Work out a real Project

II. Work on Exploration stage

Activity 1 **75 minutes**

Study now the description of the second stage (Exploration Stage) of the project and carry out all the activities described in the corresponding worksheets (Worksheet 3, Worksheet 4, Worksheet 5, Worksheet 6).

Activity 2 **15 minutes**

At the end of the Activity 1 discuss in your group the following issues:

1. What kind of difficulties may a teacher face during this stage?
2. What kind of difficulties may the students face?
3. Complete the following table with activities that may be included in the Exploration Stage.

Be prepared to share your thoughts with the rest of the class.

Exploration Stage

Stage	Teaching Strategies-Tools	Students activities	Teacher activities
Exploration Stage			

Description of the Project

Setting a Bus in Motion

Exploration Stage

3-4 hours

At the exploration stage, students become familiar with the material that they are going to use (construction material and software). Through their actions at this stage, they acquire the necessary experience which will enable them, at the subsequent stages, to develop independently their ideas. The activities at this stage are structured in such a way as to display the aspects that can be utilized in the solution of the problem they are asked to address.

At the end of this unit, learners will be able:

- ✓ to recognize and name the basic categories of building material;
- ✓ to combine materials in simple working structures;
- ✓ to observe and explain the operation of simple machines;
- ✓ to state characteristics of simple machines (relationships between angles, velocities, forces);
- ✓ to make use of the basic icon - commands to program their constructions or models;
- ✓ to investigate and compare;
- ✓ to draw conclusions.

Third Teaching Hour

Learners recognize and name the materials they are given, relating them to the functions of a robot. The activities of Worksheet 3 may be carried out by small teams.

Subsequently, the pupils combine the materials and carry out minor constructions. The materials that can be utilized are gears, pulleys beams and blocks. In our case, we chose to study gears. Gears are materials that can be used in the transfer of motion from one axle to another. They work together in groups of two or more. Let us call the moving gear "driver" and the gear that follows "follower". The size of the gears is determined by the number of teeth they have. The gears with the fewer teeth move at a higher speed as compared with the gears with more teeth. The ratio of the revolution is the reverse of the ratio of teeth.

Example: The ratio of the teeth of the smallest and biggest gear is 8/48. This means that one revolution of the big gear corresponds to 6 revolutions of the small gear. In this way, if the small gear is the "driver", then the big gear

moves at lower angular velocity and, as a result, we get lower angular velocity at the axle (gearing down). This, however, ensures higher torque and, thus, the car can perform trips where higher torque (uphill) is required. But if the big gear is the "driver", then the small one revolves at sixfold speed (gearing up). Thus, angular velocity increases, whereas the torques exercised is now reduced. Therefore, the gears may be utilized in increasing or reducing the angular velocity, the torque, the driving force they exercise and change the direction of a rotation (90^o or 180^o). Consequently, in constructing a motor car, we can use two different size gears for the transfer of motion from the motor to the wheel. The small gear will have to be placed in the motor and the big one in the wheel, thus ensuring sufficient driving force for the car, since we are not so much interested in speed.

In Worksheet 3, learners try proposed structures and formulate rules. These rules are discussed in class and modified accordingly.

Fourth Teaching Hour

The pupils continue their exploration activity with simple constructions aimed at the construction of a small car capable of moving forward and backward (Worksheet 4). Typical car structures can be found in Lego Mindstorms Edu software. At the exploration stage, a construction with one motor is enough. The cars that are to be constructed will be able to move if:

- You have connected the motor with a cable to Port A, B or C
- You have set the micro-processors NXT on by pressing the orange button,
- You have selected My files/software files/Demo by pressing the orange button

The learners will have already been familiar with the construction of the model. It is very possible that they will have already begun to compare the car models they have constructed, drawing conclusions in respect of speed, stability and functional capacity of each model.

Fifth Teaching Hour

During the fifth hour, learners can deal with their programming part. A brief introduction regarding the micro-processor operation may take place and, once the right connections of touch and light sensors and those of the motor have been made, learners can proceed with the programming environment (Worksheet 5). We propose the use of the LEGO MINDSTRORMS Education NXT software.

Once the construction of the model is complete, the learners can proceed with programming. In Worksheet 5 it is proposed that the pupils should develop two programs which drive and stop the car with the use of clock and

touch sensors. Learners are also asked to compare those two programs, which solve the same "problem", so that the advantages and disadvantages of each solution may be determined.

Sixth Teaching Hour

During this hour, the pupils are exploring the light sensor and the Investigator environment (Worksheet 6). This activity aims at the learners' understanding of the sensor operation enabling them to utilize it when carrying out their programming work at the subsequent steps. They connect the light sensor with the microprocessor and move with the sensor in space. They record the readings given by the sensor in the room's various areas: in front of the open window, in the lamp area, in the computer's monitor, on the floor, on the table, in the black color area near the window, in the black color area at a darker point of the room.

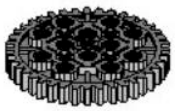
Name……**Date**……

Setting a Bus in Motion

Worksheet 3

Getting to know the structural materials

1. Match the names found in the list on your right hand side with the respective items on the left hand side.

	gear
	pulley
	tire
	axle beam
 	block connector

2. A "robot" is a structure that can:

Collect data from the environment- INPUT	→	Process those data and make decisions – PROCESSING-	→	Execute those decisions having a behavior- OUTPUT

According to the above, match the following items with the functions they serve.

INPUT PROCESSING OUTPUT




Experiment with the GEARS

A B

3. With the use of two gears and two axles create the following construction.

A. Rotate one of the gears. The revolving gear is called "driver", whereas the other one is called "follower". Which is the "follower's" revolution direction?

B. Try the experiment with the other gear. What do you observe? Can you formulate a rule regarding gear revolution direction?

A B

4. Now combine two different size gears.

Rotate the smaller one. What do you observe in the revolution speed of the big one? Now rotate the big one. What do you observe in the revolution speed of the small one? Can you formulate a rule regarding the ratio of the gear revolution speeds?

5. Create the construction you see on the picture. Move the small gear and complete the following table:

A B Γ

	A **(8 teeth)**	**B** **(48 teeth)**	**C** **(24 teeth)**
Revolution direction			
Revolution speed (angular velocity)			

Conclusion:

Name……Date…….

Setting a Bus in Motion

Worksheet 4
Construction of a robot car

1. In order to construct a car it is necessary to use a microprocessor NXT, motors and sensors, together with other structural materials. The NXT is joined to "blocks" with the use of connectors

You may try to construct a small car model like the following.

2. How many motors will be needed to move your car forward and backward?

3. Use additional materials to construct a small car capable of running forward and backward. How will you transfer motion from the motor to the wheels? Draft a sketch.

Name……**Date**……

Setting a Bus in Motion

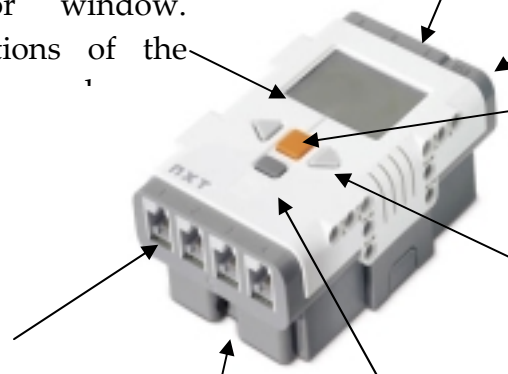
Worksheet 5

Programming a Robot

1. The NXT microprocessor can communicate with the computer through a USB cable or a Bluetooth connection.

2. On the NXT microprocessor, sensors, motors, lights are connected with cables.

In more detail:



1. Monitor window. Here the actions of the

2. Output ports A, B, C: Motors and lights can connected

3. Connection with PC

4. Enter button. By pushing it we can perform the selected action (run) from the menu or to select a submenu.

5. We use these arrows to move through menus.

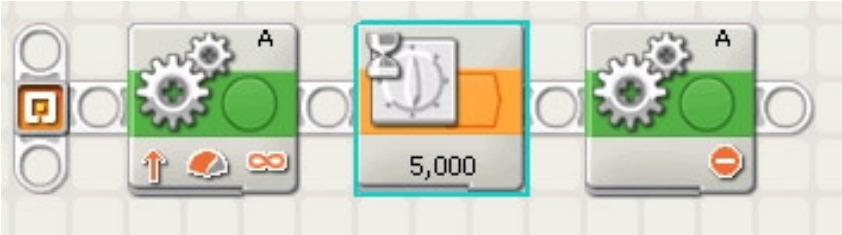
6. Use the gray button to turn off the NXT or to move from a submenu to the main menu.

7. Connection with a power source.

8. Input ports 1,2,3,4: The touch sensors, light sensors, temperature sensors etc. can be connected here.

Connect a motor, a light sensor and a touch sensor to the appropriate ports.

3. Open the LEGO MINDSTRORMS Education NXT software. In this program, the commands are symbolized by icons. What follows is a series of commands.



What do you think is going to happen if you perform this program?

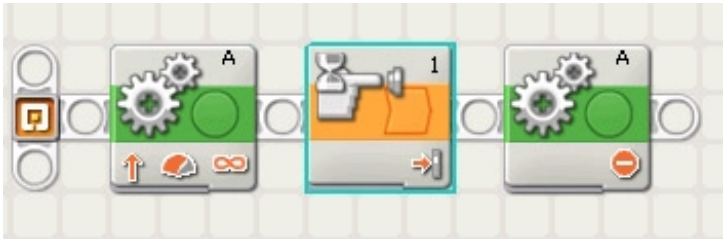
4. Develop it with the use of the LEGO MINDSTRORMS Education NXT software. The icons are all found on the Common Palette.

Open the NXT.

Connect the NXT with the PC through USB cable and download the program.

Run the program by press the Enter button (orange button) 4 times.

5. Create on your computer a program which can stop the car by means of a touch sensor. Run it.



6. Compare the use of a clock and the touch sensor in the control of the car's running interruption.

Interruption by clock	**Interruption by touch sensor**

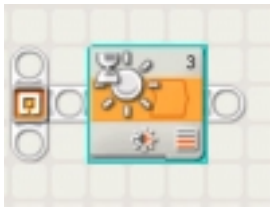
Name.....**Date**.....

Setting a Bus in Motion

Worksheet 6 : Use of Light Sensor

1. The Light Sensor enables your robot to distinguish between light and dark. It can read the light intensity in a room and measure the light intensity of colored surfaces.Which port should the light sensor be connected with?

2. Connect a light sensor with the microprocessor's Port 3. Open Lego Mindstrorms Education NXT software and create a program with a light sensor only. Download and run the program.



The value shown here is the sensor's reading.

Move the sensor in space and observe its reading changes taking place. Complete the following table:

Position	Value of Sensor
In front of the window	
Towards a lit lamp	
On black color	