

Grade 6

Energy and Control /  
Structures and  
Mechanisms

# Vehicle of the Future

## The Task

Students were asked to design and create a vehicle prototype for a fictitious automobile show. Their vehicle was to be electrical (activated by an on-off switch) and was to be capable of travelling a distance of at least one metre. Students were to complete a set of worksheets that comprised a design portfolio, including sketches, pre- and post-construction drawings, a record of trials and modifications, an explanation of how the vehicle was constructed, and a reflection on the design process.

## Expectations

This task gave students the opportunity to demonstrate their achievement of all or part of each of the following selected overall and specific expectations from the strand Energy and Control: Grade 6 – Electricity, and the strand Structures and Mechanisms: Grade 6 – Motion. (The codes that follow the expectations are from the Ministry of Education's *Curriculum Unit Planner*.)

*Students will:*

1. demonstrate understanding that electrical energy can be transformed into other forms of energy (6s51);
2. design and construct a variety of electrical circuits and investigate ways in which electrical energy is transformed into other forms of energy (6s52);
3. identify uses of electricity in the home and community and evaluate the impact of these uses on both our quality of life and the environment (6s53);
4. design and construct an electrical system that operates a device in a controlled way (6s69);
5. demonstrate an understanding of different kinds of motion (6s78);
6. design and make mechanical devices, and investigate how mechanisms change one type of motion into another and transfer energy from one form to another (6s79);
7. formulate questions about and identify needs and problems related to the properties or uses of electrical energy, and explore possible answers and solutions (6s61);
8. formulate questions about and identify needs and problems related to structures and mechanisms in the environment, and explore possible answers and solutions (6s88);
9. plan investigations for some of these answers and solutions, identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions (6s62/6s89);
10. use appropriate vocabulary, including correct science and technology terminology, in describing their investigations and observations (6s63/6s90);
11. compile data gathered through investigation in order to record and present results, using tally charts, tables, labelled graphs, and scatter plots produced by hand or with a computer (6s64/6s91);
12. communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, oral presentations, written notes and descriptions, drawings, and charts (6s65/6s92).

### **Prior Knowledge and Skills**

To complete this task, students were expected to have some knowledge or skills related to the following:

- experimenting with a motor
- building a simple circuit
- making a switch
- understanding all relevant scientific vocabulary
- identifying and understanding four types of motion
- understanding how electrical energy can be transformed into kinetic energy
- understanding how to create thumbnail sketches, a pre-construction sketch, and a labelled drawing

*For information on the process used to prepare students for the exemplar task and on the materials and equipment required, see the Teacher Package reproduced on pages 122–30 of this document.*

## Task Rubric – Grade 6: Vehicle of the Future

| Expectations*                                     | Level 1  | Level 2   | Level 3   | Level 4   |
|---|--|---|---|---|
| <b>Understanding of Basic Concepts</b>            |  |   |   |   |
| <b>The student:</b>                               |  |   |   |   |
| 1, 5  | <ul style="list-style-type: none"> <li>– demonstrates limited understanding of the transformation of electrical energy into kinetic energy in a moving vehicle</li> <li>– demonstrates limited understanding of linear and rotational motion</li> </ul>  | <ul style="list-style-type: none"> <li>– demonstrates some understanding of the transformation of electrical energy into kinetic energy in a moving vehicle</li> <li>– demonstrates some understanding of linear and rotational motion</li> </ul>   | <ul style="list-style-type: none"> <li>– demonstrates general understanding of the transformation of electrical energy into kinetic energy in a moving vehicle</li> <li>– demonstrates general understanding of linear and rotational motion</li> </ul>   | <ul style="list-style-type: none"> <li>– demonstrates thorough understanding of the transformation of electrical energy into kinetic energy in a moving vehicle</li> <li>– demonstrates thorough understanding of linear and rotational motion</li> </ul>   |
| <b>Design Skills</b>                              |  |   |   |   |
| <b>The student:</b>                               |  |   |   |   |
| 2, 6<br>– identifying the problem/need<br>7, 8    | – identifies and describes the design challenge with limited clarity   | – identifies and describes the design challenge with some clarity   | – identifies and describes the design challenge clearly   | – identifies and describes the design challenge clearly and precisely   |
| – making the plan<br>9                            | – outlines a few of the steps needed to complete the plan  | – outlines some of the steps needed to complete the plan  | – outlines most of the steps needed to complete the plan  | – outlines all or almost all of the steps needed to complete the plan   |
| – executing and evaluating the plan<br>2, 4, 5, 6 | <ul style="list-style-type: none"> <li>– uses the design process in a limited way to test the vehicle and make appropriate modifications where necessary</li> <li>– constructs a vehicle that transfers rotational motion into linear motion with minimal efficiency and that may or may not travel a distance of one metre</li> </ul> | <ul style="list-style-type: none"> <li>– uses the design process somewhat effectively to test the vehicle and make appropriate modifications where necessary</li> <li>– constructs a vehicle that transfers rotational motion into linear motion with some efficiency and that may or may not travel a distance of one metre</li> </ul> | <ul style="list-style-type: none"> <li>– uses the design process effectively to test the vehicle and make appropriate modifications where necessary</li> <li>– constructs a vehicle that transfers rotational motion into linear motion with considerable efficiency and travels a distance of one metre</li> </ul> | <ul style="list-style-type: none"> <li>– uses the design process very effectively to test the vehicle and make appropriate modifications where necessary</li> <li>– constructs a vehicle that efficiently transfers rotational motion into linear motion and travels a distance of one metre</li> </ul> |

| Expectations*   | Level 1  | Level 2  | Level 3   | Level 4   |
|---|--|--|---|---|
| <b>Communication of Required Knowledge</b>  |  |  |   |   |
| The student:  |  |  |   |   |
| 10, 11, 12  | <ul style="list-style-type: none"> <li>– communicates ideas and concepts with limited clarity to explain how electrical energy is used to create motion (e.g., in a prototype, sketches, drawings, charts, written responses)</li> <li>– makes limited use of appropriate science and technology vocabulary</li> </ul> | <ul style="list-style-type: none"> <li>– communicates ideas and concepts with some clarity to explain how electrical energy is used to create motion (e.g., in a prototype, sketches, drawings, charts, written responses)</li> <li>– makes some use of appropriate science and technology vocabulary</li> </ul> | <ul style="list-style-type: none"> <li>– communicates ideas and concepts with general clarity to explain how electrical energy is used to create motion (e.g., in a prototype, sketches, drawings, charts, written responses)</li> <li>– makes considerable use of appropriate science and technology vocabulary</li> </ul> | <ul style="list-style-type: none"> <li>– communicates ideas and concepts clearly and precisely to explain how electrical energy is used to create motion (e.g., in a prototype, sketches, drawings, charts, written responses)</li> <li>– makes extensive use of appropriate science and technology vocabulary</li> </ul> |
| <b>Relating of Science and Technology to Each Other and to the World Outside the School</b> |  |  |   |   |
| The student:  |  |  |   |   |
| 3   | <ul style="list-style-type: none"> <li>– shows limited understanding of connections to the world outside the school (e.g., environmentally friendly vehicles, advantages/disadvantages of battery-operated vehicles)</li> </ul>  | <ul style="list-style-type: none"> <li>– shows some understanding of connections to the world outside the school (e.g., environmentally friendly vehicles, advantages/disadvantages of battery-operated vehicles)</li> </ul>   | <ul style="list-style-type: none"> <li>– shows general understanding of connections to the world outside the school (e.g., environmentally friendly vehicles, advantages/disadvantages of battery-operated vehicles)</li> </ul>   | <ul style="list-style-type: none"> <li>– shows extensive understanding of connections to the world outside the school, as well as their implications (e.g., environmentally friendly vehicles, advantages/disadvantages of battery-operated vehicles)</li> </ul>  |

\*The expectations that correspond to the numbers given in this chart are listed on page 60.

*Note:* This rubric does not include criteria for assessing student performance that falls below level 1.

# Student Task Description

Students were presented with the following scenario and task instructions:

You have been invited to the annual “Vehicles of the Future” auto show. This auto show will feature student-built vehicles that:

- transform electrical energy into the energy of moving objects;
- create linear motion;
- are environmentally friendly.

Representatives of the top ten car manufacturers of the world will be attending the auto show. The selected designer will be featured on the cover of *Vehicles of the Future* magazine.

Your task is to:

- design a prototype of an electrical vehicle that can travel a distance of at least one metre;
- make an on-off switch to activate your vehicle;
- complete a design portfolio.

Your vehicle must include the following:

- a battery
- a motor
- a switch
- a circuit
- wheels

Your design portfolio will include the following:

- three thumbnail sketches (planning sketches and ideas)
- a pre-construction concept sketch (a drawing based on one of your thumbnail sketches)
- a post-construction drawing (a detailed, labelled drawing of your completed design including the electrical circuit drawings and measurements)
- a written explanation outlining how your vehicle was constructed
- any design changes that you would make in the future