EXPERIMENT MANUAL

CATAPULTS & CROSSBOWS

THAMES & KOSMOS

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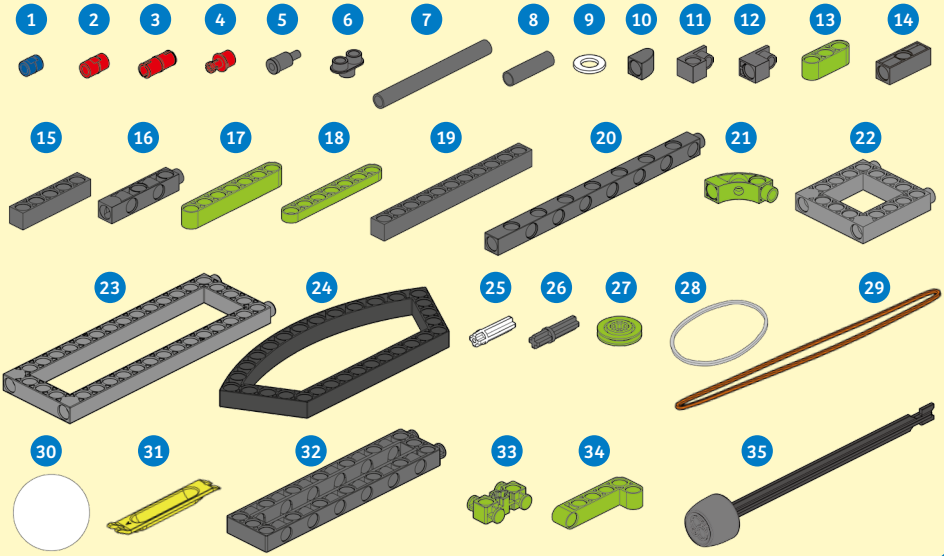
What's inside your experiment kit:



Checklist: Find – Inspect – Check off

✔	No.	Description	Qty.	Item No.
◯	1	Short anchor pin, blue	6	7344-W10-C2B
◯	2	Anchor pin, red	15	7061-W10-C1R
◯	3	Joint pin	4	1156-W10-A1R
◯	4	Shaft plug	4	7026-W10-H1R
◯	5	Shaft pin	1	7026-W10-J3D
◯	6	Two-to-one converter	4	7061-W10-G1D
◯	7	Tube, 80 mm	1	7337-W16-A1D
◯	8	Tube, 30 mm	5	7400-W10-G1D
◯	9	Washer	6	R12#3620
◯	10	Nose piece	1	7402-W10-C2D
◯	11	90-degree converter - X	2	7061-W10-J1D
◯	12	90-degree converter - Y	2	7061-W10-J2D
◯	13	3-hole wide rounded rod	2	7404-W10-C1G2
◯	14	3-hole cross rod	4	7026-W10-X1D
◯	15	5-hole rod	4	7413-W10-K2D
◯	16	5-hole dual rod C	2	7026-W10-S3D
◯	17	7-hole wide rounded rod	2	7404-W10-C2G2
◯	18	7-hole flat rounded rod	2	7404-W10-C3G2

✔	No.	Description	Qty.	Item No.
◯	19	11-hole rod	1	7413-W10-P1D
◯	20	15-hole dual rod	1	7413-W10-H1D
◯	21	Curved rod	12	7061-W10-V1G3
◯	22	Square frame	2	7026-W10-T2S2
◯	23	Large frame	1	7413-W10-J1S1
◯	24	Curved frame	2	7392-W10-I1D
◯	25	Motor axle	1	7026-W10-L1W
◯	26	Axle, 30-mm	2	7413-W10-N1D
◯	27	Small pulley	4	7344-W10-N3G
◯	28	Rubber band, small	1	R10-02
◯	29	Rubber band, large	3	R10-28
◯	30	Large foam ball	3	K30#7366-2
◯	31	Anchor pin lever	1	7061-W10-B1Y
◯	32	13x3 Frame	2	7406-W10-A1D
◯	33	3-hole bolt rod	2	7406-W10-B1G
◯	34	5-hole L rod	2	7406-W10-B2G
◯	35	Crossbow bolt	3	7406-W85-A-US

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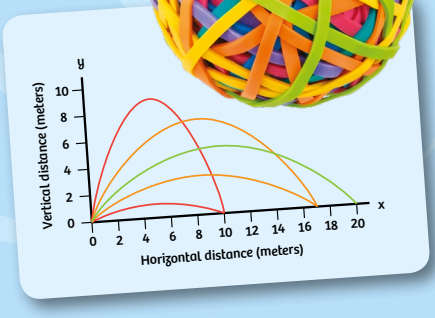


PREPARATION

Setting up a target

YOU WILL NEED

› *metal pie pan or other durable dish*
› *tape*
› *measuring stick or tape measure*

HERE'S HOW

1. Place a metal pie pan upside down on the floor. This is your bull's eye target.
2. Place a piece of tape 10 to 15 feet away from the pie pan. This is where you will stand when testing out your catapults and crossbows.

WHAT'S HAPPENING?

When you do the experiments with your crossbow, you should think about the accuracy and precision of where your bolts and projectiles land. **Accuracy** is how close your results (or shots) are to your target value — in this case, the center of the target. **Precision** is how often you are able to get the same value, or have your projectile land in the same place. Look at the pictures to the right to see how accuracy and precision are related. Accuracy and precision are both critical concepts in the scientific world.

As you perform the experiments for each model, think about how the changes affect your precision and accuracy. Keep a record of your results for the different experiments.

Low accuracy and low precision

Low accuracy and high precision

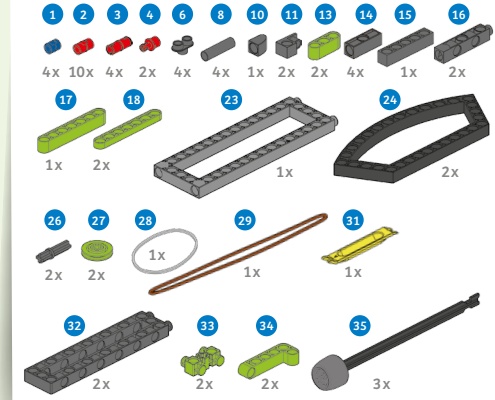
High accuracy and low precision

High accuracy and high precision

EXPERIMENT 6

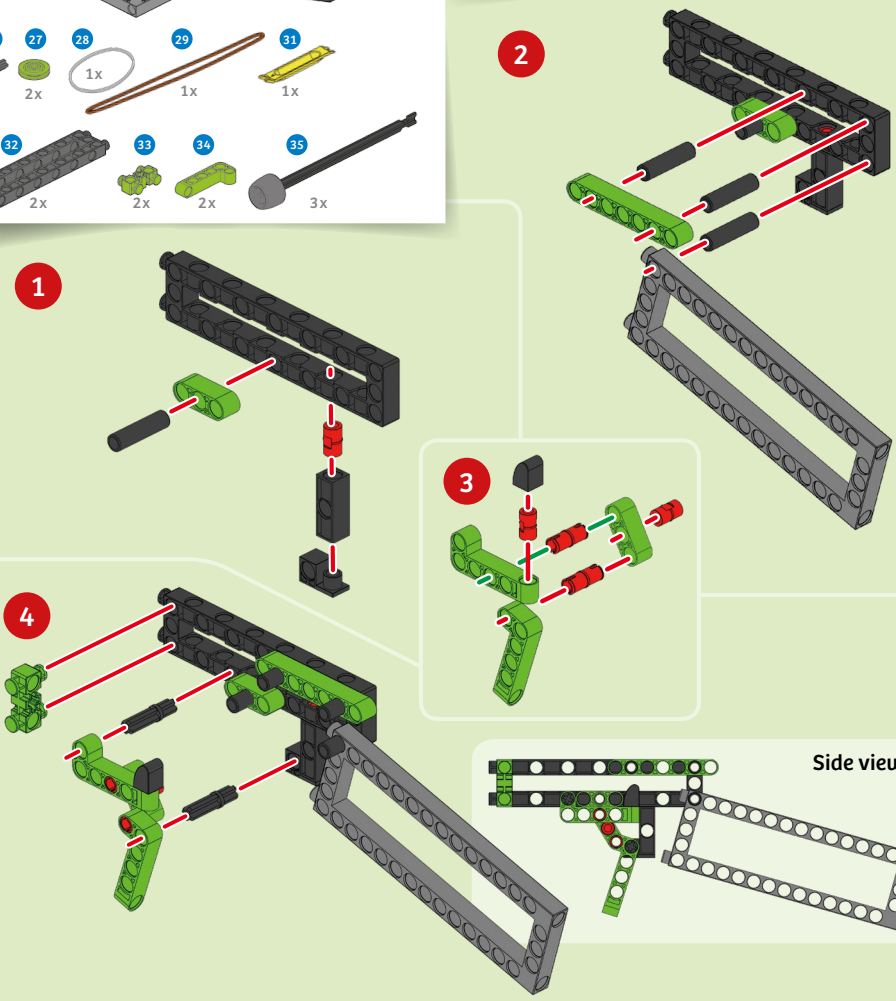
Compound crossbow

YOU WILL NEED



Background

With the development of modern materials and manufacturing process, one of the most common changes in modern crossbows is the use of pulley systems. These crossbows are known as compound crossbows. The pulley system allows for the use of stiffer limbs which transfer more energy into the bolt instead of the movement of the limbs.



EXPERIMENT 6

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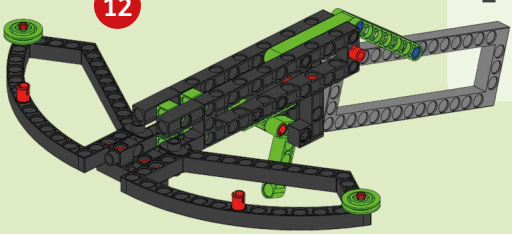

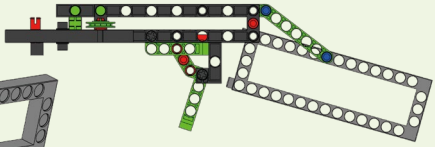

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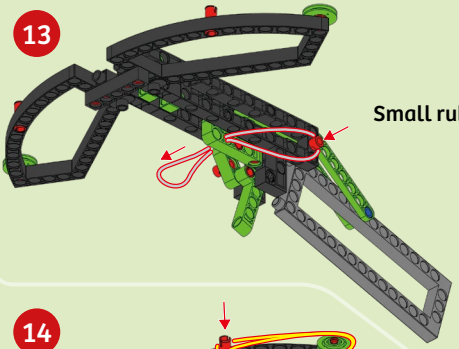
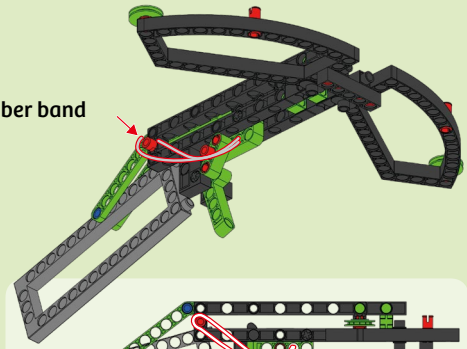


Small rubber band



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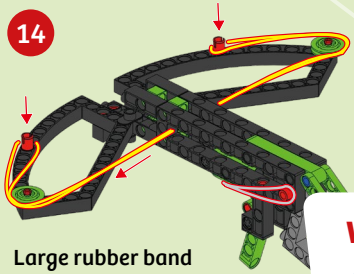
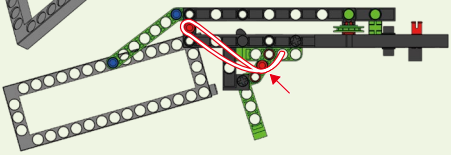


Large rubber band



15 Test out the crossbow by firing some bolts. Notice that when you load the bolt, the rubber band slides around the pulley.

16 Now try removing the pulleys and wrapping the rubber band around the peg. Do you notice any difference in behavior?

WHAT'S HAPPENING?

A **pulley** is a wheel on an axle which supports the movement of a cable or rope. The type of pulley used in this crossbow is called a fixed pulley. The fixed pulley is a two-armed lever that rotates around a fulcrum as it does work. Its load arm and lever arm are equally long in this case, so the user does not gain a mechanical advantage. However, this pulley is useful because it changes the direction that the force is applied. Looking at the rubber band you can see that the pulley allows the rubber band to be stretched farther, meaning that there is more energy in the rubber band.