**TEACHER GUIDE****The 9686 LEGO Kit****The 9686 Simple & Powered Mechanisms Set**

This kit introduces pupils to simple structures, forces, wheels & axles, levers, pulleys, gears and other mechanisms. There are full colour building instructions included that allow the pupils to build simple models for conceptualisation and more complex models that show them a real life application of the concepts learnt. You can build 18 main models and 37 principle models with the building instructions, plus many more of your own designs. There are 396 elements including a battery pack, motor and gear box.

**Curricular Workbooks and Teacher Guides**

The workbooks introduce pupils to the various concepts and then uses the experiences the pupils have gained to build a real understanding. There are also plenty of open-ended design tasks, exploration, investigation and problem solving activities. The workbooks also include rubrics for the pupils to evaluate and record their progress. The Teacher Guide assists the teacher by providing ideas for implementation, year plans, learning outcomes, key concepts, background information, copymasters, extension ideas as well as answers and possible solutions to all the activities in the workbooks. High curricular relevance and minimum preparation, even for non-specialist teachers.

Technology Workbooks

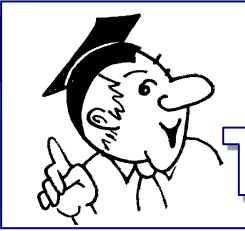
There are 4 workbooks available for the 9686 LEGO Kits. They are progressive, Outcomes Based and aligned to the SA National Curriculum. The workbooks lead pupils through a guided approach to investigation. The following is a breakdown of the concepts covered in each workbook:

- | | |
|---------------------|---|
| TECHNOLOGY 1 | Building Techniques, Technology, Graphical Communication, Structures, Materials, Wheels & Axles, Levers and Pulleys. |
| TECHNOLOGY 2 | Simple Machines, Graphical Communication, Structures, Wheels & Axles, Levers, Hinges, Pulleys, Gears. |
| TECHNOLOGY 3 | Mechanisms and Movement, The Design Process, Structures, Pulleys, Winches, Levers, Wheels & Axles, Materials and Gears. |
| TECHNOLOGY 4 | Cranks, Wheels & Axles, Pulleys, Material Processing, Linkages, Levers, Gears, Gear Ratios and Cams. |

LEGO Support and Spares

All LEGO kits have a warranty. Elements will be exchanged if they are faulty or break during normal use. Missing pieces can be replaced by purchasing Supplementary Kits.

The only limit to your imagination ... is the power of your mind !



TEACHER GUIDE

Hands On Technology Curriculum

Technology has emerged as one of the greatest factors affecting change in our lives. The Hands On curriculum provides children with the necessary skills to approach our technological society with confidence.

Piaget said, "The principal goal of education is to create men who are capable of doing things, not simply of repeating what other generations have done ... men who are creative, inventive, who discover."

Hands On involves presenting children with a need, challenge or problem and supplying them with a variety of materials that they can use, put together or construct something with to solve the problem at hand.

We encourage real research, individual learning styles and true co-operation often using the actual school themes as our vehicle. We present children with a range of experiences and situations that help them to develop their design and technology capabilities.

As well as encouraging thought processes, interaction with these materials allows many manipulative skills to be developed. Working alongside other children helps to develop social interaction and a child's interpersonal skills. Collaboration between children can be encouraged thus helping them to learn how to co-operate in carrying out different tasks. Working in this way also helps their communication skills and confidence.

Hands On is based on the belief that learning should take place through construction rather than instruction, and we are confident that the LEGO materials used, not only stimulate and encourage the learners, but also greatly accelerate the conceptualisation process.

Hands On empowers children to be "*creative, inventive and who discover.*"

Curricular Objectives :-

- ⊕ Provide an active method of learning - (discovery-type learning)
- ⊕ Provide a design-based problem solving activity
- ⊕ Encourage perseverance
- ⊕ Promote creative and divergent thinking
- ⊕ Encourage both individual and co-operative work
- ⊕ Encourage communication, co-operation, compromise and consensus
- ⊕ Develop a balance between reflective and active learning

At Hands On we understand that effective learning is driven by these emotions.

Curiosity

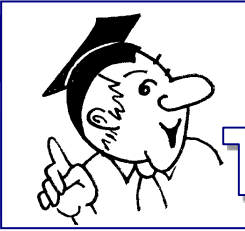
Joy

Concentration

Pride

Excitement

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TEACHER GUIDE

Management of the 9686 Set

At home, students are comfortable with dumping out the contents of the box of parts and assembling either from instructions or from their imaginations. That is another difference between these science and technology kits and the home toy kits. These do not get dumped. The list of Work Rules reinforces this idea.

Work Rules

- 1. No element leaves the kit that is not part of the assigned model.**
- 2. Any element out of the kit must be on the model.**
- 3. No loose elements are allowed on the desktop!**

These are some common sense rules that emphasize the fact that this is a situation different from playing with LEGO materials at home. The greatest occasion for lost elements is when they are loose on the desk and roll onto the floor, often without being noticed. If you are using the complete kit, then it is easy to enforce the rules. The idea here is that an element is either on the model or in the kit.

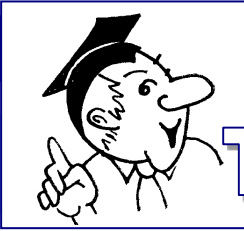
Accountability

- 1. Assign kits to pupils / teams / groups.**
- 2. Have checklist for accountability.**

Kits can be labelled with stickers of different colours or numbers. Each group/team or monitor is assigned a kit, which they will use for the duration of the year/term. This gives an added incentive to be careful with the many small parts; if a part is lost, it may hamper the ability to complete a future model.

Having a sheet with an inventory Check List and an Inventory List with the quantity and name of all the parts will help to reinforce that each group is accountable for the contents of the kit. A quick glance will let you know if everything is in place.

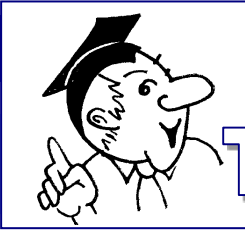
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**TEACHER GUIDE****Technology Outcomes**

There is always a close link or overlap between Maths, Science and Technology. Below is a brief summary of the Outcomes and Assessment standards of these learning areas. In each lesson we will use a simple table to show the integration in Maths, Science and Technology.

| Learning Outcomes | Assessment Standards |
|---|--|
| Technology | |
| LO 1 Technological Processes & Skills | <ul style="list-style-type: none"> - Investigates all aspects when given a problem, need or opportunity. Advantages & disadvantages a solution might bring. - Designs a brief coming up with at least 2 solutions to the problem. - Makes (briefly outlines a plan of what tools, materials to use etc..) - Evaluates the products according to the design brief (safety, purpose environmental impact, appearance etc..) - Communicates using 2D sketches (posters, charts or models). |
| LO 2 Technological Knowledge & Understanding | <ul style="list-style-type: none"> - Structures: how to strengthen the structure of products by folding, tubing, using triangular webs or joints. The types of structures (frame, shell, solid and the relationship between materials and a load. - Processing: properties of common materials (wood, food, clay, plastic, paper, fabric) how they influence the effectiveness of products. - Systems & Control: how to use simple mechanisms (wheels & axles pivots, hinges) to make a product move in some way. Using energy sources to power mechanical systems. How different types of movement can be achieved. How mechanical, pneumatic or hydraulic systems can be used to change the type and magnitude of an input movement into a different output movement. Using simple electrical circuits (e.g. connecting wires, battery, switch, output device) and how electrical energy can be converted into other forms (e.g. light, heat, sound movement). |
| LO 3 Technology, Society & the Environment | <ul style="list-style-type: none"> - Indigenous Technology & Culture: how local cultures have used scientific principles or technological products for specific purposes. How products and technologies have been adapted from other times and cultures. Similarities in problems and solutions in own and other societies - past, present, future. - Impact of Technology: opinions on how technological products make people's lives easier. The positive / negative effects of technology on the quality of people's lives and the environment. Suggest ways to improve technological products or processes to minimise negative effects on people and the environment. - Bias in Technology: reasons why certain groups of people might be disadvantaged when using technological products. Suggestions how to make technological products or services accessible to those excluded. |

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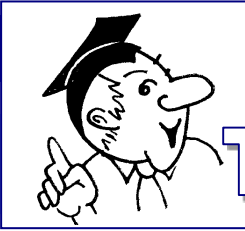
**TEACHER GUIDE****Mathematics & Natural Sciences Outcomes****Learning Outcomes****Assessment Standards****Mathematics**

| | |
|---|---|
| LO 1 Numbers, Operations & Relationships | <ul style="list-style-type: none"> - Basic mental calculations. Use a range of techniques to perform written and mental calculations. Strategies to check & judge solutions. |
| LO 2 Patterns, Functions & Algebra | <ul style="list-style-type: none"> - Investigates and extends numeric & geometric patterns. Uses number sentences to describe a problem situation. |
| LO 3 Space & Geometry | <ul style="list-style-type: none"> - Recognises, visualises & names 2D / 3D shapes & objects. Describes, sorts & compares 2D / 3D shapes & objects from the environment according to geometrical properties. - Recognises & describes lines of symmetry in 2D shapes & objects. - Makes 2D / 3D shapes, objects & patterns from geometrics with a focus on tiling E.g. Tessellations - Describes & sketches views of simple 3D objects in different positions. |
| LO 4 Measurement | <ul style="list-style-type: none"> - Use appropriate measuring units, instruments & formulae (time). - Estimate, measure, record, compare 2D / 3D shapes & objects using the SI units - g, kg, ml, l, mm, cm, m, km. - Solves problems involving selecting, calculating with and converting between the SI units (integrating Technology & Nat Sciences). - Use measuring instruments to measure mass, capacity and length. |
| LO 5 Data Handling | <ul style="list-style-type: none"> - Identifies appropriate data sources in order to address human rights, social, political, cultural & environmental issues. - Use simple data collection techniques (self & group) to answer questions posed by the teacher, class and self. - Organise and record data using tallies & tables. - Draw a variety of graphs to display and interpret data (Pictographs etc) - Critically reading & interpreting data (words and graphs). |

Natural Sciences

| | |
|--|---|
| LO 1 Scientific Investigations | <ul style="list-style-type: none"> - Plans & conducts investigations (collecting data). Explores the possibilities in materials. Evaluates data and communicates findings. |
| LO 2 Constructing Science Knowledge | <ul style="list-style-type: none"> - Recalls meaningful information in relation to animals, plants, materials, planets, structures and moving mechanical systems. - Categorises information into objects and organisms. Interprets info. |
| LO 3 Science, Society & the Environment | <ul style="list-style-type: none"> - Understands how products and technologies have been developed for specific purposes and how they've been adapted from time and cultures. - Understands the impact of Science & Technology - usefulness, positive and negative effects on peoples lives and the environment. - Recognises bias in Science & Technology. Difficulties people may have in using technological devices. The impact lack of access to technological products and services has on people. How does everybody benefit from technology products and services. |

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**TEACHER GUIDE****General Terminology of LEGO elements****Studded Beams**

- These pieces are one stud wide, of varying lengths. They have holes in the side for connectors or axles to fit into.

Modular Beams

- These beams are rounded, they are measured according to the number of holes or modules. Connectors or axles also fit into the holes.

Angular Beams

- These beams are angled, they have also modules but also have crossholes. Connectors or axles also fit into the holes or crossholes.

Axles

- Long black rods for joining pieces or mounting wheels. Axles are named according to how many studs long they are.

Plates

- Thin flat pieces named by the number of studs in the length and width.

Bushings

- Small round pieces to secure pieces in set positions and to secure the ends of axles. These bushings are similar to a nut in a nut and bolt system.

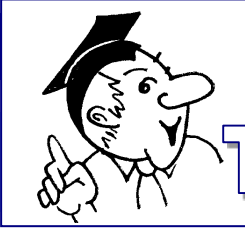
Bricks

- 2 x 4 stud brick



- 2 x 2 rounded brick

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TEACHER GUIDE

General Terminology of LEGO elements

Pulleys



- A pulley is a simple wheel with a groove in its rim. There are different size pulleys in the set. The inside of the wheel (the hub), can also be used as a pulley.

Belts

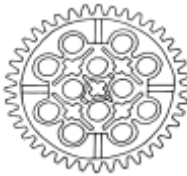


- Different colour 'elastic bands' used with pulley wheels and the motor. Each colour can stretch a set distance.

NB - use the correct colour and do not over stretch the bands.

Gears

- Toothed wheels named by the number of teeth around their edges. There are different types of gears in the set.



- 40 tooth spur gear



- 24 tooth spur gear



- Different type of gear racks



- 8 tooth spur gear



- 24 tooth crown gear



- 20 tooth double bevel gear



- Worm gear

Specialised Pieces



- Differential 28 Tooth



- Universal Joint, 3 module

Connectors

- Small round pieces to join beams and other pieces together. There are different types, they are colour coded and have unique roles.



- black connector peg



- beige connector peg
3 module



- connector peg with
bushing



- axle connector peg



- blue connector peg
3 module



- connector peg handle

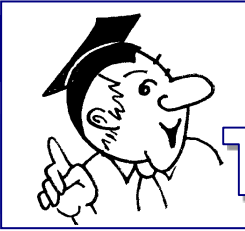


- grey connector peg



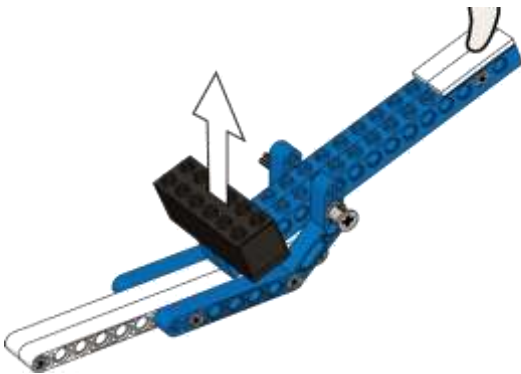
- connector peg half module

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**TEACHER GUIDE****Working with Building Instructions****Model A1 from** Building Card**I****Principle / Concept Models**

There are 3 concept booklets. These cards allow pupils to build key technological concepts. These books are numbered I, II and III.

Model A1 from the concepts booklet, allows pupils to explore lever concepts.

**STORAGE**

A good idea is to remove these cards from the LEGO kits and only allow pupils to use them when they are building a model. A simple bookshelf makes storage and accessibility very easy, it also stops the cards from getting damaged. The workbook and teacher guide inform pupils and teachers which Building Cards are needed for each lesson.

Main Models - Working in pairs

There are 18 main models. Building these models allows pupils to see how the principle / concepts models actually work in a machine. The building process allows for 2 separate building processes, each student builds their part of the model. By combining their models they create one completed model.

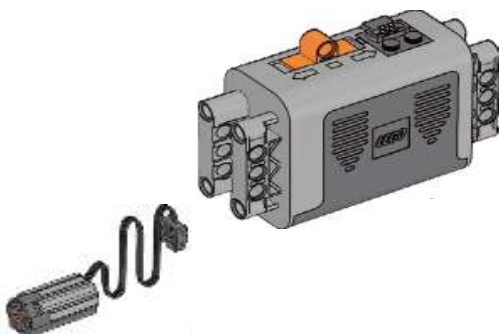
This example uses building card 16A + 16B to build a mobile crane. One student will build from building card 16A, the other will build from building card 16B. When the 2 models are put together you have a completed working crane.



Building Card

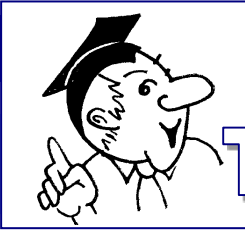
16A

Building Card

16B**MOTOR PACKS**

It is also recommended to remove the battery pack, motor and cable from the kit. Not only will it save on batteries, but can also be used as an incentive to encourage pupils to finish quickly.

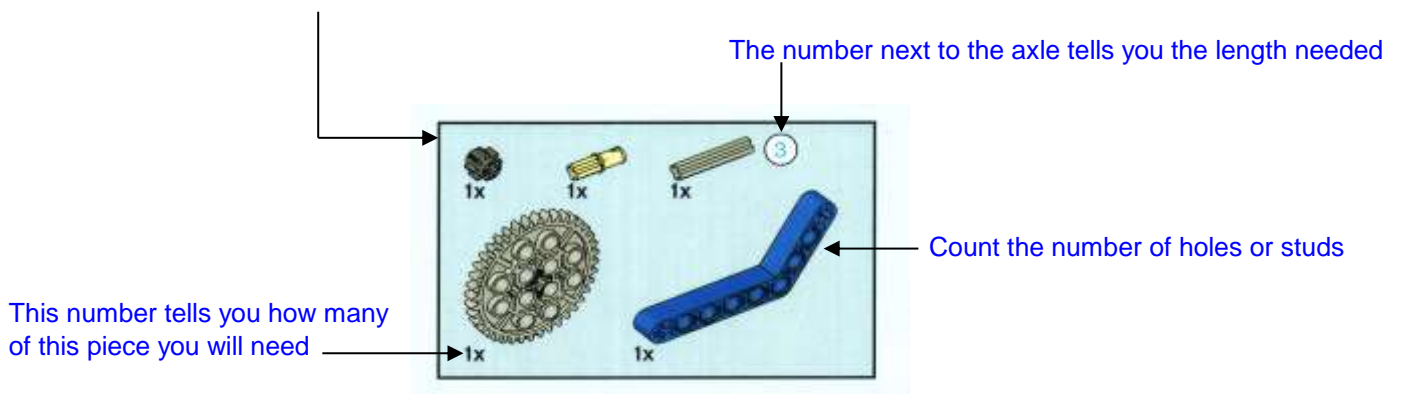
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**TEACHER GUIDE****Following Building Instructions**

Understanding the building instructions of both the concept cards and different models is very important. It can be the difference between a successful model and a failure.

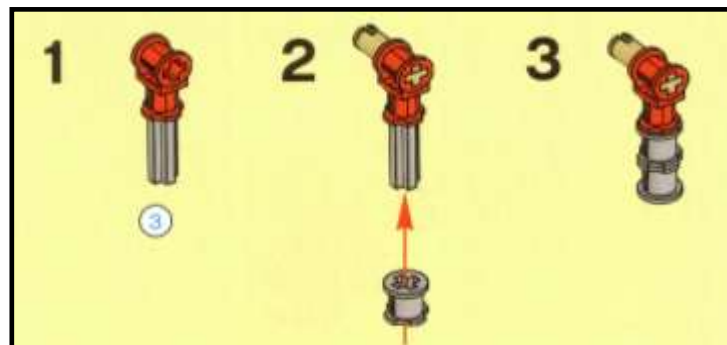
Here are the important things to look out for :

Each building step has a **blue frame** with a list of all the pieces you'll need to complete that step.

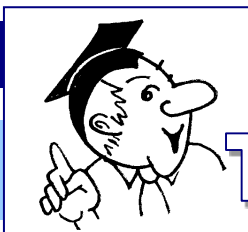
**5**

Each step will have a **number**.
(make sure you stop at the correct number according to your notes !!)

If you have to complete a step **FIRST** - before you continue with the rest of the steps, you'll get these instructions in a **yellow frame**.



The only limit to your imagination ... is the power of your mind !



TEACHER GUIDE

| Studs | No. of pieces | Cost per piece | Total |
|-------|---------------|----------------|-------|
| | 2 | R 0.25 | |
| | 4 | R 0.50 | |
| | 6 | R 0.75 | |
| | 8 | R 1.00 | |
| | 10 | R 1.40 | |
| | 12 | R 1.80 | |
| | 16 | R 2.00 | |

| | | | |
|--|----|--------|--|
| | 4 | R 0.25 | |
| | 6 | R 0.50 | |
| | 8 | R 0.75 | |
| | 10 | R 1.00 | |
| | 12 | R 1.50 | |
| | 3 | R 2.00 | |
| | 5 | R 0.25 | |

| | | | |
|--|---|--------|--|
| | 2 | R 0.25 | |
| | 4 | R 0.50 | |
| | 6 | R 1.50 | |
| | 4 | R 1.00 | |
| | 8 | R 2.00 | |

| | | | |
|--|--|--------|--|
| | | R 1.50 | |
| | | R 1.25 | |

| Modules | No. of pieces | Cost per piece | Total |
|---------|---------------|----------------|-------|
| | 3 | R 0.25 | |
| | 5 | R 0.50 | |
| | 7 | R 0.75 | |
| | 9 | R 1.50 | |
| | 15 | R 2.00 | |

| | | | |
|--|--|--------|--|
| | | R 2.00 | |
| | | R 1.50 | |
| | | R 0.50 | |

| | | | |
|--|--|--------|--|
| | | R 0.25 | |
| | | R 0.25 | |

| | | | |
|--|--|--------|--|
| | | R 0.50 | |
| | | R 0.50 | |
| | | R 0.50 | |

| All other pieces : | | | |
|--------------------|--|--------|--|
| | | R 0.10 | |

| | | | |
|--|------------------|--------|--|
| | Whole Minifigure | | |
| | | R 3.00 | |

No. of Pieces :

TOTAL