CARDINAL COMPASS - NO. 10 - HANDS-ON LEARNING - WITH CARL THE CARDINAL
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Simple Machines

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Two of these clever tools trade a long, gentle push for a short, hard one, and the third changes direction. Lift with a lever, roll up a ramp, and pull down with this single fixed pulley to lift a load up. And three experiments you can do safely at home.

A heavy block does not have to win. With the right simple tool, a small hand can lift it, slowly and safely.



Cover illustration: a workbench holding a ramp, a lever, and a pulley, all three machines in one picture.

Read together	Build together	Grown-up with you for every experiment



Meet Carl - Machine Carl

Carl the Cardinal is your guide. For this project, he lifts a wooden block with a plank resting on a turning point, and he presses slowly and gently. His green neckerchief and gold compass medallion stay on. Color your own Carl on the last page.

How to use this book: Pages 2-3 tell the story. Page 4 is safety. Read it first, and read it well. Loads stay small and low in this unit, so the load rules matter every single time. Then do the three experiments. Finish with the questions. Color Carl at the end.

Keep a notebook near you. Write what you guess. Write what you feel in your hand.

You will need, for all three experiments: a sturdy plank or a wide, strong ruler; a fulcrum (a triangular block, a book spine, or a sturdy block); a book or wooden block for the load; for the grown-up pulley rig: two equal stacks of books, a pencil across the tops, a large thread spool on the pencil, and tape; strong string; a small bucket; a few small toys; a board or stiff cardboard for a ramp; a stack of at least three books; a toy car; tape; crayons; a notebook; and a pencil for writing.

What is a simple machine?

Some jobs are too hard for hands alone. A block is too heavy to lift. A bucket is too high to reach. Long ago, people found clever tools to help. The simplest tools of all are called simple machines.

Simple machine: a simple machine is a tool with few or no moving parts. It makes a job easier by changing a push or a pull.

Lever: a lever is a stiff bar that rests and turns on a point. You push one end, and the other end lifts.

Fulcrum: the fulcrum is the turning point a lever rests on. The bar turns on the fulcrum, like a seesaw turns on its middle post.

Pulley: a pulley is a wheel with a groove around it, and a rope runs over the wheel in the groove. A pulley lets you pull down to lift something up. In this book the pulley is a single fixed pulley: its wheel stays in one place, fixed where a grown-up rigs it.

Inclined plane: an inclined plane is a slanted surface. In this book we call it a ramp every time after this line. A ramp is an inclined plane you can walk, roll, or slide on.

The big trade

Here is the honest secret of every simple machine. A machine never makes the work vanish. The work is still there. The machine trades.

Sometimes you push more gently, but your hand travels farther. Sometimes you pull in a new direction, like pulling down instead of up, with about the same force. The lever and the ramp pay with distance. The pulley changes direction, and that change is a benefit, not a cost. Nobody gets something for nothing.

The trade, three ways

Lever: press gently on the long end, and the short end lifts hard, but only a little way up.

This single fixed pulley: pull down instead of up, and the load rises up. The pull needs about the same force. Direction is the benefit here, not a cost.

Ramp: push gently all the way up the long slope, instead of one hard lift straight up.



Lever
gentle push, long travel



Ramp
gentle push, long travel



This single fixed pulley
same pull, new direction

In this unit you will feel the trade in your own hand, three times. Watch for it. It shows up in every build.