Toolbox Racer

User Guide

PITSCO EDUCATION

33100 V0413

Cautionary and Warning Statements

- This kit is designed and intended for educational purposes only.
- Use only under the direct supervision of an adult who has read and understood the instructions provided in this user guide.
- Read warnings on packaging and in this manual carefully.
- Keep fingers clear of the tape measure when it recoils.

Power from a Spring

Hidden inside most measuring tapes lie springs – each holding the potential to launch and propel a race car across your classroom or gym!

Ideal for demonstrating transfer of energy, potential versus kinetic energy, compression and tension, and other physics principles, the Toolbox Racer is easy to build and a blast to race.

When students pull the tape out of the tape measure, they are using work to pull it out and to stretch the spring inside the tape measure. This work creates tension. When they release it, the spring pulls back together (creating compression) to release the energy.

Because the vehicle for the tape measure is a race car, this energy is transferred into the car.

Materials Included

- 2 axles
- 2 front wheels
- 2 rear wheels
- 4 axle bushings
- Basswood sheet of laser-cut parts
- 2 pieces of hook-and-loop fastener

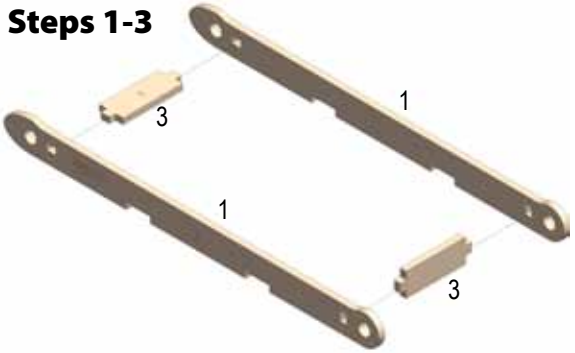
Items Required (not included)

- White construction glue (such as HD Bond II)
- 6' tape measure (Pitsco product 50394 is recommended – visit www.shop.pitsco.com to order)
- Duct tape
- 2 strings, 8" each
- Start Gate (optional)

Building the Toolbox Racer

1. Pop out the parts from the basswood sheet. Find the Part 1 pieces and set one down flat and have the other nearby.

Steps 1-3

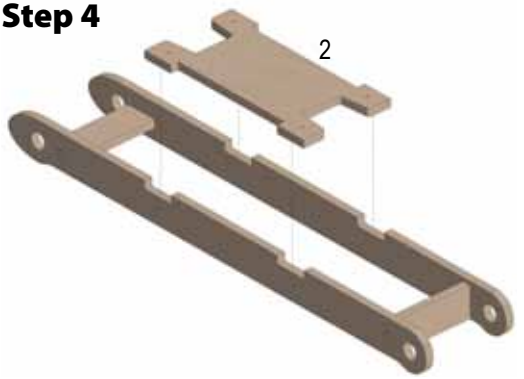


2. In the small rectangular holes on a Part 1, glue the two Part 3s. Glue one horizontal and one vertical as shown.

3. Place the other Part 1 on top of the Part 3s while still mirroring the first Part 1. Glue together and let this assembly dry.

4. With the assembly lying with the notches facing up, glue in place Part 2. Let it dry completely. This makes the chassis.

Step 4

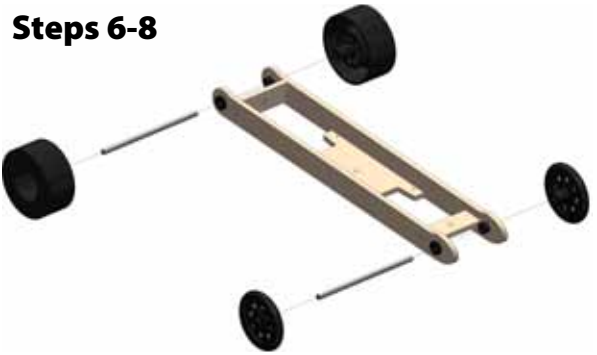


5. Place an axle bushing in each of the four holes on the chassis. Make sure the wide end of the bushing is on the outside of the chassis.

Step 5

6. Place a front wheel on one end of an axle. Push the other end through the axle bushings near the Part 3 with its flat side facing up.

Steps 6-8

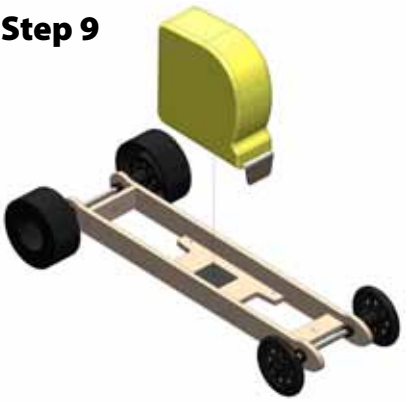


7. Place the second front wheel on the other end of the axle. Make sure not to push the wheels on so tightly that they cannot spin freely.

8. Place a rear wheel on one end of the second axle. Push the other end through the axle bushings on the back of the chassis. Place the second rear wheel on the other axle end. Make sure the wheels spin freely.

9. Place the racer so Part 2 is on the underside of the chassis. On top of Part 2, adhere one side of a piece of hook-and-loop fastener. Adhere the other side of fastener on the bottom of the tape measure. Place the tape measure on top of the racer so the tape comes out toward the front wheels.

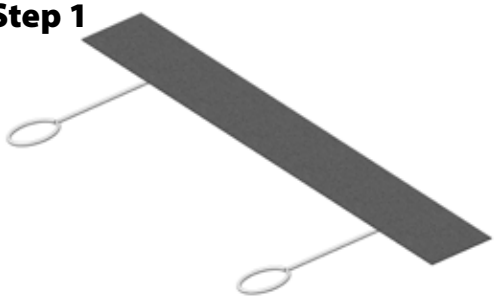
Step 9



Racing Without the Start Gate (for 2 cars)

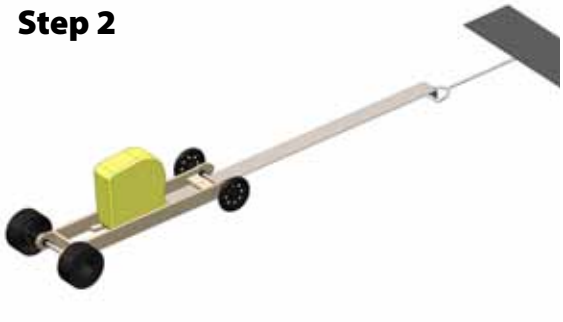
1. Tie the two pieces of string into loops. With the loops' knotted ends on the side of the area intended to be the track, place the loops several inches apart. Carefully, place a piece of duct tape over the knotted ends of the loops. Secure the duct tape to the floor.

Step 1



2. Pull the tape from the tape measure out and under the Part 3 on the front of one car.

Step 2



3. Hook the tape end on the string loop and pull the car back up to six feet.

4. Have another person hold the car in place as you repeat Step 2 for the second racer.

   CAUTION: For the following step, keep fingers clear of the tape measure when it recoils.

5. Holding the two racers back the same distance, release them to start the race.

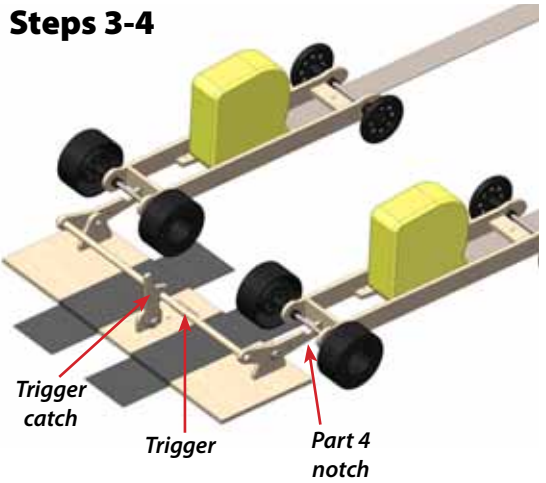
Racing with the Start Gate (for 2 cars)

1. As shown on the previous page, tie the two pieces of string into loops. With the loops' knotted ends on the side of the area intended to be the track, place the loops several inches apart. Carefully, place a piece of duct tape over the knotted ends of the loops. Secure the duct tape to the floor.

2. Making sure to keep a straight line, measure back how far from the loops you want to place the Start Gate (up to six feet). Secure the gate to the floor with duct tape.

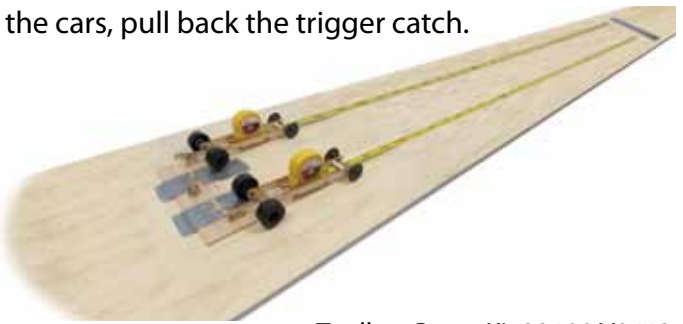
3. Pull the tape from the tape measure out and under the Part 3 on the front of one racer. Hook the tape end on the string loop and pull the car back to the Start Gate. Rest the back axle on the gate's Part 4 notch that is lined up with your racing lane.

Steps 3-4



4. Pull the trigger catch (Part 3 on the gate) and secure the trigger (the long dowel) under the catch. The weight of the car will hold the trigger under the catch. Repeat this procedure for the other racer.

5. To launch the cars, pull back the trigger catch.



A Note About Tape Measures

We highly recommend using the 6' tape measure (50394) with the Toolbox Racer – it was designed to work with that tape measure. To order this tape measure, visit www.shop-pitsco.com or call 800-358-4983.

However, other tape measures could be used, depending on their design.

Activity Ideas – Testing Different Variables

You can test a Toolbox Racer one variable at a time:

Different Tape Measures – Race the car with the standard 6' tape measure (50394). Using the same pull-back distance, race the same car with a different tape measure (you can try a longer or heavier tape measure). Log the results.

Different Weights – Race the car with the standard 6' tape measure. Find a way to add mass to the car without altering the tape measure. Race the car with the additional mass. Log the results. (Consider testing consistently larger masses – an extra 10 grams, 20 grams, 30 grams, and so on – and logging the results for each.)

Different Pull-Back Lengths – Using the same car with the standard 6' tape measure, test the car first by pulling it back two feet from the loops. Then, test it again pulling it four feet back, six feet back, and so forth (or a similar testing pattern). Log the results.

When you've decided what test you want to do, ask students to hypothesize the results of changing the chosen variable. Then, do the test. Have students study the results of the tests and ask them why they believe their hypothesis was correct (or incorrect).

Ask students if they can think of any other variables to test. Have them design a test for any single variable they think of. Do the test and discuss the results.

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