

EQUIPMENT BUILD PLAN

SIMPLE MACHINES

Toy Dissection Lab and Display

Old, broken toys and small appliances make perfect 'mechanical cadavers' for learning about simple and compound machines. Students predict what's inside, take it apart, diagram the machines they find and trace the flow of energy. A dissected toy can even be rebuilt with its insides showing as a permanent classroom display.

Written from Bruce's original workshop handout. Bruce's final review of this plan is in progress.

What it shows

Take apart a broken toy to find the gears, levers and cams hiding inside, then put it back together as a see-through display.

Key ideas: simple machines, compound machines, gears, energy transfer, efficiency



DIFFICULTY Beginner	BUILD TIME 1-3 class periods
COST Free to \$10 (donated toys)	SAFETY Adult build / supervision
GOOD FOR Teachers, Families	

Safety (Adult build / supervision).

Adult supervision required. Before students start: cut the power cord off any device that plugs into the wall, and remove all batteries. Don't dissect anything with large capacitors or hazards inside, such as microwave ovens, old tube TVs or monitors, camera flashes, or devices with lithium

battery packs. Wear safety glasses; springs can fly out and sheet-metal edges can be sharp.

CONSTRUCTION

Build it

Materials

- ☐ **Broken or unwanted mechanical toys and small appliances** · 1 per group
Wind-up and battery toys, printers, tape players, record players
- ☐ **Paper and pencils for diagrams** · As needed
- ☐ **Wooden board** · 1
Optional, for a display base

Tools

Screwdrivers (Phillips, flat and small precision)

Pliers and needle-nose pliers

Small wrenches

Wire cutters (adult use for cords)

Safety glasses

Zip-top bags and a marker

Hot glue or screws for a display base

1

Collect the 'cadavers'

Ask around for broken toys and small mechanical devices, or have students bring one in. Moving toys with several actions are best.

2

Make it safe

An adult cuts off any wall-plug cord and removes all batteries before the device goes to students. Set aside anything with large capacitors or other hidden hazards.

3

Predict

Before opening it, have students watch the toy (or a video of one like it) and guess what parts inside create each action.



4

Dissect carefully

Remove screws and panels a few at a time, bagging and labeling screws from each stage. Take photos or sketches as you go so it can be reassembled.

5

Find the simple machines

Diagram and label every simple machine found: levers, wheels and axles, gears, pulleys, screws, wedges, inclined planes, plus cams and cranks.

6

Trace the energy

Follow the path of energy from the source (spring, battery, motor or hand) through each part to the final motion or sound, and have students explain each step in writing.

7

Measure (older students)

Count gear teeth to calculate speed and force changes, or measure forces and distances through a sequence of parts to estimate efficiency.

8

Rebuild as a display (optional)

Put the mechanism back into working order without its outer covering, and mount it on a wooden base so the 'guts' show while it runs.

THE PHYSICS**How it works**

Most moving toys turn one simple motion, the spin of a small motor or the unwinding of a spring, into several different actions. They do it with chains of simple machines: gears to slow

Using it

the motor down and increase its turning force, cams and cranks to turn rotation into back-and-forth motion, and levers to move arms, heads and eyes.

Linking simple machines this way makes a compound machine. Following the chain shows how energy is passed from part to part, and how some is lost to friction and sound along the way.

- Have groups present 'autopsy reports' explaining how their toy produced each action.
- Compare the predictions made before the dissection with what was actually found.
- Count teeth on a gear train and calculate the overall gear ratio.
- Challenge students to build a new, simple machine from the salvaged parts.

GO FURTHER

Variations

- Bruce's 'terminator monkey': a cymbal-playing toy monkey that moves its arms and head, bulges its eyes and screeches, was dissected, repaired and mounted on a new base with its inner workings exposed.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

Screws won't come out.

TRY THIS

Look for hidden screws under labels and rubber feet; some cases snap together and need gentle prying instead.

IF THIS HAPPENS

Can't get it back together.

TRY THIS

Rely on the photos and labeled bags from each stage; reassemble in reverse order.

IF THIS HAPPENS

Nothing interesting inside.

TRY THIS

Choose toys with several separate actions; simple battery cars often hold only a motor and one gear.

and supervise children.