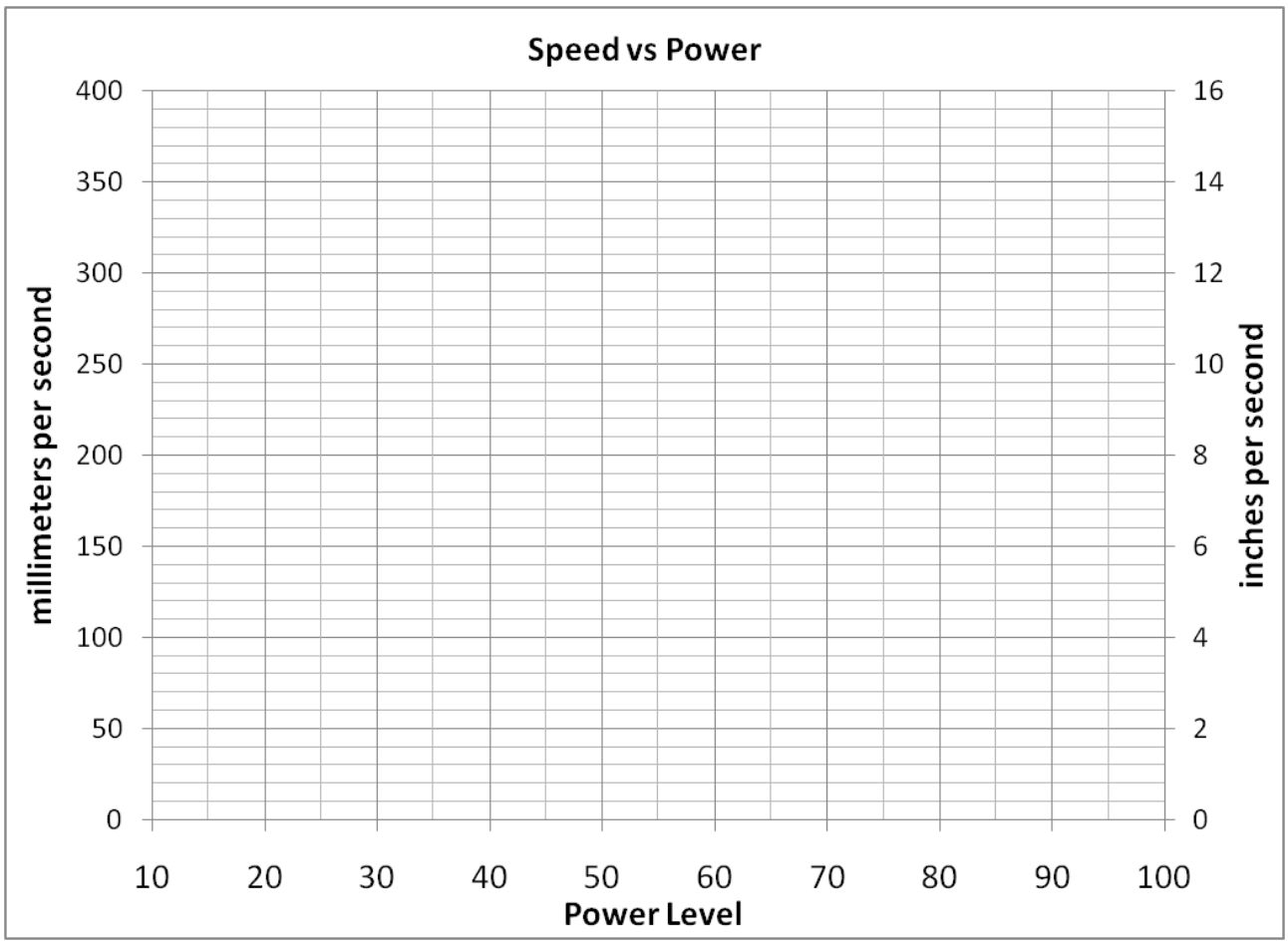
Let us now convert this time taken into a speed.

How far does 5 rotations of the wheel take us? _____

Now convert each of these times and distances into a speed for each different power level. Fill in your answers in the table below.

Power Level (%)	Time for 5 rotations	Speed (m/sec OR inches/sec)
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		

Plot the speed of your robot against the power level on the following graph.



NASA have indicated that in some parts of NXTopia, the loose sand will make it difficult to drive quickly. They have calculated that the robot cannot exceed a maximum speed of 25 mm/s OR 10 inches/sec.

What power level is required to meet this speed? _____ % power level

Mark the speed on your graph in a different colour. Program your robot to travel for 10 seconds and check to make sure your robot stays within the guidelines.

What would happen if we were to run the same experiment on carpet?

What was the most difficult part of this challenge? _____

How did you go about solving it? _____

Student worksheet – How Many Sides?

Group Name_____ Group Members_____

Overview: Once on NXTopia, your robot will be required to identify interesting aspects for later analysis. Your robot will be required to mark off an area such that a passing satellite can easily identify the item in question. Initially you will be required to draw a square, but will then move onto other shapes and designs.

Build the drawing attachment and fix it to your robot and program your robot drive in a square, with each side 500mm (20") in length.

How many sides does a square have? _____

How many angles? _____

How many degrees in each angle? _____

Could you use the loop block to make the program simpler?

Fill in the following table for other common shape

Shape	**Number of sides**	**Internal angle**	**External angle**	**Turn Angle required by the robot**
Octagon				
Hexagon				
Triangle				

What was the most difficult part of this challenge? _____

How did you go about solving it? _____

Student Worksheet – Help! I'm Stuck

Group Name_____ Group Members_____

Overview: Whilst on NXTpoia, your robot will undoubtedly come up against some terrains that are too difficult for the robot to navigate. NASA is worried about a particular chasm near the drop zone where the robot could conceivably get trapped. They have asked that you demonstrate your robots ability to detect such an obstacle and navigate out of the chasm.

Build a bumper to be attached to the front of your robot.

There are several progressive steps we would like to make in order to solve this problem. Each program should be done individually and demonstrated to a teacher before moving on.

We would like our robot to drive forward until it encounters an obstacle.

- Drive until object is detected, then stop.
- Shout 'ouch!' when you hit an object
- Turn around when you hit the object.
- Repeat this action until you find your way out of the chasm

What was the most difficult part of this challenge? _____

How did you go about solving it? _____

Student Worksheet – Help! I'm (still) Stuck

Group Name_____ Group Members_____

Overview: NASA are happy with your bumper, but are concerned that the physical impact with the chasm walls will dislodge rocks sitting above. Modify your robot to include the Ultrasonic Sensor and run the same program, but this time recognising the walls before you touch them.

Connect the Ultrasonic Sensor to your robot.

Use the 'View' menu on your robot to see what types of readings you get with the Distance Sensor

View → Ultrasonic (cm OR inch) → Port 4

There are several progressive steps we would like to make in order to solve this problem. Each program should be done individually and demonstrated to a teacher before moving on.

We would like our robot to drive forward until it encounters an obstacle.

- Drive until object is detected, then stop.
- Shout 'hello!' when you are close to an object
- Turn around when you are close to the object.
- Repeat this action until you find your way out of the chasm

What was the most difficult part of this challenge? _____

How did you go about solving it? _____

Student Worksheet – Stay Away from the Edge

Group Name_____ Group Members_____

Overview: Another challenge the robot might face is safe navigation along a ridge line. Get too close and over you go. NASA has asked that you prove your robot is capable of staying away from the edge of a cliff.

Build a light sensor attachment for your robot.

We will need to take some readings to determine what values your robot reads for the table and the edge of the table.

View → reflected light → Port 3

What value do you get when your robot is on the desk? _____

What value do you get when the light sensor is over the edge of the desk?
(hint: keep your hands and legs out of the way) _____

What is your threshold number? _____

There are several progressive steps we would like to make in order to solve this problem. Each program should be done individually and demonstrated to your teacher before moving on.

We would like our robot to drive forward until it recognises the edge of the desk. Get ready to catch it just in case!

- Drive until the edge is detected then stop.
- Shout 'whoops!' when you get to the edge.
- Turn around when you reach the edge.
- Repeat this action staying away from the edge of the chasm

What was the most difficult part of this challenge? _____

How did you go about solving it? _____

Student Worksheet – Did you Hear That?

Group Name_____ Group Members_____

Overview: The possibility of alien life forms present on NXTopia is quite high. NASA are concerned that they might be hiding and that the robot will not see them unless it can hear them approaching. Build a robot that can react to loud sounds.

We will need to take some readings to determine what values your robot reads for different noises.

View → Sound dB → Port 2

How loud is a clap? _____

How loud is silence? _____

Like previous challenges, we will be breaking this one down into small manageable programs

- Drive forward until you hear a sound and then stop
- Once the sound is heard, stop for 2 seconds and slowly turn around for 360 degrees of the robot.

How much duration does the wheel require to enable your robot to turn around 360 degrees? _____

We will now use 2 sensors to locate our alien.

- Drive forward until you hear a loud sound.
- Turn around slowly until you see an object within 30 cm (12")
- When you see your alien, stop and say hello

What was the most difficult part of this challenge? _____

How did you go about solving it? _____

Student Worksheet - MiniGolf Score Sheet

	Points					Total
Group Name	**Round 1 Position A**	**Round 2 Position A**	**Round 3 Position B**	**Round 4 Position C**	**Round 5 Position D**	

Student Worksheet – Dancing Robots

Group Name_____ Group Members_____

Artist:		**Song Name:**	
Section	*Time*	*Description*	*Intended robot movement*

Student Worksheet – As seen on TV!

Overview: NASA decided on using your design to fly to NXTopia. As a result of the associated publicity, many other people want to buy their own version of the robot. Come up with a marketing promotion to sell your robot.

Your presentation may consist of one or more of the following media formats as notated by your teacher

- School Newspaper article
- Video commercial
- PowerPoint Presentation
- Poster presentation
- Website
- Oral Presentation

Be sure to include the following information in your presentation

How does it look?

What can it do?

How does it move?

How does it sense its surrounding environment?

What are the standard missions it can perform?

Look back over your previous activities to help you answer these questions.

Remember, you are now pitching your idea to everyday people, not NASA scientists.