Stationary Legos

HOW TO Key Words:
• Build a sturdy Structure
• Brace your Structure
• Change Axis on your structure
Building a Sturdy Structure

The keys to building a Sturdy Structure are as follows:

1. Use Interconnecting bricks-when you interconnect your bricks, the structure will not fall apart when you move it.

2. Flick Test: Test the durability of your structure with a simple flick of your finger. If the structure falls apart, look at the structure you built and see what was the weakest point, try to mend this problem simply. (This step should be repeated throughout the building process).

3. Drop Test: Finally test your project by dropping it (knee high, waist high, chest high). Making this into a competition is often fun for children to see who can build the strongest structure, but make sure that you discuss why the structure that won was strong. (Also be sure to take some pictures before conducting this test as losing work is often tragic if you do not have any sort of back up).
Step 1 – Interconnecting beams

Building a Sturdy Structure
Step 2 – Flick Test

Building a Sturdy Structure
Step 3 – Drop Test

Building a Sturdy Structure

Stationary Legos
Bracing

In order to sufficiently brace your structure you want to use 2X plates to keep the structure square. Also using black (with friction) or gray connectors will help to keep your beams together.

Key Words:
2X plates, Black/gray connectors
Bracing

Each stud on the plate or beam acts like a finger, and the more fingers you have touching the part, the better your grip!

Key Words:
2X plates
Bracing

Black connector pegs are used when you do not want the beams to slide back and forth and you want the structure to remain square. Gray connector pegs do not have friction so they can slide within the hole in the beam.

Key Words:
Black/gray connectors
Bracing

Key Words:
Black/gray connectors

Using black connector pegs keeps your beams together firmly without adding anything to the top of bottom of the beam structure.
Sturdy Structures:

Bracing with beams

Pieces:

1. x2
2. x2
3. x4
4. x2
5. x2
Sturdy Structures:

**Bracing with beams**

**Pieces:**

- x3
- x2
Changing Axis

Key Words:
Bevel Gear, Crown Gear, Toggle Joints, Beams
Bevel Gear

**Key Words:**
Bevel

**Changing Axis:**

**Stationary Legos**

**Pieces:**
- 6 x2
- x2
- x2
- x2

1. 
2. 
3. 
4.
Crown Gear

Key Words:
Crown Gear

Changing Axis:

Stationary Legos

Pieces:
- x2
- x2
- x2

1

2

3
Changing Axis:

Toggle Joint

Stationary Legos

Pieces:

Type 1Key Words:

Type 2Key Words:

Note: This type of toggle joint can lock into position at an arbitrary angle.
Changing Axis Using Beams

Pieces:

- Stationary Legos
  - 2 of each piece
- Sturdy Structures
  - 4 of each piece

Steps:

1. Assemble the pieces
2. Adjust the axis using beams
Moving Parts

• Building Vehicles
• Building Animals
• Artistic Lego Adventures
• Smart Structures
• Miscellaneous
How to Attach Motors

Due to the curved bottom of the motor it is sometimes difficult to build structures with motors. For this reason we have constructed a typical motor “housing” as shown above.

Also when adding motors to a project you want to be sure to attach the wires before building on top of the motor. The top of each motor has a wire gulley which the wire should fit through and still be able to have a lego piece on top.
How to Attach Motors

Pieces:

On either side of the motor there are slots which are very helpful when you do not have room to build the motor housing shown previously. Instead you can slide in the piece shown at the right which then connects to any lego piece above or below it.
Wheels:
How to choose the right wheel for the right job

Add tractor treads
Wheels: How to choose the right wheel for the right job

- Medium wheel: This is a great all-purpose tire. Well suited for most building projects.

- Wide wheel: This tire is good for traction. In general, the wider the tire, the better grip it has to the road. This is helpful when pulling loads or climbing hills.

- Thin wheels and skid plates: These work best when there is little weight on them. Skid plates are especially helpful in stabilizing 2-wheel cars.

- Small wheels: These are best for small cars, but can be used in place of a medium wheel if need be.

- Large wheels: These wheels are great for big projects, or to make fast cars. In general, the larger the wheel, the faster the car will go, however, larger wheels also have slower acceleration.
Wheels:
How many wheels should I use?

4 Wheels: Use four wheels when your vehicle will only be going forward. Do not use four wheels if you want your vehicle to turn easily. (ex. Snail Car Race).

2 Wheels: Use two wheels and a skid plate when you want your vehicle to turn easily and it is not too heavy that the skid plate would cause too much friction.

3 Wheels: Use three wheels with a swivel wheel in the front or back when you want your structure to turn easily. While swivel wheels can be hard to construct, the benefits due to the turning ability and the ability to hold more weight is great.

Note: When trying to build a car that turns both directions, goes in reverse, and can turn on a dime; you want to use two motors.
If your car only needs to go forward or reverse, one motor is sufficient.
Gearing Up

**Pieces:**
- Gears
- Axles
- Wheels
- Bricks

**Key Words:**
- Gearing up
- Driver
- Follower
Building a Vehicle

Gearing Down

Pieces:

Key Words:
Gearing down, Driver, Follower
Building a Vehicle

Multiple Gears

Pieces:

Note: Here’s an example of how some of the more common gears mesh together. There are many other options for meshing these gears as well.
Uses:
Pulleys, like gears, can be used to change axle speeds. In fact, pulleys can sometimes be an easier to use than gears, if the axles they connect to are in hard to reach places.
Special Gears

Building a Vehicle

Bevel Gear

Cam

Differential

Moving Parts

Worm Gear

Gear Rack
Bevel Gear

Pieces:
- 6 x2
- x2
- x2
- x2

Key Words:
Bevel
Building a Vehicle

Cam

Moving Parts

Pieces:

- 8 long bars
- 3 bars
- 2 bars x2
- 6 plate bars x6
- 2 plate bars x2
- Circles x5
- Circles x2
- Tire x1
- Tire x1
Building a Vehicle

Cam

Pieces:

1. x4
2. x2
3. x4
4.

Moving Parts
Building a Vehicle

Cam

Pieces:

- 8
- 3
- 2
- 2
- 2

Moving Parts

6

7

8
This program switches the direction wheel spins every time the touch sensor is pressed.
**Pieces:**

- 6 x2
- 3

**Uses:** With wheels attached to each axle of the differential, a device is made that turns more easily. If other gears and a motor are attached to the differential itself, a mechanical gear selector can be made.
Worm Gear

Two easy ways to use the worm gear:

- With Gear Box
- Without Gear Box
Worm Gear: With Gear Box

Pieces:
- 6 x2
- 4 x4
- 4 x4
- 2 x2
- 2 x4
- 1 x2
- 1 x2
- 1 x2
- 1 x2

Uses: The worm gear generates lots of torque. Therefore, even though its turns slowly it can be used to lift heavy loads, or move big cars.
Worm Gear: With Gear Box

Pieces:

- 6 pieces
- 4 x 2 pieces
- 2 x 2 pieces
- 2 x 4 pieces

Building a Vehicle

1. Assemble the black LEGO pieces.
2. Attach the yellow gear box to the black pieces.
3. Install the moving parts into the gear box.
4. Complete the assembly by connecting the remaining pieces.
Building a Vehicle

Worm Gear: With Gear Box

Pieces:

*6*
*2*

5

6

7

8

Moving Parts
Worm Gear: Without Gear Box

**Pieces:**

- 6 x2
- 2 x2
- 4 x4
- 2 x2
- 2 x2
- 2 x2

**Uses:** The worm gear generates lots of torque. Therefore, even though its turns slowly it can be used to lift heavy loads, or move big cars.
Worm Gear: Without Gear Box

**Pieces:**
- 6
- + x2
-  x2
-  x4

Building a Vehicle

1.

2.

3.

4.
Worm Gear: Without Gear Box

Building a Vehicle

Moving Parts

Pieces:

5

6

7

8

9
Uses: The gear rack can be used, often with a worm gear, to make trains, move arms, or lift objects.
Building a Vehicle

Gear Rack: Train

Train Pieces:

- 6 pieces
- 4 pieces

Moving Parts
Building a Vehicle

Gear Rack: Train

Train Pieces:

- 6
- x2
- x4

Moving Parts
Gear Rack: Track

Track Pieces:

- x4

Key Words:

Put the train on the track, attach an RCX, and watch it go!
Crown Gear

**Key Words:**
Crown Gear

**Pieces:**
- x2

1. Initial setup
2. Adding blue elements
3. Final assembly

Building a Vehicle

Moving Parts
Building an Animal

Animal Parts

Key Words:
Flywheel, crank, gear rack, pulley, (football shaped gear)
Building a beak or jaws

Pieces:
- x2 of a certain piece
- 8 of another piece
- x2 of a third piece
- x10 of a fourth piece

1. First step
2. Second step
3. Third step
Making Wings

Pieces:

Key Words:
Flywheel, crank, gear rack, pulley, (football shaped gear)
Building an Animal

Walking Legs

Pieces:

- 5 units of x5
- 3 units of x3
- 2 units of x2
- 2 units of x2

Moving Parts
Building an Animal

Walking Legs

Pieces:

- x2
- x3
- x2
- x3
- x3
- x5

Moving Parts

1. Pieces
2. Assembly steps 3 to 6
3. Motor connection
4. Final assembly
Making a Tail

Building an Animal

Moving Parts

Pieces:

1. x2

2.
Building an Animal

Fly Wheel

Pieces:

Key Words:
Flywheel
Building an Animal

Building a tongue

**Key Words:**
Flywheel, crank, gear rack, pulley, (football shaped gear)
Building an Animal

Common Animals

Moving Parts
Building an Animal

Building a Penguin

Pieces:

1. x2
2. x2
3. x3
4. x9
5. x3
6. x15
7. 6x16

Moving Parts

1
2
3
4
5
Building an Animal  
Giraffe  
Moving Parts
Giraffe

Pieces:

- x2
- x4
- x5
- x7
- x5
- x4
- x2
- x6
- x2
- x10

Moving Parts

Building an Animal
Building an Animal

Giraffe

Moving Parts

Pieces:

- x2
Giraffe

Building an Animal

Connect wires to ports A and C

Pieces:

- x2
- x2
- x2
- x2

Moving Parts
Giraffe

Pieces:

x2
Building an Animal

Giraffe

Pieces:

- Tire: x2
- Axle: x2
- 1x2 brick: x2
- 1x1 brick: x2
Building an Animal

Giraffe

Pieces:

x4
Building an Animal

Giraffe

Pieces:

- x2
- x4

Moving Parts
Giraffe

Building an Animal

Moving Parts

Pieces:

- x2 of 12 units
- x2 of 4 units
- x4 of 2 units
Building an Animal

Giraffe

Pieces:

- 12
- x3

Moving Parts
Giraffe

Building an Animal

Moving Parts

Pieces:

- Yellow bars: x2
- Black bars: x8

Pieces:

- Yellow bars: x2
Building an Animal

Giraffe

Moving Parts

Pieces:
- x2
- x3
- x3
- x2
Slide the neck onto the axle
Building an Animal

Giraffe

Pieces:

Moving Parts 13
Building an Animal

Giraffe

Pieces:
- x2
- x4
- x5

Moving Parts 14
Giraffe

Building an Animal

Pieces:
- x4
- x2
Building an Animal

Giraffe

Pieces:

x2

Moving Parts 16
Building an Animal

Frog

Moving Parts
Frog

Building an Animal

Moving Parts

Pieces:

- x4
- x2
- x6
Building an Animal

Frog

Moving Parts

Pieces:

- x4
- x2
- x2
Building an Animal

Frog

Pieces:

- x2
- x2
- x2

Moving Parts
Building an Animal

Frog

Moving Parts

Pieces:

x2
Building an Animal

Frog

Moving Parts

Pieces:

- x2
- x4
- x2
Building an Animal

Frog

Moving Parts

Pieces:

x4
Building an Animal

Frog

Moving Parts

Pieces:

- x2
- x6
Building an Animal

Frog

Pieces: 8

Moving Parts
Building an Animal

Frog

Moving Parts

Pieces:

x3

9
Building an Animal

Frog

Pieces:

- x2
- x2

Moving Parts
Frog

Pieces:

- x2
- x2
In order to do this project you should review the following concepts:
Building Kinetic Sculptures

Catapult

Pieces:

- Rubber Band (x7)
- Lego Band (x38)
- 18” Rope (x2)
- Moving Parts (x11)
- x8
- x21
- x2
- x5
- x4
- x6
- x20
- x17
- x16
- x20
- x6
- x6
- x4
- x3

Moving Parts
Building Kinetic Sculptures

Catapult: Arm

Moving Parts

**Pieces:**

- 4
- 5
- x2
- x2
Building Kinetic Sculptures

Catapult: Arm

Pieces:

- 3
- [Image of piece]
- One or more rubber bands, about 2-3 inches long.

Moving Parts
Catapult: Arm

Pieces:

Leave the other end of the rubber band loose for now.
Building Kinetic Sculptures

Catapult: Right Side

Moving Parts

Pieces:

- x2
- x3
Building Kinetic Sculptures

Catapult: Right Side

Pieces:

\[ \begin{array}{c}
\begin{array}{cccc}
\circ & \circ & \circ & \circ \\
\circ & \circ & \circ & \circ \\
\end{array} \\
\times 2
\end{array} \]
Building Kinetic Sculptures

Catapult: Right Side

Pieces:

- 4x4 stud brick (x2)
- 1x4 plate (2)
- 2x6 beam
- 4x4 panel
Catapult: Right Side

Building Kinetic Sculptures

Pieces:
- x2
- x2
- x2
- x2
- x2
- x2
Building Kinetic Sculptures

Catapult: Right Side

**Pieces:**

- 6
- x3
- x2
- x2

Moving Parts
Building Kinetic Sculptures

Catapult: Right Side

Moving Parts

Pieces:

- x2
- x2
Building Kinetic Sculptures

Catapult: Left Side

Pieces:

- [ ] x2
- [ ]
- [ ] x3
Building Kinetic Sculptures

Catapult: Left Side

Moving Parts

Pieces:

<table>
<thead>
<tr>
<th>Pieces</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>x3</td>
</tr>
<tr>
<td></td>
<td>x4</td>
</tr>
</tbody>
</table>
Building Kinetic Sculptures

Catapult: Left Side

Moving Parts

Pieces:

<table>
<thead>
<tr>
<th>Piece</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>x3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>x2</td>
<td></td>
</tr>
</tbody>
</table>

a. b. c.
Catapult: Left Side

Building Kinetic Sculptures

Moving Parts

Pieces:

3

[Diagram of pieces used]
Building Kinetic Sculptures

Catapult: Left Side

Pieces:

[Diagram of parts and pieces for building a catapult]
Building Kinetic Sculptures

Catapult: Left Side

Moving Parts

Pieces:

- (3 pieces)
- x3
- Gear
Building Kinetic Sculptures

Catapult: Left Side

Pieces:
- 2
- 4
- x3
Catapult: Left Side

Note: Wire should be at 4”-6” long. Leave the other end loose for now.

Pieces:

- x2
- x2
Building Kinetic Sculptures

Catapult: Left Side

Moving Parts

Pieces:
- x2
- x2
- x2
- x2

18
Building Kinetic Sculptures

Catapult: Left Side

Pieces:

- 6
- x3
- x2
- x2
Building Kinetic Sculptures

Catapult: Left Side

Pieces:

- [ ] x2
- [ ] x2

Moving Parts
Catapult: Assembly

Building Kinetic Sculptures

**Pieces:**
- x2
- x7

Other end of rubber band attaches here.

To firing arm
Catapult: Assembly

Building Kinetic Sculptures

Moving Parts

Pieces:
- x4
- x2
Building Kinetic Sculptures

Catapult: Ammo Loader

Pieces:

Moving Parts
Catapult: Ammo Loader

Pieces:

- [ ] x4
- [ ] x2
- [ ] x2
Catapult: Ammo Loader

Pieces:
- x2
- x2
- x2
- x2

Building Kinetic Sculptures

Moving Parts
Catapult: Ammo Loader

Pieces:

- x2
- x2
- x2
- x2

Building Kinetic Sculptures

Moving Parts

27
Catapult: Ammo Loader

Pieces:

- x6
Catapult: Ammo Loader

Pieces:

- x2
- x10

Building Kinetic Sculptures
Catapult: Ammo Loader

Pieces:
- x2
- x2
- x2
Catapult: Ammo Loader

**Building Kinetic Sculptures**

**Moving Parts**

**Pieces:**
- x2
- x2
- x2
- x4

**Pieces:**
- x6
- x2

31

32
Catapult: Ammo Loader

Pieces:

- x2
- x2
- x2

Building Kinetic Sculptures

Moving Parts
Catapult: Ammo Loader

Pieces:
- x2

Building Kinetic Sculptures
Moving Parts
Catapult: Ammo Loader

These arms will connect the ammo loader to the rest of the catapult.
Insert the axles from the arms of the ammo loader into the green bricks on the back of the catapult.
The final pin to attach the ammo loader goes through the last hole on the catapult just below the smooth plates to the hole on the ammo loader just below the sloped brick. When connected and secured on each end with a bushing, the ammo loader will be at an angle to the rest of the catapult.
Building Kinetic Sculptures

Catapult: Assembly

Side view

Bottom view

Moving Parts
Note: When the motor is in the position above, the lever arm should be locked into the differential gear. When the motor is turned halfway, the lever should be free from the differential. If this is not the case, readjust the bands.

**Pieces:** Lego rubber bands

- x3
**Wiring Guide**

Port 1 connects to the touch sensor under the arm.

Port 3 connects to the touch sensor on the rcx.

Port A connects to the motor on the front of the catapult.

Port B connects to the motor on the ammo loader

Port C connects to the motor on the middle of the catapult
Catapult: Assembly

**Pieces:**

- 18” string

The sting is tied at one end to the angled arm and at the other end to the yellow cylinder.
These white wheels will serve as the ammo, they slide into the loader as shown.
1. Make sure that when the arm is pulled down, the sloped brick hits the touch sensor.

2. The gears on the ammo loader work best if they are in the position shown.

**How it works:**

When the program below is run, the firing arm will wind down until touch sensor 1 is pressed. Then, motor A will stop and a single white wheel will be moved from the loader onto the arm. When touch sensor 2 is pressed, motor C will move. This will pull the firing lever, and release the arm. The catapult will then reload itself automatically.
Building a Music Box
Building a Music Box

Pieces:

1. 
   - 16 elements

2. 
   - 17 elements
   - 17 elements

48X48 plate
Building a Music Box

Pieces:

x2

5

6
Building a Music Box

Pieces:

| | | | | | | | | | | x4 |
Building a Music Box

Pieces:

- 10 pieces: 2 each
- 12 pieces: 2 each
- Gears: 3 each
Building a Music Box

Pieces:

- x2
- x4

10 pieces

2 views
Building a Music Box

Pieces:

- 8 pieces
- 2 x2 pieces

11

12
Building a Music Box

Pieces:

13

14
Building a Music Box

Pieces:

15

16
Building a Music Box

Pieces:

- x2

Total Pieces: 17

Moving Parts

Total Pieces: 18
Building a Music Box

Note: From this point, you can build one of two tops. The first top will just open and the second top is motorized to open when the music box has been cranked.
Building a Music Box

Pieces: TOP #1

- Blue piece: x10
- Black piece: x36
- Black piece: x22
Building a Music Box

Pieces:

20

21
Building a Music Box

Pieces:

x10
Building Kinetic Sculptures

Building a Music Box

Pieces: TOP #2

- Bars: 10 x 2
- Lathe: 12 x 2
- Notes: 16 x 2
- Toned: 2 x 2
- Rotor: 6 x 2
- Keys: 7 x 2
- Parts: 6

Moving Parts
Building Kinetic Sculptures

Building a Music Box

Pieces:

- x9
- x2
- 10
- 12

Moving Parts

20

21
Building a Music Box

Pieces:

- 12 pieces, x7
- 22 pieces, x4
- 10 pieces, x7

Moving Parts
Building a Music Box

Key Words:
Rotation Sensor
Building a Music Box

Pieces:

x6
Building a Music Box

Pieces:

- x2

27

28
Building a Music Box

Note:
At this point, tie a piece of string from the wheel to the 6 stud beam on the top.
Building a Music Box
Garage

Smart Structures

Moving Parts

Pieces:

Key Words:
Gear rack
Garage

Smart Structures

Pieces:

x26

Moving Parts

1

2
Smart Structures

Pieces:

- x5
- x10

Garage

Moving Parts
Garage

Pieces:

- Smart Structures
  - x3
  - x4

Moving Parts

Steps:

1. 8
2. 7
Garage

Smart Structures

Pieces:
- x10
- 2x

Moving Parts
Garage

Pieces:
- Smart Structures x2
- Moving Parts

11

12
Garage Door

Smart Structures

Pieces:

1. Gear Rack

Key Words:

- Gear Rack

Moving Parts

13
14
15
16
Garage
In order to do this project you should review the following concepts: multiple gears, using a worm gear, gearing down.
Note: This project requires the use of a custom made piece. Using a standard 40-tooth gear and a 13/16” drill bit, make a smooth hole through the cross at the center of a 40 tooth gear. (see picture)
Clock: Housing

Pieces:

- x4
Building Smart Structures

Clock: Housing

Pieces:

- 2 units
- 4 units
- 2 units
- 2 units
- 2 units
Note: Attach one end of the wire to port A at this time, leave the other end loose for now.
Building Smart Structures

Clock: Gearing

Pieces:

- 12 long pieces
- 4 x 2
- x 2

Moving Parts
Building Smart Structures

Clock: Gearing

Pieces:

- 4 x 2

- Piece x 2

Moving Parts
Building Smart Structures

Clock: Gearing

Pieces:
- 1 x2
- 2 x2

Moving Parts

Pieces:
- 1 x2
- 4 x2
Building Smart Structures

Clock: Gearing

Moving Parts

**Pieces:**

- Gear x2
- 4
- Axle x2
- Plate x2

**Pieces:**

- Gear x2
- Axle x2
- Plate

Custom gear goes here
Clock: Gearing

Pieces:

1

2

x2

Building Smart Structures

Moving Parts
Building Smart Structures

Clock: Gearing

Moving Parts

Pieces:

6
Clock: Gearing

**Pieces:**
- x4
- x4
- x24

Attach chain here
Attach the gearing to the housing. Feed the wire from the RCX through the gearing as shown.
Clock

Building Smart Structures

Moving Parts

Pieces: x8
Building Smart Structures

Clock

Moving Parts

Pieces:

x4
Clock

Pieces:

- 10 long pieces
- 3 short pieces
- 2 x 2 pieces

Building Smart Structures

Moving Parts
Building Smart Structures

Clock

Moving Parts

Pieces:

4
Building Smart Structures

Clock

Moving Parts

Pieces:

- [Diagram of clock pieces]

- [List of pieces]
Clock

Building Smart Structures

Moving Parts

**Pieces:**

- Gear pieces
- Rods

Image of a complex mechanical setup, possibly a clock mechanism.
Building Smart Structures

Clock

Moving Parts

Pieces:

[Diagram of clock with moving parts and pieces]
Building Smart Structures

Clock

Moving Parts

Pieces:

![Image of clock pieces]
Clock

Pieces:

Attach the other end of the wire to the motor.
To change the time:
Pull out and turn the two gears to the right and left of the custom gear to change the hour and minute hands.

Note: This clock is designed to keep reasonably accurate time for motors that spin at 360rpm. Most lego motors spin at this speed, however, some may vary.
Creating a Drawbridge

Pieces:

Key Words:
Creating a Drawbridge

Pieces:

1. 16X16 pieces
2. Long pieces (x2)
3. Short pieces (x3)

Steps:

1. Lay down the 16X16 pieces.
2. Attach the long pieces to the sides.
3. Attach the short pieces to the top.
Creating a Drawbridge

Building Smart Structures

Moving Parts

Pieces:

- x2
- 12
- 8

2 views

4

2 views
Creating a Drawbridge

Pieces:

12
10

2 views
Creating a Drawbridge

Pieces:

[Image of a camera]

Building Smart Structures

Moving Parts
Creating a Drawbridge

Pieces:

- 6x6
- 4x4

Images:
- 7
- 8

Building Smart Structures
Moving Parts
Creating a Drawbridge

**Pieces:**

- x6

9

10
Creating a Drawbridge

Pieces:

Building Smart Structures

Moving Parts

11

x2

12
Creating a Drawbridge

Pieces:

13

14
Creating a Drawbridge

Pieces:

15

8

16
Creating a Drawbridge

Pieces:

[Diagram of LEGO pieces and mechanisms]
Creating a Drawbridge

Pieces:

Building Smart Structures

Moving Parts
Creating a Drawbridge

Pieces:

- 12
- x2
Creating a Drawbridge

Pieces:

x2
Creating a Drawbridge

Pieces:

- 12 pieces
- 2 pieces
- 3 pieces
- 24 pieces
Creating a Drawbridge

Pieces:

- 25
- 26

x2 12 8
Creating a Drawbridge

Pieces:

29

30
Creating a Drawbridge
How to build a putter

Building Smart Structures

Moving Parts

Pieces:
- x2
- x4
- x7
- x3
- x4
How to build a putter

**Pieces:**

- 7x (long piece)
- 3x (small piece)

1. Assemble the long piece.
2. Attach the moving parts to the assembled piece.
How to build a putter

Pieces:

Moving Parts
How to build a putter

Pieces:

5

6
How to build a putter

Pieces:

x3
# Building a Conveyor Belt

**Pieces:**

<table>
<thead>
<tr>
<th>Pieces</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>x4</td>
<td>4</td>
</tr>
<tr>
<td>x6</td>
<td>6</td>
</tr>
<tr>
<td>x2</td>
<td>2</td>
</tr>
<tr>
<td>x2</td>
<td>2</td>
</tr>
<tr>
<td>x3</td>
<td>3</td>
</tr>
<tr>
<td>x4</td>
<td>4</td>
</tr>
<tr>
<td>x20</td>
<td>20</td>
</tr>
<tr>
<td>x15</td>
<td>15</td>
</tr>
<tr>
<td>x8</td>
<td>8</td>
</tr>
<tr>
<td>x4</td>
<td>4</td>
</tr>
<tr>
<td>x2</td>
<td>2</td>
</tr>
<tr>
<td>x2</td>
<td>2</td>
</tr>
<tr>
<td>x3</td>
<td>3</td>
</tr>
<tr>
<td>x2</td>
<td>2</td>
</tr>
<tr>
<td>x2</td>
<td>2</td>
</tr>
<tr>
<td>x3</td>
<td>12</td>
</tr>
<tr>
<td>x2</td>
<td>2</td>
</tr>
<tr>
<td>x3</td>
<td>8</td>
</tr>
<tr>
<td>x6</td>
<td>6</td>
</tr>
</tbody>
</table>
Building a Conveyor Belt

Pieces:

- 2 pieces, each 2 units long, repeated 2 times
- 6 units, repeated 6 times
- 1 piece, 1 unit long
Building a Conveyor Belt

Pieces:
- x2
- x4
- x2
Building Smart Structures

Building a Conveyor Belt

Pieces:

- 4
- x2
- x3

2 views

Moving Parts
Building a Conveyor Belt

Pieces:

5

6
Building a Conveyor Belt

Pieces:
- x8 of one type
- x4 of another type

Building Smart Structures
Building Smart Structures

Building a Conveyor Belt

Pieces:

- 2 pieces each of x2, x4, and x2
- 9 pieces of x2
- 10 pieces of x2
Building a Conveyor Belt

Pieces:

- 11 x5
Building a Conveyor Belt

**Pieces:**

- 8 tubes (x8)
- 4 open bars (x4)

**12**

2 views
Note:

Add a wide chain between the two 24-tooth gears going under the 10 stud axles.
Making an Alarm

Pieces:

Key Words:
Building Smart Structures

Jack and the Box

Moving Parts

In order to do this project you should review the following concepts:
Building Smart Structures

Jack and the Box

**Pieces:**
- Rubber Band x2

**Moving Parts**
Jack and the Box: The Box

Pieces:

- x6
- x2
- x2
- x2
- x6
- x6
- x2
Jack and the Box: The Box

Building Smart Structures

Pieces:
- x2
- x2
- x4
- x2
Jack and the Box: The Box

Building Smart Structures

Moving Parts

Pieces:

- x6
- x2
- x2
- x2
Jack and the Box: The Box

Pieces:
- x6
- x6
- x8
Jack and the Box: The Box

Pieces:

- x2
- x8

Building Smart Structures Moving Parts
Jack and the Box: The Box

Pieces:

- x4
- x4
Jack and the Box: The Box

Building Smart Structures

Pieces:

- x4
- x2
- x2
- x2
- x2
- x4
- x4

Moving Parts
Jack and the Box: The Box

Building Smart Structures

Pieces:

- x2
- x2
- x2
- x4

Moving Parts
Jack and the Box: The Box

Pieces:

- 8 x 3
- 2 x 2
- 2 x 2
- 2 x 2
- 2 x 2

Building Smart Structures

Moving Parts
Jack and the Box: The Box

Pieces:

- 4
- x2
Jack and the Box: The Box

Pieces:

[Image of the pieces shown in the diagram]
Why not just fasten it?
The reason for using a rubber band to fasten the liftarm is to allow the arm some flexability when in use. This will help the Jack in the Box work correctly.

Note: Below is a suggested way to attach the rubber band. Any way however will work, so long as the band is attached tightly.
Jack and the Box: The Box

Pieces:

- x2 6
Jack and the Box: The Box

Pieces:
- x2
- x4
- x6
- x2

Building Smart Structures

Moving Parts
Building Smart Structures

Jack and the Box: The Box

Pieces:

- [Image of building blocks]

- Moving Parts
Jack and the Box: The Box

Pieces:
- x3
- x2

Building Smart Structures
Moving Parts
Jack and the Box: The Box

Pieces:

Building Smart Structures

Moving Parts
Jack and the Box: The Box

Pieces:

- x3

Building Smart Structures

Moving Parts

a.
b.
c.
Jack and the Box: The Platform
Jack and the Box: The Platform

Pieces:

- x4
- x2
- x4

Building Smart Structures

Moving Parts

20
Jack and the Box: The Platform

Building Smart Structures

Pieces:
- x2
- x12

Moving Parts
Jack and the Box: The Platform

Building Smart Structures

Moving Parts

Pieces:
1. 4 x2
2. 3 x2
3. x2 x6
4. x2 x2
5. x2 x2
6. x2 x2
7. x2 x2

a. 
b.
Jack and the Box: The Platform

Note: Make sure the lift arm locks into the gears.
Jack and the Box: The Platform

**Pieces:**

<table>
<thead>
<tr>
<th>Pieces</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Building Smart Structures
Jack and the Box: Jack

Pieces:

a. Pieces:

b. Pieces:

c. Pieces:

d. Pieces:
Building Smart Structures

Jack and the Box: Jack

Moving Parts

Pieces: e.

Pieces: f.

Moving Parts

Pieces: g.

Pieces: h.

Pieces: x2

Pieces: x2

Pieces: x3

Pieces: x2

Pieces: x2
Jack and the Box: Jack

Building Smart Structures

i.

Pieces:

j.

Pieces:

k.

Pieces:

l.

Pieces:

Moving Parts 27
Note: This is just one idea for Jack’s head. Be creative! Use your own design.
Jack and the Box: Assembly

Building Smart Structures

**Pieces:**

- 2-3” long Rubber Bands x2

Moving Parts 30
Building Smart Structures

Jack and the Box: Assembly

Pieces:

Note: After Jack slides into his box, insert the pegs as shown.
This is the same procedure as step 31, but on the other side.

After both rubber bands are attached to Jack, test everything out. As you push Jack down, the gears should lock him in place. He will need to be pushed all the way down in order to be triggered by the crank. Make sure you understand how everything works before you proceed.
Jack and the Box: Assembly

Building Smart Structures

Pieces:
- Pieces x2
- Pieces x2
Jack and the Box: Assembly

Building Smart Structures

Pieces:

- Black pieces: 2 x 2
- Black pieces: 2 x 2
- Black pieces: 2 x 2

Moving Parts 34
Jack and the Box: Assembly

Pieces:

- 18 pieces (x18)
- 8 pieces (x8)

Building Smart Structures Moving Parts 35
Troubleshooting:
If Jack doesn’t shoot up:

• Make sure that the crank is triggering Jack
• Add Stronger rubber bands
• Try looking underneath as the crank turns to make sure all the gears are turning.
How to build a stair Climber

Pieces:

Key Words:
Train Wheels

Pieces:

- Miscellaneous
  - x3

- Moving Parts
  - x2
  - x2
  - x2

1

2

3
Our Favorite Things

Basic Lego Car (no motors)

Pieces:

- x4
- x8
- x2
- x2
- 12
Our Favorite Things

Basic Lego Car

Pieces:
- x4
- x2

Steps:
1. Attach the wheels to the axles.
2. Insert the axles into the base.
3. Place the black bars on top.
4. Complete the car assembly.
Our Favorite Things

Basic Lego Car

Pieces:

5

6

7

8
Our Favorite Things

Basic Lego Car

Pieces:

x2
Our Favorite Things

Pulley Car

Note: In order to do this project you should review the following concepts: Pulleys

Key Words:
Pulley
Our Favorite Things

**Pieces:**
- x2
- x2

**Pulley Car**

1

2
Our Favorite Things

Pieces:

Pulley Car

3

4
Our Favorite Things

Pieces:

Pulley Car

5

6
Our Favorite Things

**Pieces:**

```
+---+---
|   |   |
+---+---
     x4
```

**Pulley Car**

7

8
Our Favorite Things

Pieces:

9

10

Pulley Car
Our Favorite Things

**Pieces:**

Pulley Car

11

12
Our Favorite Things

Pulley Car

Pieces: x2

13

14
Our Favorite Things

Pulley Car

Pieces:

17

18
Our Favorite Things

**Pieces:**

![Image of pieces](image)

**Pulley Car**

- 19
- 20
Our Favorite Things

**Pieces:**

Pulley Car

21

22
Our Favorite Things

Pieces:

Pulley Car

23

24
Our Favorite Things

Pulley Car

Pieces:

25

26
Our Favorite Things

Pulley Car

Pieces:
- 27 Pulley
- 28 Wheel
- x4 Rod
Our Favorite Things

**Pulley Car**

**Pieces:**

- x2

![Pulley Car Image]
Our Favorite Things

Pulley Car

Pieces: x4

31

32
Our Favorite Things

Pieces:

33

34
Our Favorite Things

Pulley Car

Pieces:

x2

35

36
Our Favorite Things

Simple Two Motor Car

Pieces:
Our Favorite Things

Simple Two Motor Car

Pieces:

1

x2

x2
Our Favorite Things

Simple Two Motor Car

Pieces:

- 2x2 blocks: x2
- 2x4 blocks: x4
Our Favorite Things

Simple Two Motor Car

Pieces:

3

x2
Our Favorite Things

Simple Two Motor Car

**Pieces:**
- x2
- x2
Our Favorite Things

Simple Two Motor Car

Pieces:

x2
Our Favorite Things

Simple Two Motor Car

Note: To make your car turn easily program it so that the motors turn in opposite directions when the car is turning.
Our Favorite Things

Sturdy One Motor Car

Pieces:
Our Favorite Things

Sturdy One Motor Car

Pieces:

1

x2

x2

x2
Our Favorite Things

Sturdy One Motor Car

Pieces:

2

x2

x2
Our Favorite Things

Sturdy One Motor Car

Pieces:

- x2
- x2
- 3
Our Favorite Things

Sturdy One Motor Car

Pieces:

x2

4
Our Favorite Things

Sturdy One Motor Car

Pieces:

5
Our Favorite Things

Sturdy One Motor Car

Pieces:

6
Our Favorite Things

Sturdy One Motor Car

Pieces:

7
Our Favorite Things

**Sturdy One Motor Car**

**Pieces:**

8
Our Favorite Things

**Sturdy One Motor Car**

**Pieces:**

9
Our Favorite Things

Sturdy One Motor Car

Pieces:

10
Our Favorite Things

Solar System ROVer

Pieces:
Our Favorite Things

Solar System ROV'er

Pieces:

1
Our Favorite Things

Solar System ROVer

Pieces:

2
Our Favorite Things

Solar System ROV'er

Pieces:

3
Our Favorite Things

Solar System ROV'er

Pieces:

4
Our Favorite Things

Solar System ROV'er

Pieces:

5
Our Favorite Things

Solar System ROV'er

Pieces:

6
Our Favorite Things

Solar System ROV'er

Pieces:

7
Our Favorite Things

Solar System ROVVer

Pieces:
Our Favorite Things

Solar System ROV

Pieces:

9
Our Favorite Things

Solar System ROVer

Pieces:

10
Our Favorite Things

Solar System ROV er

Pieces:
Our Favorite Things

Solar System ROVVer

Pieces:

12
Our Favorite Things

Solar System ROVer

Pieces:

13
Our Favorite Things

Solar System ROVer

Pieces:

14
Our Favorite Things

Solar System ROVer

Pieces:

15
Our Favorite Things

Solar System ROVVer

Pieces:

16
Our Favorite Things

Solar System ROVer

Pieces:

17
Our Favorite Things

Solar System ROVer

Pieces:

18
Our Favorite Things

Solar System ROV'er

Pieces:
Our Favorite Things

Solar System ROV'er

Pieces:

20
Our Favorite Things

Solar System ROV'er

Pieces:

- 21
Our Favorite Things

Solar System ROVer

Pieces:

22
Our Favorite Things

Solar System ROV'er

Pieces:
Our Favorite Things

Solar System ROVer

Pieces:

24
Our Favorite Things

Solar System ROVer

Pieces:

25
Our Favorite Things

Solar System ROVer

Pieces:

26
Our Favorite Things

Solar System ROVVer

Pieces:

- 27
Our Favorite Things

Solar System ROVer

Pieces:

28
Our Favorite Things

Solar System ROVer

Pieces:
Our Favorite Things

Solar System ROV'er

Pieces: 30
Our Favorite Things

Solar System ROVer

Pieces:

31
Our Favorite Things

Solar System ROVer

Pieces:

32
Our Favorite Things

Solar System ROVEr

Pieces:

33
Our Favorite Things

Solar System ROVVer

Pieces:
Our Favorite Things

Solar System ROVer

Pieces:

35
Our Favorite Things

Solar System ROVer

Pieces:

36
Our Favorite Things

Solar System ROVer

Pieces:

37
Our Favorite Things

Solar System ROVer

Pieces:

38
Our Favorite Things

Solar System ROVer

Pieces:

39
Our Favorite Things

Solar System ROVVer

Pieces:

40
Our Favorite Things

Solar System ROV er

Pieces:
Our Favorite Things

Solar System ROVer

Pieces:

42
Our Favorite Things

Solar System ROV
er

Pieces:

43
Our Favorite Things

Solar System ROVer

Pieces:

44
Our Favorite Things

Solar System ROVer

Pieces:

[i]

45
Our Favorite Things

Solar System ROVer

Pieces:
Our Favorite Things

Solar System ROVVer

Pieces:

![Image of a Lego ROVVer model](image-url)
Our Favorite Things

Solar System ROV'er

Pieces:

48
Our Favorite Things

Solar System ROVer

Pieces: 49
Our Favorite Things

Solar System ROVer

Pieces: 50
Our Favorite Things

Solar System ROV\!er

Pieces: 51
Our Favorite Things

Solar System ROVEr

Pieces: 52
Our Favorite Things

Solar System ROVer

Pieces:

53
Our Favorite Things

Solar System ROVer

Pieces:

54
Our Favorite Things

Solar System ROV'er

Pieces:

55
Our Favorite Things

Solar System ROVVer

Pieces:

56
In order to do this project you should review the following concepts: worm gears, gearing down, gear ratios, and how to attach motors.
Our Favorite Things

Snail Car

Pieces:

1

2
Our Favorite Things

Snail Car

Pieces:

3

4
Our Favorite Things

Snail Car

Pieces:

1. 5 pieces
2. 6 pieces
Our Favorite Things

Snail Car

Pieces:

7

8
Our Favorite Things

Snail Car

Pieces:
Our Favorite Things

Snail Car

Pieces:

10

11
Our Favorite Things

Snail Car

Pieces:

12

13
Our Favorite Things

Snail Car

Pieces:

14

15
Our Favorite Things

Snail Car

Pieces:

16

17
Our Favorite Things

Snail Car

Pieces:

18

19
Our Favorite Things

Snail Car

Pieces:

20

21
Our Favorite Things

Snail Car

Pieces:

22

23
Our Favorite Things

Snail Car

Pieces:

24

25
Our Favorite Things

Snail Car

Pieces:

26

27
Our Favorite Things

Snail Car

Pieces:

28

29
Our Favorite Things

Snail Car

Pieces: 30
Our Favorite Things

Snail Car

Pieces:

31

32
Our Favorite Things

Snail Car

Pieces:

33

34
Our Favorite Things

Snail Car

Pieces:

35

36
Our Favorite Things

Snail Car

Pieces:

37

38
Our Favorite Things

Snail Car

Pieces:

39

40
Our Favorite Things

BUG

Key Words:
Flywheel
Our Favorite Things

BUG

Pieces:

- Gears (x2)
- Rods (x4)
- Plate (x6)
- Axles (x4)
- Wheels (x2)
- L-shaped (x3)
- Bricks (x6)
- Studs (x5)
- Double Bricks (x2)
- Connectors (x2)
- Windows (x4)
- Red Plate (x4)

Total: 10 Pieces
Our Favorite Things

BUG

Pieces:

- x8
- x4
- x2
Our Favorite Things

**Pieces:**

2 x2

**BUG**
Our Favorite Things

Pieces:

BUG

3
Our Favorite Things

**Pieces:**
- 4
- x2
- 3
- x3
- 8
- x3
- 10

**BUG**
Our Favorite Things

Pieces:

- 5x2 gear
- 6x2 bars
- 3x6 bars
- 2x2 bars
- 3x3 bars
Our Favorite Things

Pieces:

- Gear (x2)
- Small piece (x2)
- Standard piece (x2)

BUG

6
Our Favorite Things

Pieces:

7 x4 x2

BUG
Our Favorite Things

**BUG**

**Pieces:**

Wires
Our Favorite Things

Pieces:

- x2
- x2
- x3
- x2

BUG

9
Our Favorite Things

 PIECES: 

10x2

BUG
Our Favorite Things

**Pieces:**

- 11 x2
Our Favorite Things

Bug

Pieces:

x2

12
Our Favorite Things

Pieces:

13

BUG
Our Favorite Things

**BUG**

14

**Pieces:**

- x2
- x3
- x2

x2
Our Favorite Things

Pieces:

BUG

15
Our Favorite Things

**Pieces:**

- x2
- x2
- x2
- x2
- 4
- 3

**BUG**

16
Our Favorite Things

Pieces:

- 8 pieces (x2)
- 2x2 pieces (x2)
- Wheel (x2)

BUG

17
Our Favorite Things

**Pieces:**

- Wheel: 1 x2
- Brick: 1 x2
- Gear: 1 x2

**BUG**

18
Our Favorite Things

Pieces:

BG

19
Our Favorite Things

Pieces:

![Image of LEGO bug with 20 pieces and 2x2 pieces](image-url)
Our Favorite Things

Pieces:

- 8
- Cylinder x2
- Circle x2
- 21
Our Favorite Things

Optical Illusions

Note: In order to do this project you should review the following concepts: gearing up, crown gears, changing axis of rotation
Our Favorite Things

Optical Illusions

Pieces:

1

2
Our Favorite Things

Optical Illusions

Pieces:

3

4
Optical Illusions

Our Favorite Things

Pieces:

5

6
Our Favorite Things

Optical Illusions

Pieces:

7

8
Our Favorite Things

Optical Illusions

Pieces:

9

10
Our Favorite Things

Optical Illusions

Pieces:

11

12
Optical Illusions

Our Favorite Things

Pieces:

- 13
- 14
- 4
Our Favorite Things

Optical Illusions

Pieces:

10

15

16
Our Favorite Things

Optical Illusions

Pieces:

17

18
Our Favorite Things

Optical Illusions

Pieces:

19

20
Optical Illusions

Pieces:

Our Favorite Things