Workshop 4 – Advanced Lego Techniques
Monday, January 10th, and Tuesday, January 11th, 2005

1   Items to Bring

- All of your legos

2   Comparing Pieces

To the untrained eye, Legos can be considered a very limited development environment: All the holes are predrilled, the lengths of the beams and axels predefined. But there are many "odd pieces" in your set of Legos that give it versatility.

Comparison 1:

Connecting Rod
2 FLUs tall

Angle Element, 0 degrees
1 FLU + 3/8 inch tall

Bushing/Catch Combo
2 FLUs tall

The axel inserted into this longer catch will grip better.

Comparison 2:

Angle Element, 157.5 degrees
Can create a 16 sided polygon

Angle Element, 108 degrees
Can create a 5 sided polygon
Can approximate curved surfaces

Comparison 3: Lever Arms VS. Beams

Lever Arms: Curved Ends, No Nubs, 2 different thicknesses: 1 FLU and ½ FLU
Uses:
Brace gearboxes to allow for good gear clearance
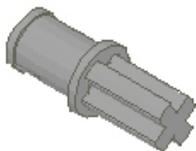Create odd angles

Comparison 4: Connector Pegs

Not Black = Low Friction

Connector Peg
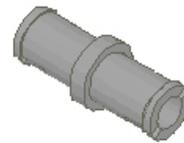Useful for joining 2, 1 FLU wide pieces

Connector Peg ¾
Useful for joining 1 FLU and ½ FLU wide piece

Top: Connector Peg with Friction and Slot
Middle: Connector Peg with Friction
Bottom: Connector Peg Long with Friction
Black = High Friction; Useful for bracing

Connector Peg ½
Useful for joining 1 FLU beams at 90°
and locking in axles
Notice that there is no raised edge

There are a variety of connector pieces in a variety of colors that have short axle lengths. These can be used for connecting lever arms. . .use your imagination.
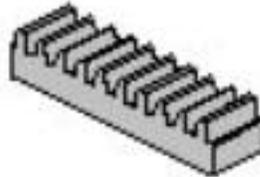
3   Changing Rotational Motion

Why are there all these holes in my gears?

A train moves by using a piston to drive the first in a chain of wheels. The holes in your gears besides the central axel catch can similarly be used to attach an axel that moves almost linearly.

This "piston effect" leads to some interesting ways of harnessing rotational motion:
- Transferring rotational motion over long distances
- A driven, oscillating gear train

What can I use a gear rack for?

The gear rack can be used to change rotational motion into linear motion. With your servos, some of the attachments already allow you to use linear motion without "legoizing."

4   The Rubber Band

- Keeping tread tension
- Maintaining contact with the ball
- Regulating the strength needed to depress a switch
- Rubber part of a gripper
- Restoring Force

5   Gears and the Mechanical Stop

Gears:
- The Worm Gear
- Driving two outputs
- Add/Subtraction Differential

The Mechanical Stop:
- Ratchet
- Tape Re-Winder System
- The Claw
- One way ball gate

6   Putting it Together

Motor Mounting: See Attached

Odds and Ends:
- Extending the usefulness of the switch
- Attaching Legos to treads
- Caster Design – centered VS offset
- Long axles - the extender piece, the gear extension, and the connector peg

7 Interesting Sources

The things talked about during this workshop are just the tip of the iceberg. For those Lego enthusiasts may we recommend a few sites. Legos are EXTREMELY versatile: with a little ingenuity you can create almost any real-world working design.
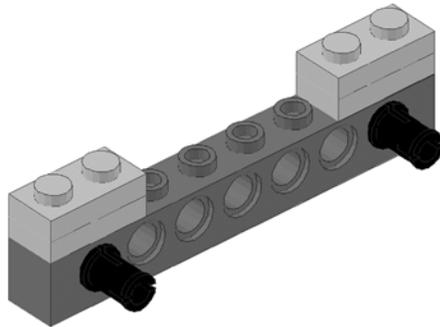
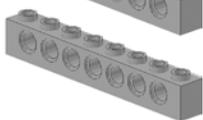http://staff.science.uva.nl/~leo/lego.html
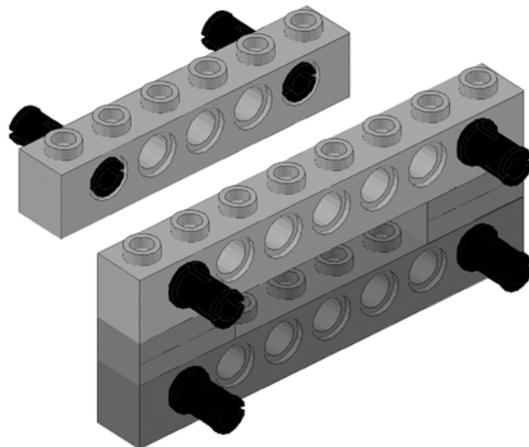
8 Activity
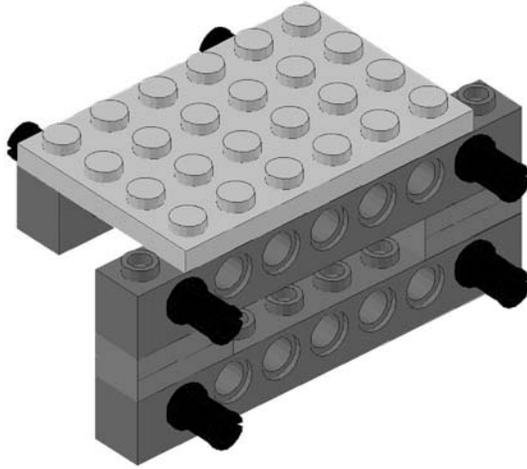
Build a one way ball gate.
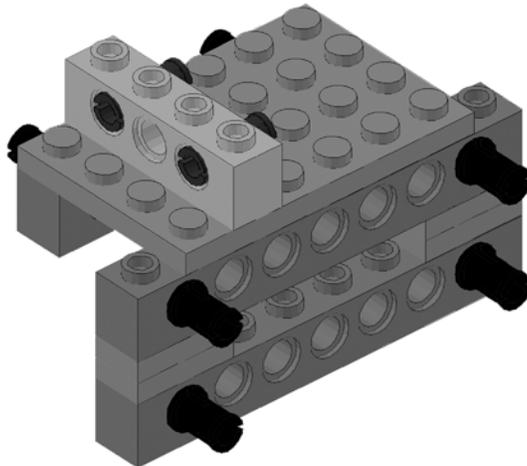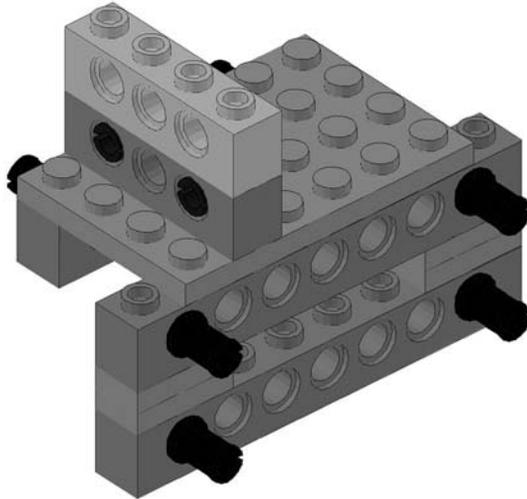
Motor Mount 1
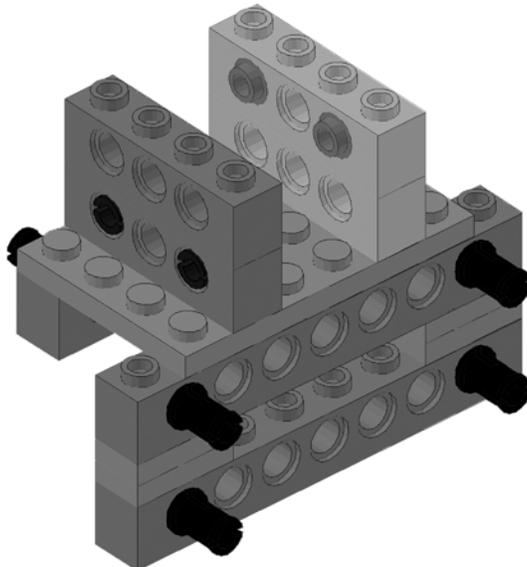
1 x
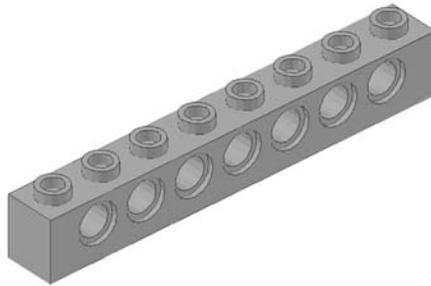
2

4 x

2 x

3

4 x

1 x

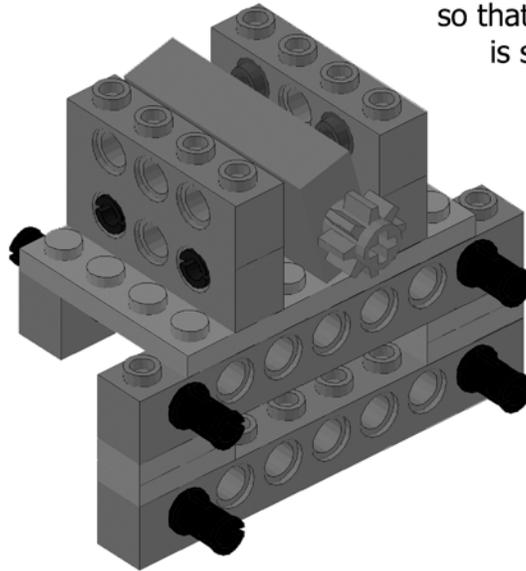1 x

4

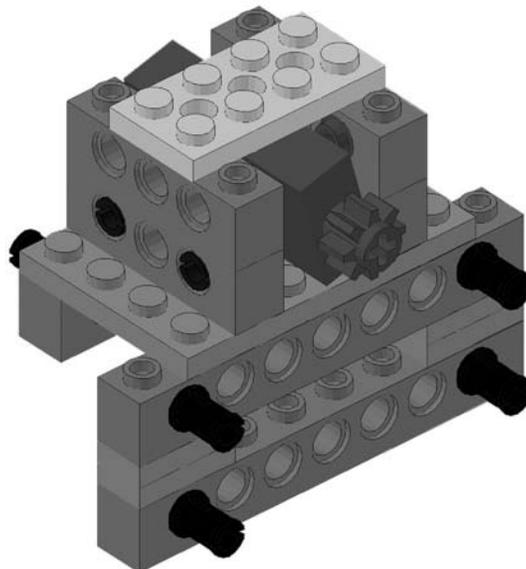1 x

5

2 x ● (3/4 pin)

1 x

6

1 x

7

2 x (1/2 pin with stud)

2 x

8

Motor with attached gear

Put on top of motor
two pieces of foam tape
so that 2x4 plate (step 9)
is snug against motor

9

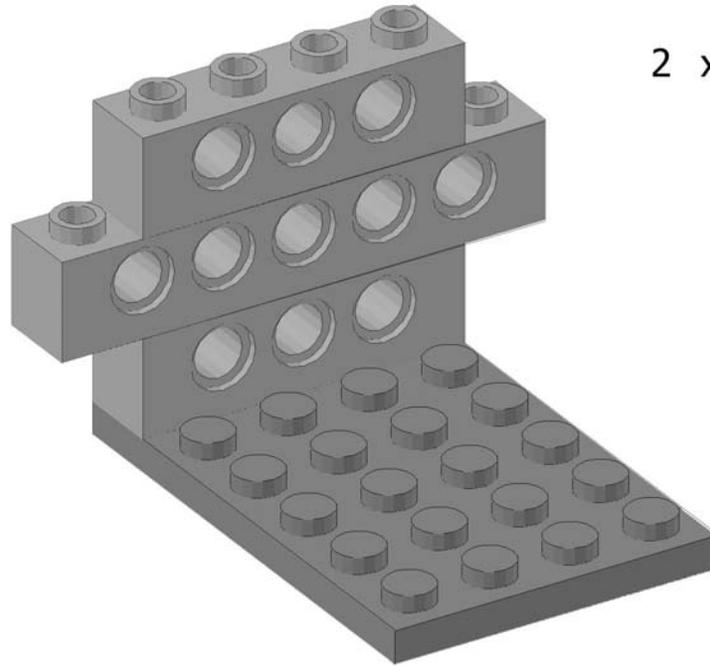1 x

10
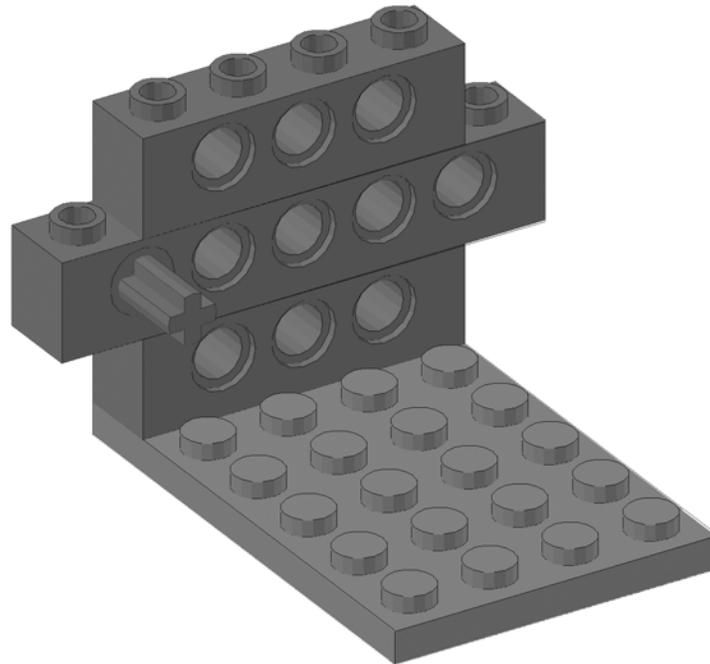
2 x

1 x

11
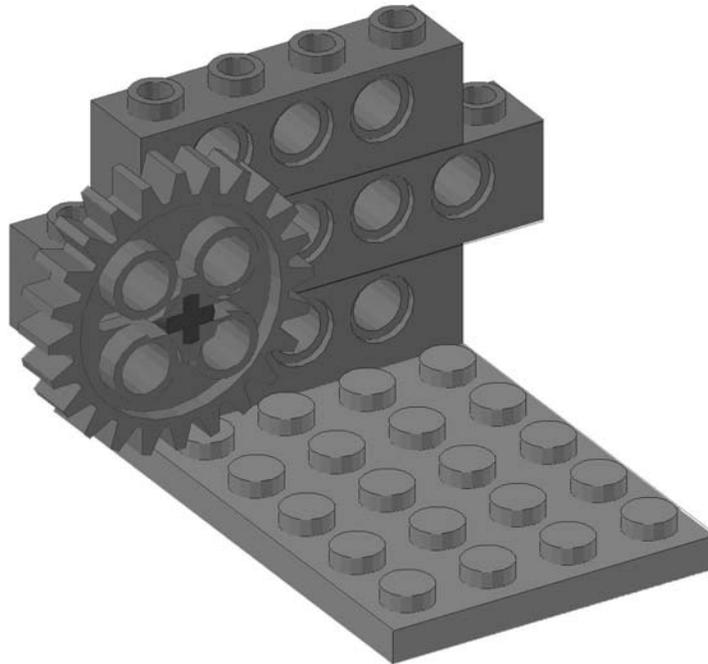
2 x

1 x
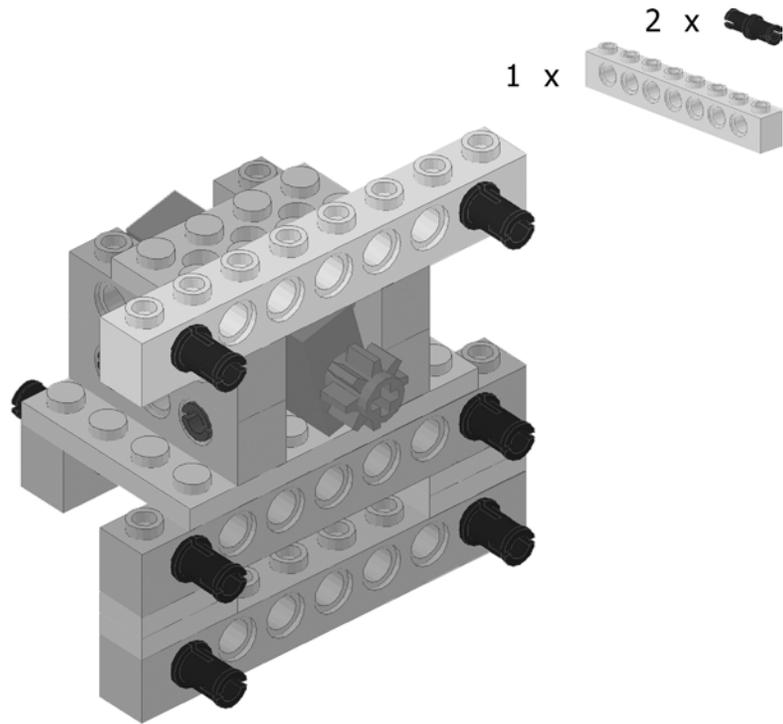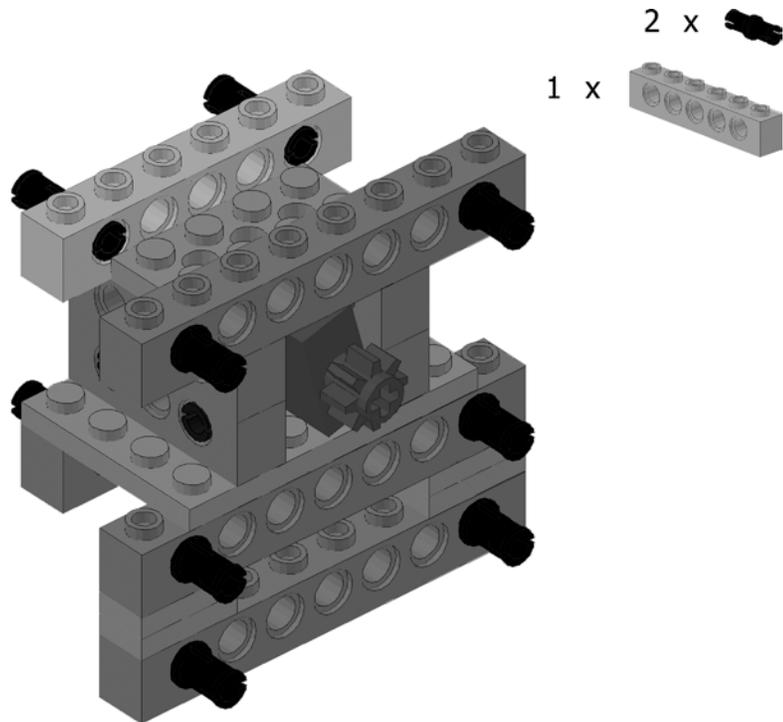
12

2 x (axle length 4)
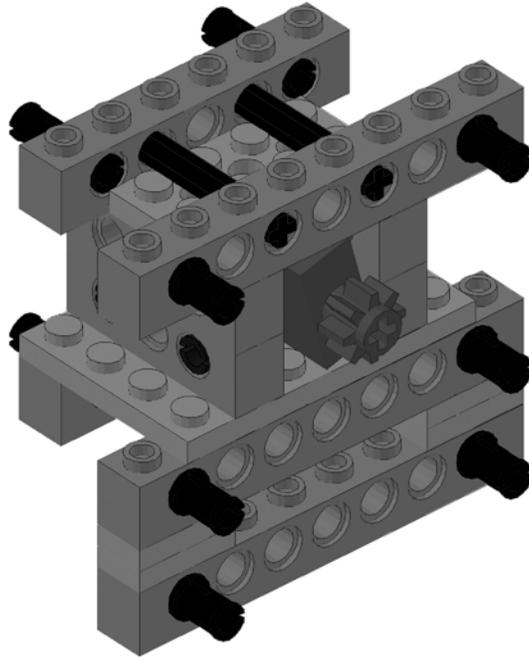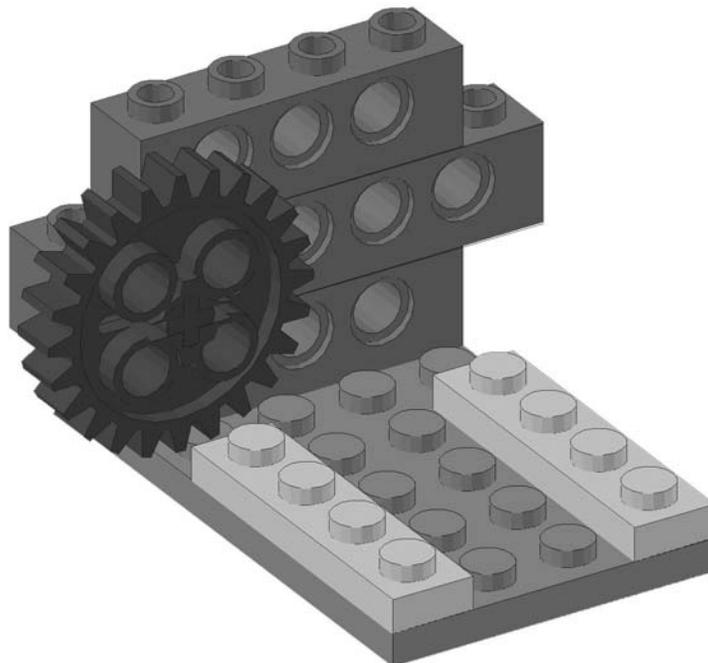
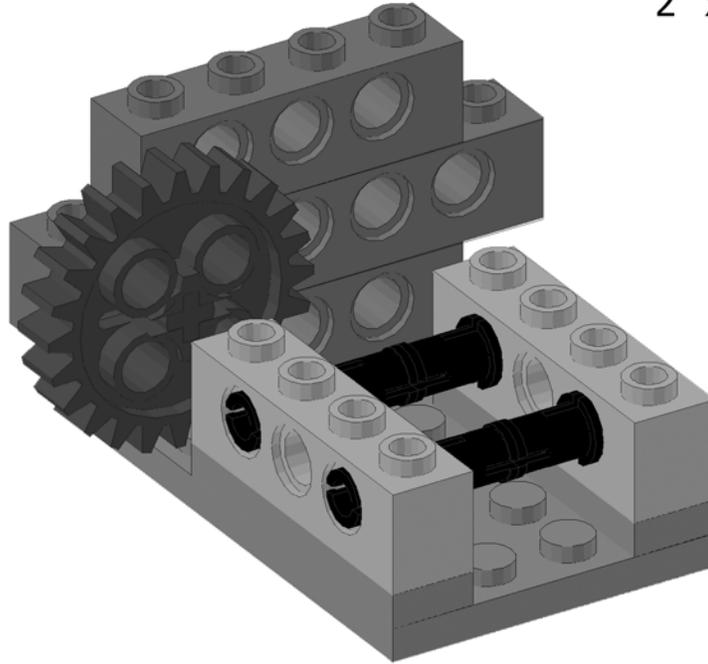13

2 x

2 x
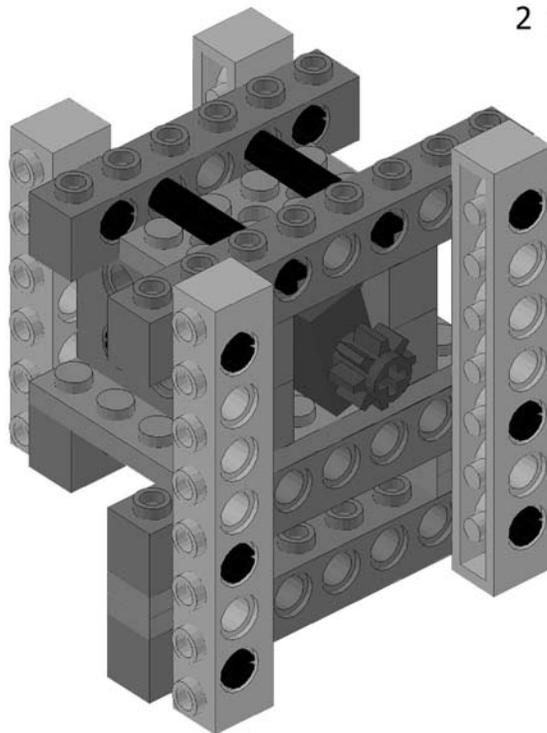
14

1 x
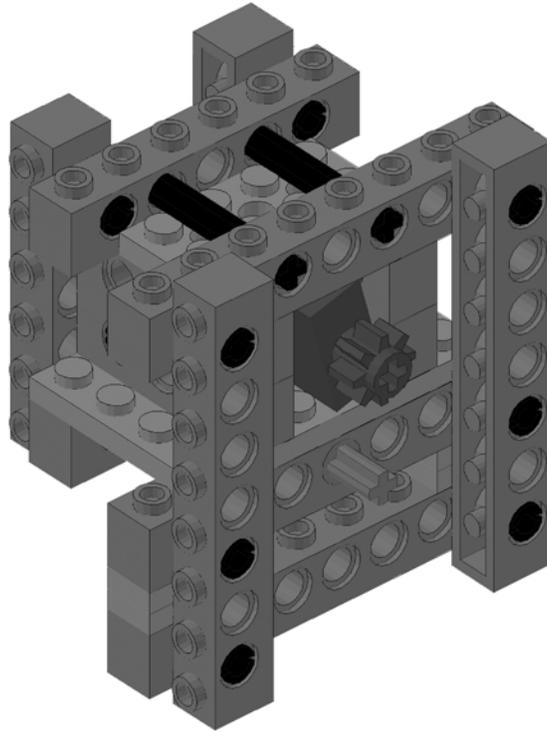
15

1 x
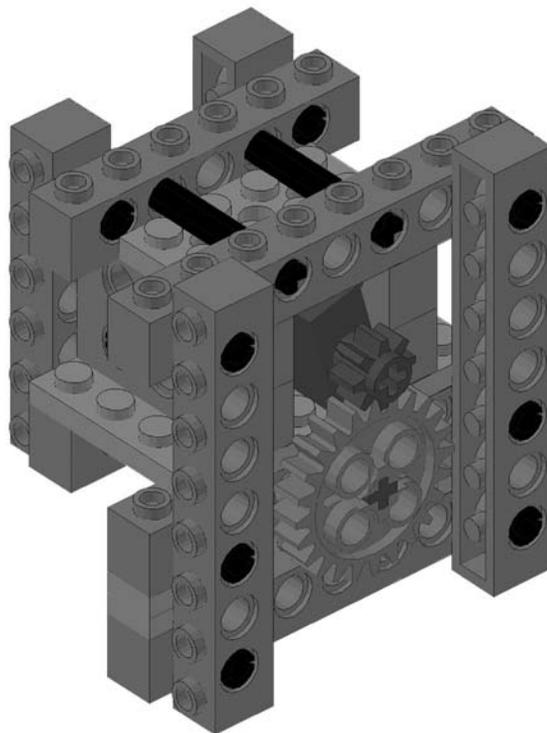
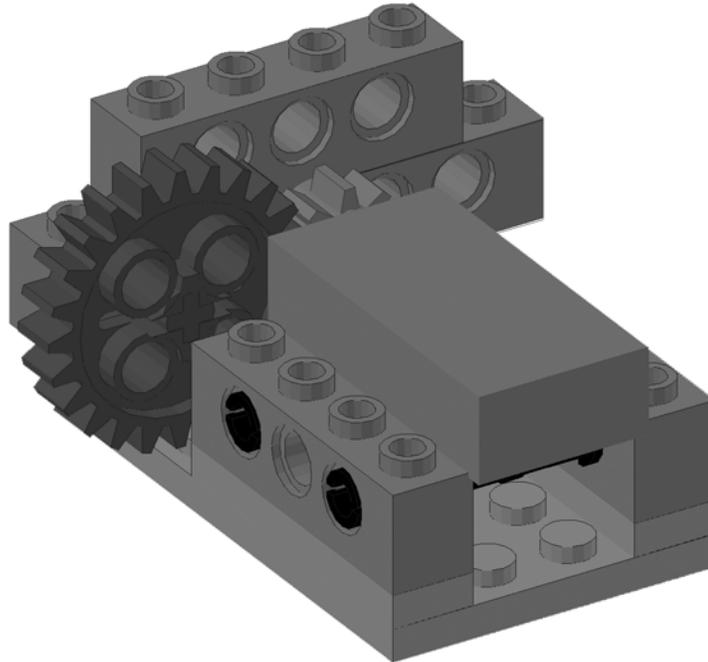# Motor Mount 2
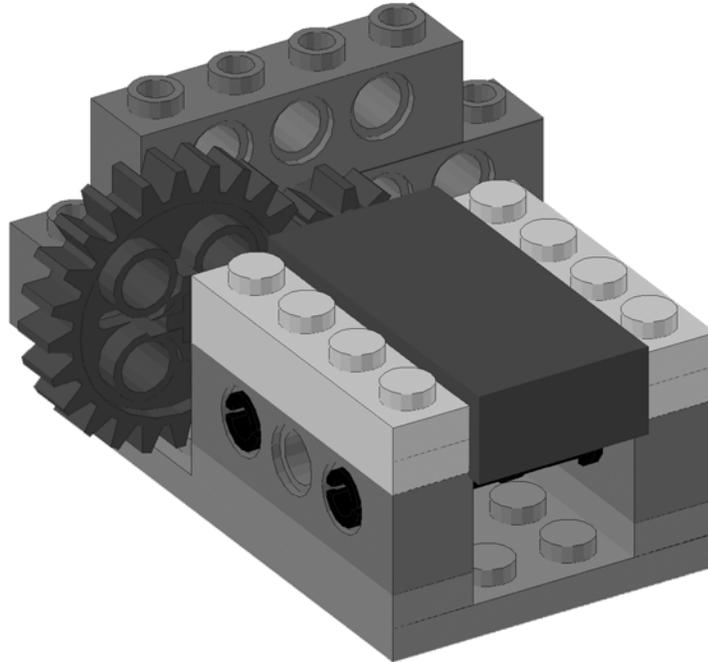
1 x
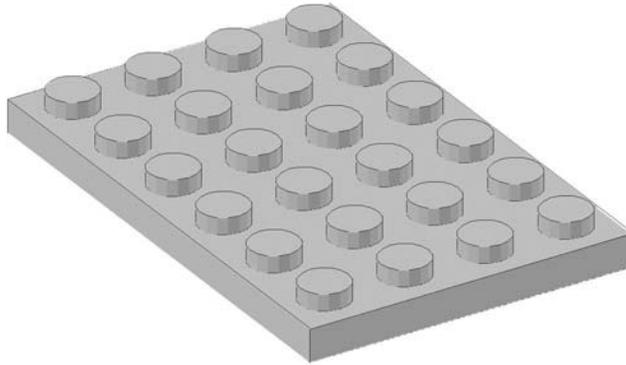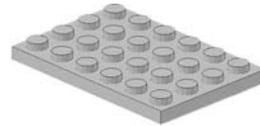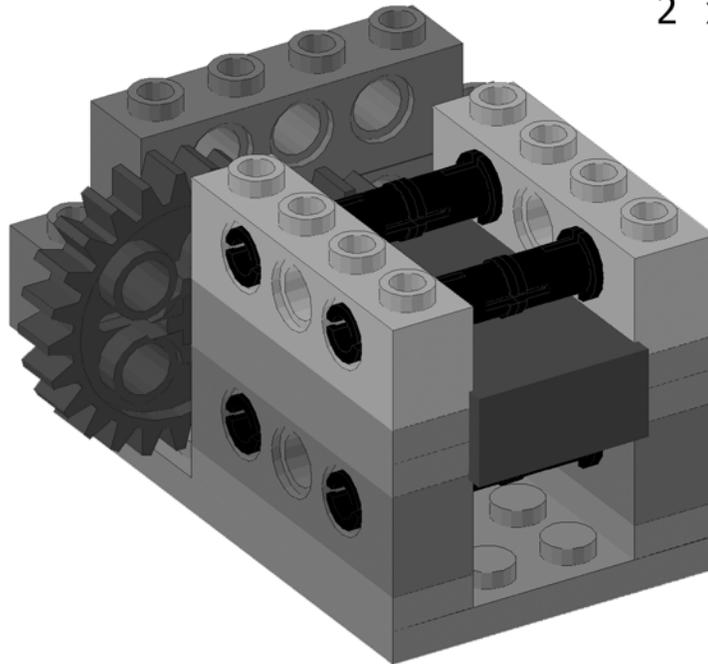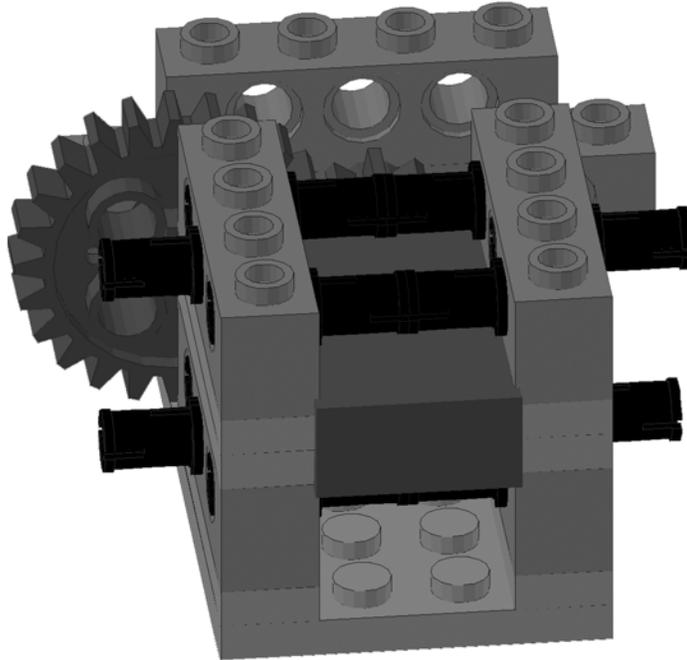
2

1 x

2 x

3

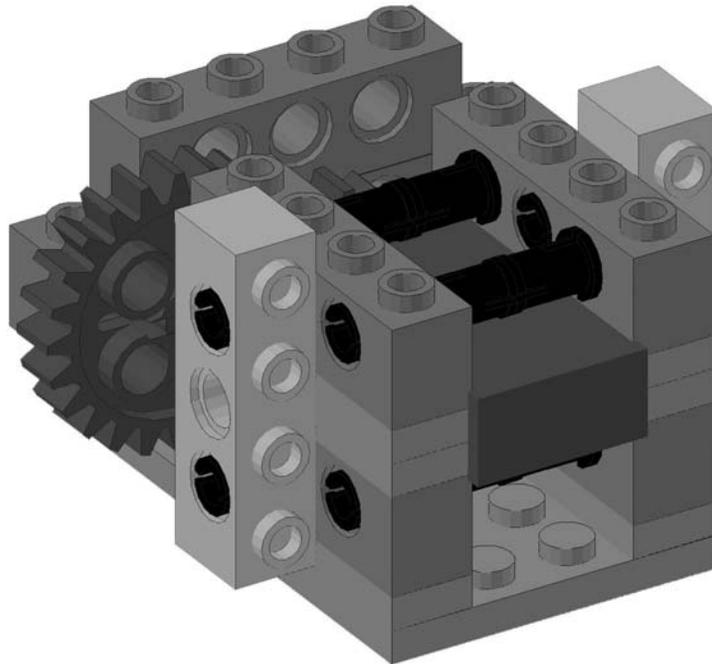1 x

4

1 x

5

2 x
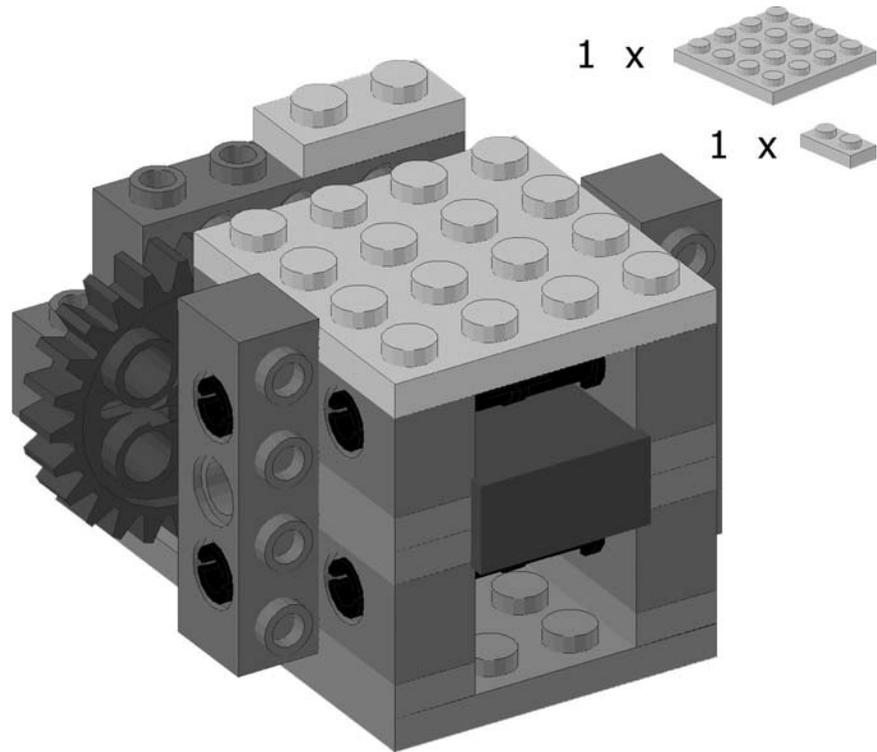
6

4 x

2 x

Motor with attached gear

7

8

4 x

9

4 x

2 x

10   4 x

11   2 x

12   1 x

13   1 x