

EQUIPMENT BUILD PLAN

SIMPLE MACHINES

Lever Larry

Lever Larry is a classic old-style toy: two long handles pivot on a spacer block, and a twisted string between their tops spins a jointed figure. It shows levers, torque and rotational inertia, and the loose arms and legs add a dose of unpredictable, chaotic motion.

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



<div>DIFFICULTY</div> <div>Intermediate</div>	<div>BUILD TIME</div> <div>3-4 hours (plus paint drying)</div>
<div>COST</div> <div>About \$10</div>	<div>SAFETY</div> <div>Adult build / supervision</div>
<div>GOOD FOR</div> <div>Teachers, Makers, Families</div>	

What it shows

Squeeze two wooden handles and a jointed wooden acrobat flips, swings and somersaults over the bar like a high-bar gymnast.

Key ideas: levers, torque, rotational inertia, chaotic motion

Safety (Adult build / supervision).

Cutting the figure and drilling the handles call for a scroll saw or coping saw and a drill; an adult should do or closely supervise those steps.

CONSTRUCTION

Build it

Materials

- ☐ **Plywood, 1/8 in** · Enough for the figure
Body, two arms and two legs
- ☐ **Hardwood strips, about 3/4 in wide x 1/2 in thick** · 2
Each about three times as long as Larry with arms stretched out
- ☐ **Square spacer block, 2 in** · 1
Separates the handles; Bruce's appears to be 2 in long, square in section
- ☐ **Bolt about 4 in long, with washers and a lock nut** · 1 set
Or two wood screws
- ☐ **Heavy nylon string** · About 3 ft
- ☐ **Small wooden bead or spacer** · 1
Optional, keeps the hands apart
- ☐ **Paper for a pattern** · 1 sheet

Tools

Scroll saw or coping saw

Drill (a drill press helps) with bits for the string and bolt

Sandpaper

Paint, varnish and brushes

Wrench or screwdriver

1

Draw a pattern

Sketch the body (head and torso as one piece), two arms and two legs on paper or cardboard, or enlarge Bruce's pattern on a copier. Any size works, and you can make the figure male or female or give it an Olympic look.



2

Cut out the parts

Trace the pattern onto 1/8 in plywood and cut out the body, two arms and two legs. Drill a small hole at each shoulder and hip joint, and one through the hands for the main string.



3

Sand and paint

Sand the edges smooth, then varnish and paint the parts.



4

Joint the limbs

Join the arms and legs to the body with short pieces of string threaded loosely through the holes and knotted on both sides. The limbs should swing freely.



5

Cut and drill the handles

Cut two handles about three times as long as Larry stretched out. Stack them and drill the string holes through both at once near the top so they line up.



6

Drill the spacer block

Drill a hole straight through the middle of the spacer block for the bolt, and matching holes through the handles where the block will sit.



7

Assemble the handles

Bolt the handles to either side of the spacer with washers and a lock nut, snug but not tight: the handles must be able to pivot when squeezed. Two wood screws, not fully tightened, also work.



8

String Larry

Thread the nylon string through the holes at the tops of the handles and through Larry's hands so the strands cross between each handle and the hands, with the optional bead between the hands. Knot the ends. Larry should sit out from the bars, not between them.



9

Check the twist

Let Larry hang down: the strings twist around each other. That stored twist is what will spin him.



10

Make him perform

Squeeze the bottoms of the handles slowly and Larry rises. Squeeze quickly and he swings right over the top, twisting the string the other way, ready to come back.



THE PHYSICS

How it works

Each handle is a lever with the spacer block as its fulcrum. Squeezing the bottom ends

Using it

together pushes the top ends apart, pulling the string taut.

The tightened string untwists, and as it does it applies a torque that rotates Larry's hands around the string, lifting him.

If he is moving fast enough, his rotational inertia carries him past the top and all the way around, twisting the string the opposite way. The next squeeze untwists it in the other direction, so the routine can repeat.

The loosely jointed arms and legs swing on their own, so tiny differences in each squeeze lead to very different moves: a simple, hands-on taste of chaotic motion.

- Have students identify the levers, the fulcrum, the effort and the load.
- Compare slow and fast squeezes. What decides whether Larry makes it over the top?
- Give the moves gymnastics names and 'scores'; Bruce rates moves like the vertical split and giant circles.
- Build Larrys of different sizes and compare how hard they are to flip, connecting size to rotational inertia.
- Try fixing the legs in place and see whether the motion becomes more predictable.

GO FURTHER

Variations

- Bruce has built them from about 1 ft to 3 ft long; the largest needs two hands to operate.
- Change the character: a gymnast, an animal or a robot.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

Larry will not lift.

TRY THIS

The handles may be bolted too tight to pivot, or the string has too little twist; loosen the bolt and re-string with more crossing.

IF THIS HAPPENS

He lifts but never goes over the top.

TRY THIS

Squeeze faster and sharper, or lighten the figure.

IF THIS HAPPENS

The limbs bind.

TRY THIS

Enlarge the joint holes or loosen the joint knots.

IF THIS HAPPENS

TRY THIS

The bolt loosens over time.

Use a lock nut.

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