EXPERIMENT MANUAL

REMOTE-CONTROL MACHINES DLX

THAMES & KOSMOS

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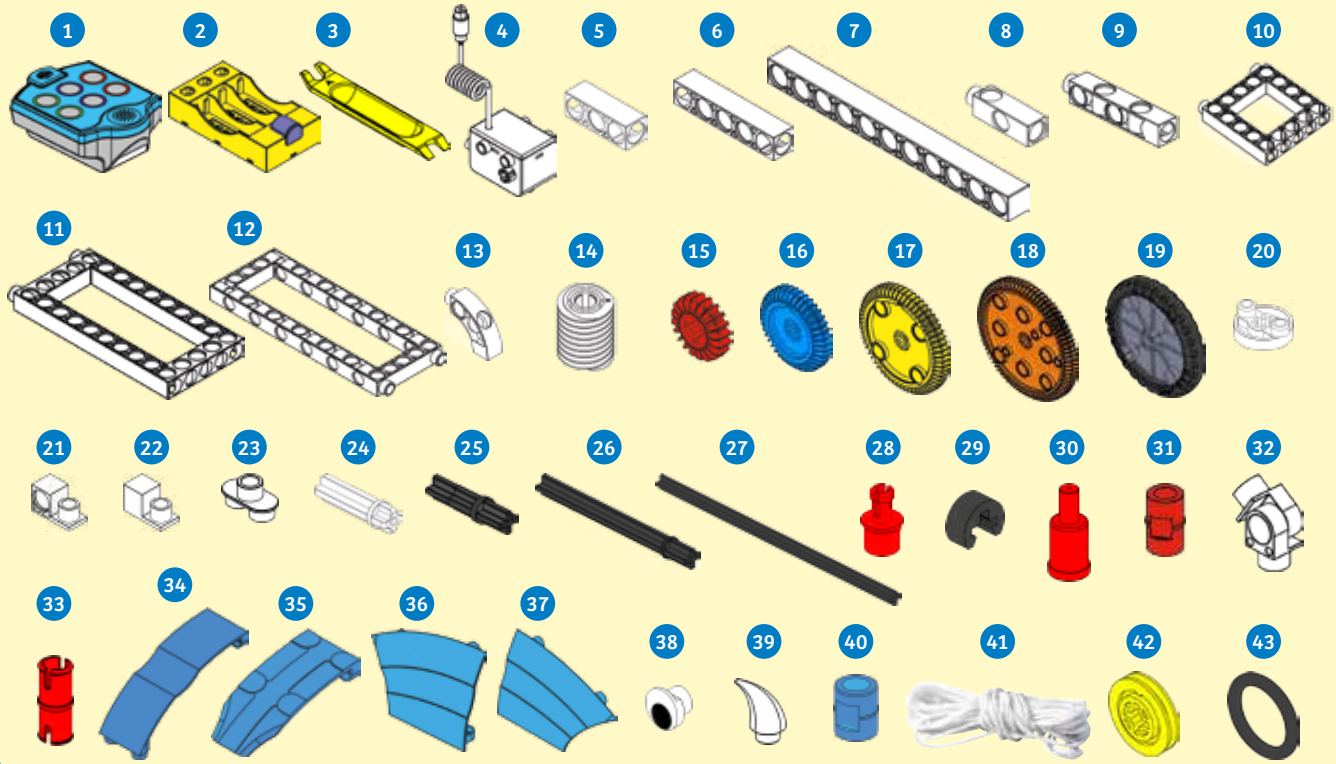
GOOD TO KNOW ! If you are missing any parts, please contact Thames & Kosmos customer service. Any materials not included in the kit are indicated in *italic script* under the "You will need" heading.

The parts in your kit:



Checklist: Find – Inspect – Check off

✔	No.	Description	Count	Item No.
❍	1	IR remote control	1	715 040
❍	2	Battery box with receiver	1	715 041
❍	3	Part separator tool	1	702 590
❍	4	Motor with wire	3	710 419
❍	5	3-hole rod	3	715 042
❍	6	5-hole rod	6	714 179
❍	7	11-hole rod	8	714 282
❍	8	3-hole dual rod	4	714 283
❍	9	5-hole dual rod	6	714 126
❍	10	Square frame	4	714 284
❍	11	Short frame	3	715 044
❍	12	Long dual frame	3	715 045
❍	13	Curved rod	2	714 285
❍	14	Worm screw	3	715 046
❍	15	Small gear, red	4	710 062
❍	16	Medium gear, blue	2	710 061
❍	17	Large gear, yellow	2	715 047
❍	18	Extra-large gear, orange	1	715 048
❍	19	Wheel and tire	4	715 049
❍	20	Rod connector	2	715 050
❍	21	90-degree converter - X	4	715 051
❍	22	90-degree converter - Z	2	714 128
❍	23	Two-to-one converter	6	714 286
❍	24	Motor shaft axle	4	702 801
❍	25	Short axle (3 cm)	2	703 236
❍	26	Medium-long axle (7 cm)	3	713 490

✔	No.	Description	Count	Item No.
❍	27	Extra-long axle (15 cm)	1	703 518
❍	28	Axle pin	2	702 525
❍	29	Axle lock	2	702 813
❍	30	Shaft pin	2	702 526
❍	31	Anchor pin (red)	28	702 527
❍	32	Hinge	2	715 052
❍	33	Joint pin	10	702 524
❍	34	Large body plate	1	714 013
❍	35	Small body plate	2	715 280
❍	36	Body plate 3	1	714 276
❍	37	Body plate 4	1	714 277
❍	38	Eye	2	715 053
❍	39	Horn	2	715 054
❍	40	Short anchor pin (blue)	8	714 129
❍	41	String	1	715 055
❍	42	Small pulley	1	707 011
❍	43	Small rubber o-ring	1	703 205

You will also need:

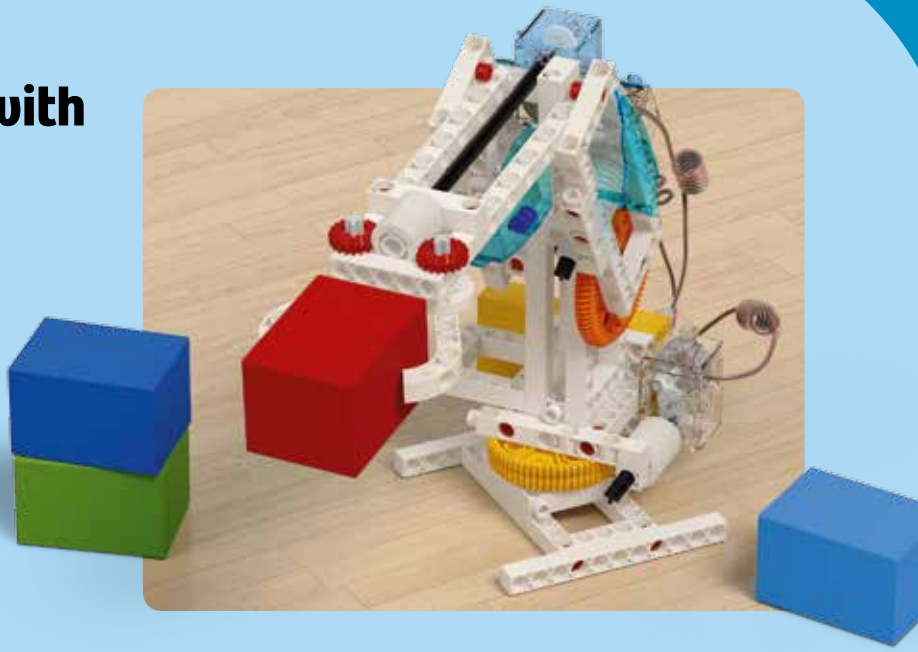
No matter what: 5 AA batteries (1.5-volt, type AA/LR6) or 5 AA rechargeable batteries, (1.2-volt, min. 2300 mAh/type AA)

You will need the following items in order to perform the experiments: Experiment kit packaging, coin, masking tape, stop watch, screw top from a water bottle, water, dish cloth, scissors, felt-tip pen, large marble, measuring tape, note pad, pen, small paper cup, paper clip, pin, fine sand, trowel and hand broom, toy figure, books, calculator, balloon, ruler, table tennis ball

Also: Material for making boxes and pallets (see pages 127-128): colored card stock or heavy construction paper, glue, tracing paper or wax paper

EXPERIMENT 1

Moving delicate cargo with the robotic arm



YOU WILL NEED

- **The assembled robotic arm**
- **IR remote control**
- *5 AA batteries or 5 AA rechargeable batteries*
- *4 or more boxes (see page 127)*
- *Experiment kit packaging*
- *Coin*

HERE'S HOW

1. Set the robotic arm someplace where it will have enough room to move. Perform a test run to familiarize yourself with its controls and to be sure you know which touch pad buttons you use to steer it.
2. Are you ready to start? Pile up a stack of four (or more) boxes within easy reach of the arm.
3. Steer the robotic arm so that it grabs the top box. Lift up the box and rotate the robotic arm 180 degrees, or a half-circle.
4. Carefully set down the box and release it. Lift the arm straight up so it doesn't knock over the box as it moves away.
5. Move the arm back to the original stack, grab the next box, and move it to the new stack. Keep going until you have brought the entire stack to the new location.
6. Or, you can try transporting all of the boxes at once. Or try using a support platform for your cargo, such as the experiment kit box.
7. And now for the ultimate challenge: Set a coin on its edge, grab it with the robotic arm, and set it back down on its edge again!

WHAT'S HAPPENING?

The touch pad works more or less the same as the touch pad of a tablet computer or a smart phone. When you touch a button with your finger, it triggers the remote control's electronics to make the motor turn. See how much pressure you have to apply and for how long in order to get the motor to turn a desired amount.

If you want, you can control all three motors at the same time, and in any combination. In other words, you can make them all move in the same direction or make one move in a different direction from the others. Sudden changes from left to right or vice versa are also possible.

WANT MORE?

Organize a little competition: Who can load the cargo the fastest? Try to save time by operating the motors simultaneously rather than in sequence.

EXPERIMENT 5

Bat race

YOU WILL NEED

- **The assembled bat**
- **IR remote control**
- *5 AA batteries or 5 AA rechargeable batteries*
- *Masking tape*
- *Measuring tape*
- *1 teammate*
- *Stop watch, note pad, and pen*

HERE'S HOW

1. Use the masking tape to mark a starting line.
2. Take the measuring tape and place a second piece of masking tape a meter away, for example, and mark that one as your finish line.
3. Warm up by familiarizing yourself with the controls and movements of your bat.
4. Now get your bat into the race: Set it on the starting line facing the finish line.
5. Ideally, have a teammate give the starting instructions (for example: "On your marks, get set, go!") and measure the time with the stop watch.
6. Write down the time and let the next player take a turn. Who will win the race?

WHAT'S HAPPENING?

The bat moves differently from your other mobile robots — not on wheels, but on legs. You have probably already noticed that two legs don't usually offer a very reliable way to move. That's why robot engineers tend to rely on more than two legs. Six-legged constructions are an ideal foundation for legged robots that can move securely and stably, even across uneven terrain.

KEYWORD: BIONICS

In robotics, engineers often try to borrow abilities and techniques from nature. The science of doing this is called **bionics**, coined from the Greek word for "life."

Bats have a lot of useful abilities to offer bionics, particularly their ultrasound echolocation system. Bats emit ultrasound waves that bounce back off of objects located in their surroundings, which the bat can use to interpret the objects' locations. Robots also take advantage of systems like this. For example, they use echolocation systems to find out how far away obstacles are.

Global Positioning System (GPS)

You probably know about GPS from car navigation systems and smartphones. This is a kind of technology that draws on information from around 30 space-based satellites that constantly transmit their current position along with the exact time. That information can be used to help you determine your location within 10 meters. GPS signals can also be used to calculate your speed and direction and thus serve as an artificial compass.

WIRELESS LOCAL AREA NETWORK (WLAN)

In buildings, you often can't get a good GPS signal, or any signal at all. That's because GPS signals travel in practically straight lines, just like light, and anything that gets in their way can affect their quality. A robot inside a building that relies completely on GPS would therefore get completely disoriented and lost. This is where wireless LAN technology comes in handy — the same type of technology you know from your PC, laptop, or tablet computer, or smartphone. WLAN can also be used to establish a wireless connection between a robot and a central computer.

UNIVERSAL MOBILE TELECOMMUNICATIONS SYSTEM (UMTS)

A robot is even more flexible, of course, if it doesn't have to rely on a WLAN access point. This can be accomplished through a mobile communication connection, ideally a cellular network based on third-generation digital mobile communications phone technology.

Appearing today in a home near you: robotic vacuum cleaners

Some of these technologies are already being used by robotic vacuum cleaners. Simple models use just a single sensor to size up their surroundings. If the robot runs into an obstacle, it changes its direction. More expensive models use infrared light or lasers to calculate their distance from an object by reflecting a beam off of it.

CARS AS ROBOTIC TECHNOLOGY PIONEERS

Automobile company engineers already have a lot to show us about what's possible in the realm of **autonomous driving**. Even today, autonomous driving works well in bumper-to-bumper traffic, given the low speeds involved and the relatively predictable traffic conditions. Different states and countries are adopting their own new laws regarding driverless vehicles, with many more changes to be expected as the technology improves.