

# Gear Up!

**Science, Technology,  
Engineering & Mathematics Activities**



**Sandra Bishop**

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Lesson plans based on using Gears!  
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## Foreword

As a teacher it gives me great satisfaction to watch students discover things for themselves, apply this knowledge and be creative. I designed these lessons with that in mind. The aim is to spark the imagination of our students, making learning fun while fostering creative endeavours. In my opinion, that is something worth striving for.

*Gear Up! Science, Technology, Engineering & Mathematics Activities* will help guide students in the primary to middle years levels as they further develop their understanding of STEM concepts. This book has been written as a sequel to *Gears: Science, Technology, Engineering & Mathematics Activities*, and can be used with Australian Curriculum: Mathematics, Science and Technology instruction at the years 3 to 6 level. *Gear Up!* adds further investigation tasks requiring the students to revise basic skills and reinforce the notion of action/reaction, force and movement.

The lessons form an integrated unit of study, and have an extensive list of skills and outcomes based on Australian Curriculum content. They not only reinforce basic concepts of physics, but also encourage creativity, allowing children to let their imaginations run wild. The students have the opportunity to be artistic, as well as construct, research and work cooperatively as group members. The length of the lessons varies according to the content and extent to which you, the teacher, wish to pursue a particular notion. Some lessons may take a few hours to complete, while others may take a whole session. This depends on the age of the students, their previous experience and the outcome that you have in mind.

The lessons begin with the students sharing their prior knowledge and moving towards investigating the gears, researching them, pulling them apart and seeing them in a "real life" context. From there, the students develop their own models, write instructions for constructing those models and develop a kit to market them.

As the classroom teacher you have the capacity to create an environment where you can foster children's imagination and allow them to have fun while sharing. Take the opportunity to give them the feeling that every effort is valued and that they can contribute to the learning and teaching of those around them.

Our students are our future. Look after them and believe in them, build their confidence and they in turn will reward you with enthusiasm to learn and move forward.



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## Years 3–4

### Year 3 Achievement Standard

By the end of Year 3, students use their understanding of the movement of the Earth, materials and the behaviour of heat to suggest explanations for everyday observations. They describe features common to living things. They describe how they can use science investigations to respond to questions and identify where people use science knowledge in their lives.

Students use their experiences to pose questions and predict the outcomes of investigations. They make formal measurements and follow procedures to collect and present observations in a way that helps to answer the investigation questions. Students suggest possible reasons for their findings. They describe how safety and fairness were considered in their investigations. They use diagrams and other representations to communicate their ideas. (ACARA, 2014)

### Year 4 Achievement Standard

By the end of Year 4, students apply the observable properties of materials to explain how objects and materials can be used. They use contact and non-contact forces to describe interactions between objects. They discuss how natural and human processes cause changes to the Earth's surface. They describe relationships that assist the survival of living things and sequence key stages in the life cycle of a plant or animal. They identify when science is used to ask questions and make predictions. They describe situations where science understanding can influence their own and others' actions.

Students follow instructions to identify investigable questions about familiar contexts and predict likely outcomes from investigations. They discuss ways to conduct investigations and safely use equipment to make and record observations. They use provided tables and simple column graphs to organise their data and identify patterns in data. Students suggest explanations for observations and compare their findings with their predictions. They suggest reasons why their methods were fair or not. They complete simple reports to communicate their methods and findings. (ACARA, 2014)

## Gears – Skills, Processes and Procedures:

### Energy and its uses

#### Identify transformations of energy involving movement.

- Recognise that energy can be changed from one form to another.
- Identify movement as a form of energy.
- Identify that energy changes take place in common appliances.
- Demonstrate transformations of energy.

### Forces and their effects

#### Identify the action of forces in everyday situations.

- Recognise that force is a push or a pull.
- Identify, through observation, the forces that cause things to move, stop and change speed or direction of motion.
- Build a model that demonstrates the action of movement.

## Years 5–6

### Year 5 Achievement Standard

By the end of Year 5, students classify substances according to their observable properties and behaviours. They explain everyday phenomena associated with the transfer of light. They describe the key features of our solar system. They analyse how the form of living things enables them to function in their environments. Students discuss how scientific developments have affected people's lives and how science knowledge develops from many people's contributions.

Students follow instructions to pose questions for investigation, predict what might happen when variables are changed, and plan investigation methods. They use equipment in ways that are safe and improve the accuracy of their observations. Students construct tables and graphs to organise data and identify patterns. They use patterns in their data to suggest explanations and refer to data when they report findings. They describe ways to improve the fairness of their methods and communicate their ideas, methods and findings using a range of text types. (ACARA, 2014)

### Year 6 Achievement Standard

By the end of Year 6, students compare and classify different types of observable changes to materials. They analyse requirements for the transfer of electricity and describe how energy can be transformed from one form to another to generate electricity. They explain how natural events cause rapid change to the Earth's surface. They describe and predict the effect of environmental changes on individual living things. Students explain how scientific knowledge is used in decision making and identify contributions to the development of science by people from a range of cultures.

Students follow procedures to develop investigable questions and design investigations into simple cause-and-effect relationships. They identify variables to be changed and measured and describe potential safety risks when planning methods. They collect, organise and interpret their data, identifying where improvements to their methods or research could improve the data. They describe and analyse relationships in data using graphic representations and construct multi-modal texts to communicate ideas, methods and findings. (ACARA, 2014)

## Gears – Skills, Processes and Procedures:

### Energy and its uses

#### Identify transformations of energy involving movement.

- Describe the operation of simple devices that transfer or transform energy.
- Distinguish between simple examples of energy transfer and energy transformation.
- Choose and organise materials to produce a working model that transfers or transforms energy.
- Describe the operation of the produced working model in terms of energy transfer or transformations.

### Forces and their effects

#### Describe the motion of objects in terms of simple combinations of forces.

- Describe the effect of two forces acting on an object.



# Explore and Investigate

## Skills/Outcomes

Related Australian Curriculum content descriptions include:

### Australian Curriculum: Science

- Forces can be exerted by one object on another through direct contact or from a distance (ACSSU076)

### Australian Curriculum: Design and Technologies

- Investigate how forces or electrical energy can control movement, sound or light in a designed product or system (ACTDEK020)

### Materials

- Sets/kits of gears (these will vary)
- Student worksheets

### Procedure:

1. The first phase to beginning this series of lessons is to ascertain the students' prior knowledge and experience with gears. Depending on the students' prior experiences/knowledge you may choose to skip the next session.
2. Before handing the materials to the children, begin by questioning them as a whole class about their experiences with gears.
  - Has anyone seen these materials before? If so, have you had the opportunity to use them?
  - What are gears used for?
  - Where in the environment other than the classroom might we find/see gears? (Make a list for future reference.)

Probe children about their knowledge of gears.

3. Hand the students a worksheet that will be used as a diagnostic tool for determining the direction of future lessons.
4. After the students complete the worksheet, give them all of the materials and let the students "play" with them. Observe the students closely, looking for such things as the way that they join the bases, the materials that they use, whether or not they have some gears at right angles to others, stack the gears and so on.
5. It is a good opportunity to talk with individuals about what they are doing, why and how they did particular things. Make notes as you observe the students.
6. Conclude the lesson by inviting students to share with others what they have built as well as pointing out particular design features exist.
7. Encourage students to comment about what the gears could do, any limitations they came across etc.