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.

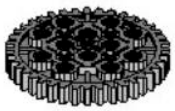
Name……**Date**……

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: