Introduction

LEGO® Education is pleased to bring you the 2009689 Activity Pack for the 9689 Simple Machines Set.

2009689

Who Is the Material For?

This material is designed for primary school teachers who wish to introduce their learners to the following simple machines:

- Gears
- Wheels and Axles
- Levers
- Pulleys

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The LEGO models that can be made using the 9689 Simple Machines Set and the Learner Worksheets supplied with the 2009689 Activity Pack for Simple Machines are suitable for learners from years one to three. Most learners at the younger end of this age range will need to be supported and encouraged in reading and understanding the technical vocabulary and exercise descriptions used in the Learner Worksheets.

What Is it For?

Used together, the 9689 Simple Machines Set and this Activity Pack enable learners to work as young scientists, designers and engineers, helping them to investigate and understand the operation of simple and compound machines found in everyday life. The materials promote an enjoyable but challenging classroom environment in which learners can develop skills such as creative problem-solving, communication of ideas, and teamwork. The activities lead learners to make initial use of scientific method through observation, reasoning, prediction and critical thinking.

What Are Simple Machines?

We use simple machines every day – when we open a door, turn on a tap, open a tin, or ride a bike. Simple machines make it easy for us to do work. A force (a push or a pull effort) makes something (a mass or load) move a distance.

Simple machines have only one part to do the work and they have very few or even no moving parts. A lever is an example of such a simple machine. You can use a lever, for example a crowbar, to move a large load with a smaller effort than you would need if you did not have a machine to help you. The force applied to the lever makes the load move, but the effort needed is less than if the force was applied directly to the load. The work is thus easier to do.

The terms *load* and *effort* are used in describing how simple machines work. The load is the object that is moved, e.g. a box. The effort is the force used to do the work. In the situation illustrated, the effort is the force that someone will apply to the sack barrow to move (or lift) the load (the box).

Simple machines have very few parts; compound machines are made up of two or more simple machines. A sack barrow is one example of a compound machine. It combines two simple machines. The handles are levers which help lift the load, and the wheel and axle help move the load forward easily. The same principle applies to a wheelbarrow.

Machines help us do many things: they help us lift, pull, split, fasten, cut, carry, mix, etc. All machines are made up of simple machines. More complicated machines (compound machines) are made up of a number of simple machines that function together to help do the work. Gears are sometimes categorised as compound machines, but in this material we have regarded them as simple machines.

Did you know?
A crowbar is a simple machine called a lever.

Did you know?
A wheelbarrow is a compound machine.

What Is in the 9689 Simple Machines Set?

The set consists of four full-colour sets of Building Instructions for the four simple machines, including instructions for both the principle models and the main models, and 204 LEGO® elements, including an element (brick) separator. The main models and the principle models described in this Activity Pack can all be built from the elements in the set, though only one at a time.

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What Is in the 2009689 Activity Pack for Simple Machines?

This Activity Pack contains teaching suggestions and materials that will enable teachers to make effective use of the 9689 Simple Machines Set in class. The Activity Pack is divided into the following sections:

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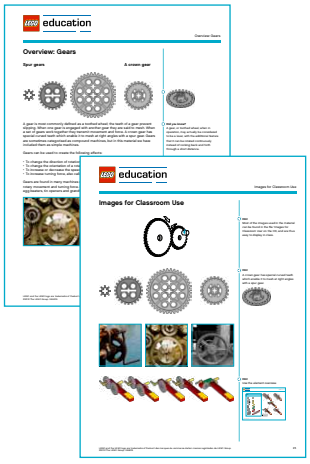
Curriculum:
This section offers a clear overview of the curriculum standards and learning goals targeted for each activity. Check which activities match your current teaching programme, or use it to find inspiration for creating your own course of study.

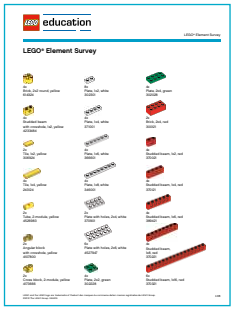
The four simple machine sections:
These sections provide information and activities for the four simple machines: gears, wheels and axles, levers, and pulleys. All four simple machine units are presented in the same way.

- An overview of the simple machine in focus is given. The overview starts with an introduction and with ideas for establishing the concept and providing the vocabulary relevant to the simple machine. A brief outline for using the principle models is also included.
- Following this is an overview of relevant images from Images for Classroom Use. Images for Classroom Use is a collection of photographs, pictures, drawings and illustrations, contained on the Activity Pack computer disk, which can be used to support the teaching of simple machines. These images are intended to help learners understand the links between the models they build and the real world. There is also an overview of the elements used for building both the principle models and the main models.
- Each unit then introduces the Teacher's Notes and Learner Worksheets (described later) for the principle models, the related main model, and the problem-solving activity.



Glossary:
The Glossary is designed as a reference for teachers. It explains most of the terms used in the materials.

LEGO® Element Survey:
The Element Survey illustrates and names the LEGO elements in the 9689 Simple Machines Set.



Teaching Sequence

Though naturally teachers may well wish to vary their teaching sequence to suit their own learners and needs, we recommend the following progression:

1. Establish the concept of the simple machine in focus:
   a) Use the information from the relevant **Overview** section (Gears, Wheels and Axles, Levers, or Pulleys).
   b) Show images from **Images for Classroom Use**.
   c) Ask questions and discuss in class.

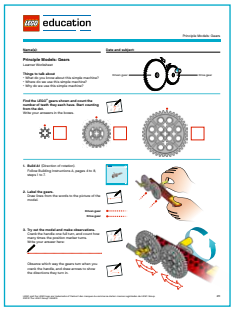
2. Provide the relevant vocabulary, e.g. by using it to talk about the simple machine in focus. See the recommended vocabulary in the **Overview** and/or see the **Glossary** for inspiration.

3. Build and investigate one or all of the principle models.

4. Build and investigate the main model and activity, but only when the related principle model activities have been carried out.

5. Try the problem-solving activity.

An alternative for older learners would be to work with all the principle models and then move directly to the problem-solving activities. As always, it is very important for teachers to be thoroughly familiar with the materials before using them in class, and therefore it is suggested that teachers should build the models themselves and try them out in conjunction with the Learner Worksheets.



General Comments Regarding the Material

Observations and fair tests

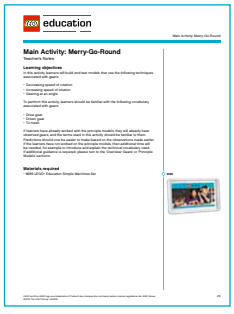
It is important that learners make their observations at least three times, since their initial observations may not be correct and will need to be checked. A minimum of three test observations is probably needed to constitute a *fair test*. Learners should be encouraged to repeat the study or activity as many times as necessary to be sure that they are getting the same answer consistently; however, note that there is only space for one final answer on the worksheet.

Scientific predictions

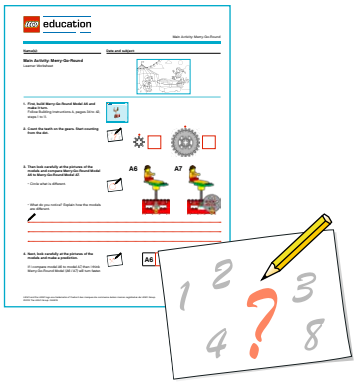
Making a scientific prediction is often based on prior observations and experiences. It is important that learners attempt to state a prediction and then check to see whether their prediction was correct. The main models and the accompanying Learner Worksheets will often assume that learners have made relevant observations while working on the principle models, and therefore will be better able to predict a reasonable outcome.

Teacher's Notes

There are detailed Teacher's Notes for each simple machine section. In some cases, additional materials will be necessary for the activities and investigations; these are listed. The Teacher's Notes indicate key learning areas, give suggestions for carrying out each activity, provide hints, questions and vocabulary specific to the activity, and suggest further ideas for investigation. The answers to questions asked on the Learner Worksheets, together with comments to the teacher, are written in ***blue italics*** in the Teacher's Notes.



Learner Worksheets
The worksheets help learners to work individually, in pairs, or in groups to apply the knowledge they have acquired about the simple machine concept through building or discussion activities. The Learner Worksheets can be copied as required. Writing is kept to a minimum on the worksheets for the principle models – learners only need to mark choices, draw lines to label illustrations, or write numbers. On the worksheets for the main models learners will be challenged to predict an outcome, which they will then investigate, and finally they will document their findings.

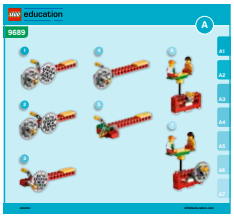


Text on the worksheets is kept to a minimum, but nevertheless early readers may need help in understanding the written instructions. Icons have been included on the worksheets to help learners through the activity in focus; these symbolise, for example, that something must be marked or drawn, circled or joined, or that learners are asked to write in a number.

The problem-solving activity
The problem-solving activity is intended to encourage learners to apply the knowledge they have gained from both the different principle models and/or the main model concerning the simple machine in focus. The suggested problem-solving model solution included is only meant as a guiding principle to solving the problem posed.

Classroom Management Tips

How do I organise the Building Instructions?
For easy classroom management we suggest storing the Building Instructions in binders so that they are close-at-hand and ready to use at the beginning of each lesson.



How much time is needed?
There are many ways to use the LEGO® 9689 Simple Machines Set in your classroom, and many different ways to plan your class schedule. Activities can be completed by individuals or by small teams or groups, depending upon the number of sets that are available to your class.

If you choose to introduce the principle models of one simple machine, 2-3 of the models can be built, investigated and explored, and the parts put away again, within a single 45-minute lesson if the learners are already experienced LEGO builders.

Hint
We suggest learners work together in pairs, sharing a set between them.

However, if you choose to continue with a main activity, then at least two more class periods will be needed, depending on the time spent on discussion, the building skills of your learners, and the time you allow for experimentation. A double lesson is ideal to be able to explore, build and investigate in depth most of the (optional) extension ideas built into the main activity, and especially for the learners to make any creative variations of their own.

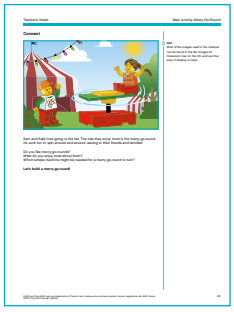
In the case of the problem-solving activities, learners should be able to tackle the challenge in a sequence of two lessons.

LEGO® Education's 4C approach

In working with the main models, in all four sections, you will be guided through LEGO® Education's 4C approach: Connect, Construct, Contemplate and Continue, enabling your learners to progress naturally through the activities.

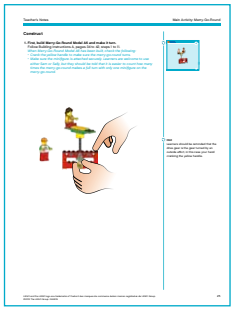
Connect

The Connect story places the characters Sam and Sally in real-life surroundings, linking an object/item from the real world which most learners will recognise to the simple machine concept under consideration. This real-world object will closely resemble the LEGO models learners will work with and build. In the Connect passage the language is more child-oriented, as it is intended for you to read aloud.



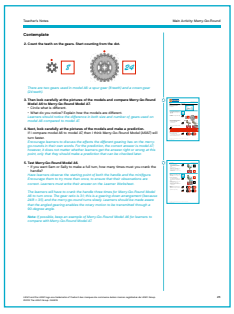
Construct

Using the building instructions, learners build models covering the concepts related to the simple machine in focus. Tips are provided for testing and for making sure that each model functions as intended.



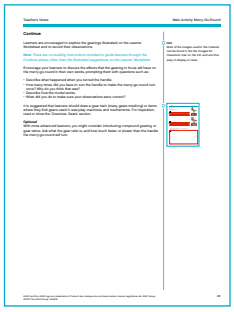
Contemplate

This stage involves learners investigating the models they have constructed. Through these investigations, learners will learn to observe and compare results from tests that they make, and to report on their observations. They will be encouraged to describe the outcomes of their investigations. Questions are included that are designed to further deepen learners' experience and understanding of the investigation. This phase provides the opportunity for you to begin evaluating learning outcomes and the progress of individual learners, especially by looking at their worksheets and talking to them about their reflections and answers.



Continue

Continued learning is always more enjoyable and creative when it is sufficiently challenging. Extension ideas are therefore provided to encourage the learners to change or add features to their models and to investigate further – always with the key learning area in mind. This phase encourages learners to experiment and to apply their knowledge creatively.



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