



BUL 1129

Organizing the LEGO SPIKE Prime Robotics Kit



Tim Ewers

Professor (retired)
4-H Youth Development
University of Idaho Extension

Robin Baumgartner

Program Coordinator
4-H Youth Development
University of Idaho Extension

Contents

- 1 Part 1: Introduction
- 2 Part 2: Constructing the SPIKE Prime Parts Organization System
- 5 Part 3: Conclusion
- 6 Appendix A
- 10 Appendix B

Part 1: Introduction

LEGO EDUCATION'S CURRENT robotics platform, SPIKE Prime, is utilized worldwide in classrooms, 4-H and after-school enrichment programs, and in competitive robotics opportunities like FIRST LEGO League Challenge and World Robot Olympiad. It's a popular product, but the number and variety of its parts make organizing them an absolute necessity. This publication provides step-by-step instructions for how to build an inventory management system for LEGO Education SPIKE Prime (45678), with or without its Expansion Set (45681). The following steps describe one approach which, depending on your needs, can be customized and personalized.

This model is the latest addition to a management series we have successfully developed. Indeed, our systems for the LEGO Mindstorms NXT (9797), WeDo (9580), EV3 (45544), and WeDo 2.0 (45300) robotics kits have been adopted by teachers, out-of-schooltime educators, hobbyists, and competitive robotics teams worldwide. They were developed with two primary objectives: efficient management of LEGO parts during building sessions and simplifying parts inventory between sessions.

In this publication, we introduce two new organization systems for the LEGO SPIKE Prime robotics platform, released in 2020. They accommodate two different kit options:

- **Option 1:** A single SPIKE Prime Set (#45678). This set contains 108 unique parts, with a total of 528 pieces. Of those 528 pieces, 111 are spare parts, intended to be set aside for replacements as needed. These parts are not listed in the parts count on the kit insert card and are packaged together as bag 13 (Figure 1).

- **Option 2:** The LEGO Education SPIKE Prime Set (#45678) combined with the LEGO Education SPIKE Prime Expansion Set (#45680). These two sets combined include 164 unique parts and a total of 1,021 pieces. As with option 1 above, the parts cards for this option do not include the 111 spare parts included in bag 13.

The SPIKE Prime Organization system separates parts into clearly labeled, compartmentalized trays; three trays for option 1 (base kit only) or six trays for option 2 (base kit + expansion). All trays fit into a standard letter/legal-sized file crate or a lidded letter/legal-sized file tote for easy, stackable storage and transportation. Each tray has a parts key card that indicates the LEGO part name, quantity included, and the part's location in the tray. For the parts card for option 2, tray 6, see Figure 2.

Part 2: Constructing the SPIKE Prime Parts Organization System

Step 1: Purchase Parts Trays and Storage Crate

Purchase the specified organizer trays for your specific kit configuration (Option 1 Base Kit only or Option 2 Base Kit + Expansion Set) plus a letter/legal-sized file crate or tote. Table 1 lists recommended organizer trays, along with their model numbers



Figure 1. LEGO SPIKE Prime spare parts (bag 13).

and dimensions. Trays are available for purchase online from a variety of vendors, but we have found that sporting goods stores typically offer the best prices, since the trays are commonly used as fishing tackle boxes. The total cost for the trays, storage crate, and sorting card printing and lamination is approximately \$50 for option 1 and \$100 for option 2.

Step 2: Find and Edit the Correct Parts Card Set for your Kit(s)

- See Appendix A for the parts cards for Option 1: Base Kit Only. See Appendix B for the parts cards for Option 2: Base Kit + Expansion Set.
- Parts cards are in a fillable PDF format. **If you have multiple kits, modify the kit name/number at the top of each parts card for your kits (for example, 4-H Club Kit 1, 4-H Club Kit 2). Also, rename your SPIKE Prime hub via the SPIKE app with the same name and number as the kit it belongs to (for example, 4-H-01, 4-H-02) for easy identification/Bluetooth connection during classes. Using a label maker or permanent marker to write the kit number directly on each hub is also helpful.**

Step 3: Print and Laminate the Parts Cards

- Print out the parts cards on legal-sized paper (8.5" x 14"), landscape orientation, at 100%. Print at 100% and not "fill page" so that the cards are the correct size to fit into the tray lids.

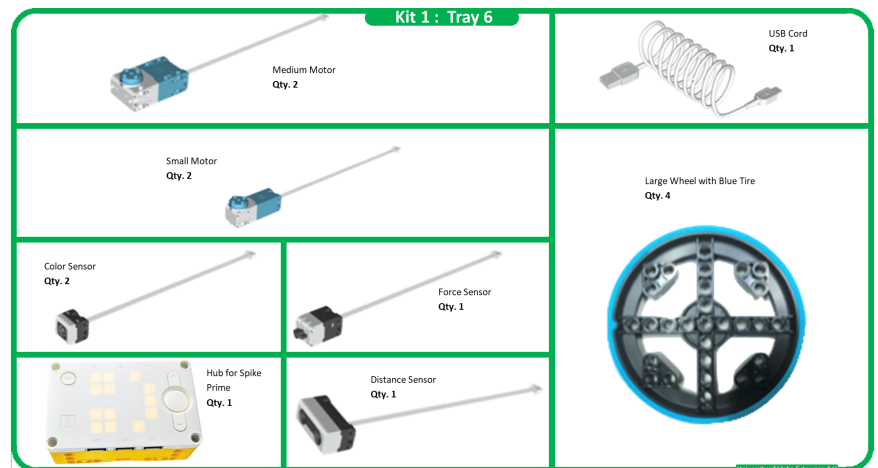


Figure 2. Image of the system parts card for option 2, tray 6.

Table 1. Recommended organizer trays.





Equipment Part Number/Description/Photo	Option 1: SPIKE Prime Base Kit Only	Option 2: SPIKE Prime Base Kit + Expansion Set
<p>Plano Custom Divider 3771 Description: 12 Versi-Slant angled dividers, 24 straight, locking dividers Dimensions: 14" x 9.13" x 1.38"</p> 	<p>Quantity: 2 Use: Parts Trays 1–2</p>	<p>Quantity: 3 Use: Parts Trays 1–3</p>
<p>Plano ProLatch Stowaway 3750 Description: 3-28 Compartment Utility Box Dimensions: 14" x 9.13" x 2"</p> 	<p>Quantity: 0 (This tray is not used for Option 1: Base Kit Only)</p>	<p>Quantity: 1 Use: Parts Tray 4</p>
<p>Plano Deep Pro Latch Stowaway 3780 Description: 6-21 Compartment Deep Utility Box Dimensions: 14" x 9.13" x 2.8"</p> 	<p>Quantity: 1 Use: Parts Tray 3</p>	<p>Quantity: 2 Use: Parts Trays 5–6</p>
<p>Letter/Legal-Sized File Crate Dimensions: 17.25" x 14.25" x 10.625"</p> 	<p>Quantity: 1 Use: Contain/transport parts trays</p>	<p>Quantity: 1 Use: Contain/transport parts trays</p>



Figure 3. The correct page orientation for the two sides of a printed parts card.

i. Print two (2) copies of the file so you end up with two (2) identical copies of each tray card. Print them single-sided to avoid bleed-through, which makes the parts cards difficult to read. However, if you have legal-sized cardstock available, you may print double-sided, flipping on the long edge. If you choose this option, test-print one set of cards and ensure that the printed sides align correctly to avoid trimming errors.

- b. Trim each card along its outer green border.
- c. If you single-side print, place the matching cards back-to-back and rotate them 180° so that the top of one card lines up with the bottom of its copy (Figure 3). This orientation lines up the parts shown on the key card with the part location in the tray when the lid is both open and closed.
- d. Laminate the matching and properly aligned key card sets together. You will end up with three (Base Kit only) or six (Base Kit + Expansion Set) double-sided laminated cards.
- e. Trim the excess lamination so that the key card fits inside the lid of each compartmentalized tray. Don't trim too closely to avoid breaking the lamination seal.

Step 4: Prepare Parts Trays for Parts

- a. See Table 1 to match the appropriate tray for each of the laminated parts cards.
- b. Use clear double-sided or packing tape to affix

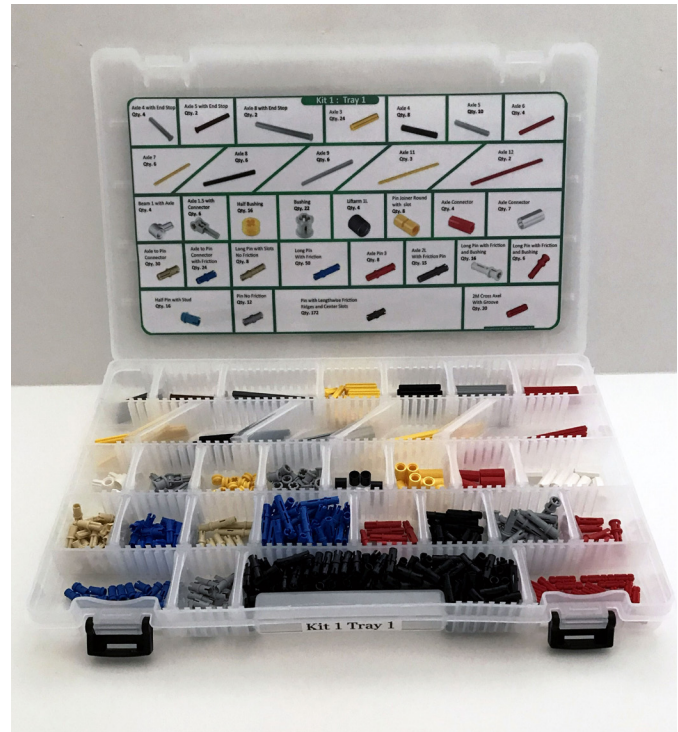


Figure 4. Printed parts card correctly oriented inside an open tray lid.

each card to the inside of a correct tray's lid, orienting the card so that the top (when viewed from the outside of the closed tray, through the transparent lid) is near the hinged edge of the lid. When you open the lid, the top of the parts key card should be near the latches (Figure 4).

- c. Place the tray dividers into the tray, matching the parts card layout.
- d. Label the front of each tray (between the latches) with a permanent marker or label maker so the label is visible when the trays are placed in a storage crate (for example, Kit 1 Tray 1, Kit 1 Tray 2).

Step 5: Sort the Parts into the Trays (as shown on each parts key card)

Step 6: Place Sorted Trays into the Crate

Filled crates can be easily stacked for storage and transportation.

Step 7: Label Each Original LEGO Yellow Storage Bin with a Corresponding Kit Number

Retain the yellow plastic LEGO box as temporary storage for student notebooks, robots, and attachments between class sessions. Label the bins with a label maker or permanent marker to make it easier for students to find their robot at the beginning of each lesson and to keep all of their kit pieces together.

Figure 5 shows an example of the completed system in which all the parts from the Option 2: Base Kit + Expansion Set have been organized into six trays, which are in turn contained in one file crate.

Part 3: Conclusion

Organizing your LEGO robotics kits using trays greatly facilitates a learner's ability to find and return parts to a specified location. This subsequently helps youth build more efficiently, stay organized, and take responsibility for equipment used during sessions. Use of the system also helps facilitators manage and maintain kits for longer use and saves time when conducting inventory at the end of learning units.

Comments and feedback regarding this system are welcome. Please contact Robin Baumgartner at rbaumgartner@uidaho.edu or 208-364-4603.



Figure 5. Complete system: SPIKE Base Kit + Expansion Set (option 2).

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Barbara Petty, Director of University of Idaho Extension, University of Idaho, Moscow, Idaho 83844. It is U of I policy to prohibit and eliminate discrimination on the basis of race, color, national origin, religion, sex, sexual orientation and gender identity/expression, age, disability, or status as a Vietnam-era veteran. This policy applies to all programs, services, and facilities, and includes, but is not limited to, applications, admissions, access to programs and services, and employment.

U of I is committed to providing reasonable accommodations to qualified individuals with disabilities upon request. To request this document in an alternate format, please contact CALS Extension Publishing at 208-885-7982 or calspubs@uidaho.edu.



Appendix A

Option 1: SPIKE Prime Base Kit Only



Tray 1

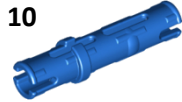
Connector Peg with Friction
Qty. 70



Connector Peg/
Cross-Axle 1+1
Qty. 20



Connector Peg with Friction, 3
Qty. 10



Connector Peg with Friction/Cross Hole 2+1
Qty. 10



Connector Peg with Friction/Cross Axle 1+2
Qty. 10



Ball w/Friction Peg
Qty. 4



Axle, 2
Qty. 8



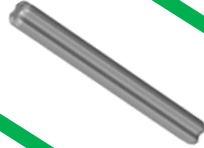
Axle, 3
Qty. 8



Axle, 4
Qty. 4



Axle, 5
Qty. 4



Axle, 7
Qty. 4



Axle, 8
Qty. 4



Axle, 9
Qty. 4



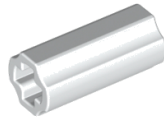
Axle, 11
Qty. 2



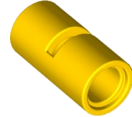
Bushing
Qty. 10



Axle Extender, 2
Qty. 2



Tube, 2
Qty. 2



Angle Connector 1,
0°
Qty. 4



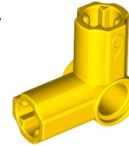
Angle Connector 2,
180°
Qty. 4



Angle Connector 4,
135°
Qty. 4



Angle Connector 6,
90°
Qty. 4



Double Cross Block
Qty. 4



Rubber Damper
with Cross Holes, 2
Qty. 4



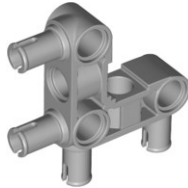
Track Rod 6m
Qty. 2



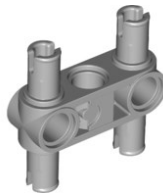
Double
Connector
Peg with
Hole, 3
Qty. 2



Angular
Beam with
4 Connect-
or Pegs,
3x3
Qty. 4



Beam with 4
Connector
Pegs, 3
Qty. 12



Double Bevel
Gear, 12 Tooth
Qty. 2



Double Bevel
Gear, 20 Tooth
Qty. 2



Double Bevel Gear
28 Tooth
Qty. 2



Double Bevel Gear
36 Tooth
Qty. 2



Rim, Narrow Cross
Qty. 2



Tire, Low Narrow
Qty. 2

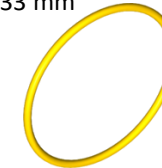
Bion Eye
Qty. 2



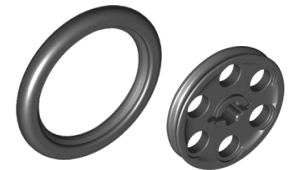
Gear Rack, 13
Qty. 2



Rubber Bands,
Yellow 33 mm
Qty. 2

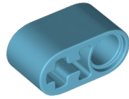


Tire, 30.4x4mm
& Hub/Pulley
Qty. 2 each

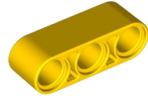


Tray 2

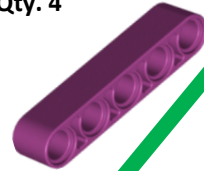
Beam with Cross Hole
Qty. 4



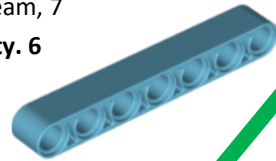
Beam, 3
Qty. 6



Beam, 5
Qty. 4



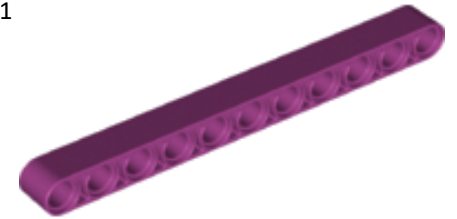
Beam, 7
Qty. 6



Beam, 9
Qty. 4



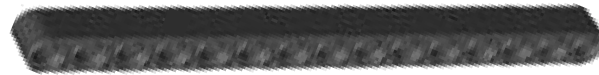
Beam, 11
Qty. 4



Beam, 13
Qty. 4



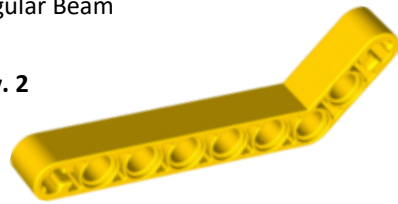
Beam, 15
Qty. 6



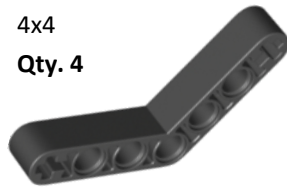
Double Angular Beam
3x7 45°
Qty. 4



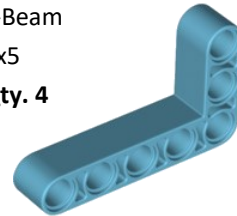
Angular Beam
3x7
Qty. 2



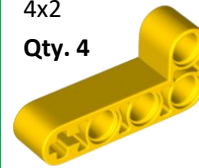
Angular Beam
4x4
Qty. 4



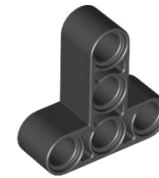
L-Beam
3x5
Qty. 4



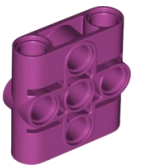
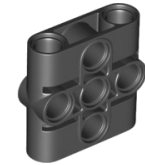
L-Beam,
4x2
Qty. 4



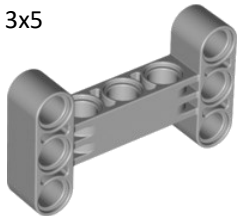
T-Beam, 3x3
Qty. 4



Connector Beam 1x3x3
Qty: 4 Black
4 Magenta



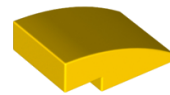
I-Frame, 3x5
Qty. 2



Roof Tile,
1x2x½
Qty. 4



Brick with Half
Bow and Cut, 2x3
Qty. 4



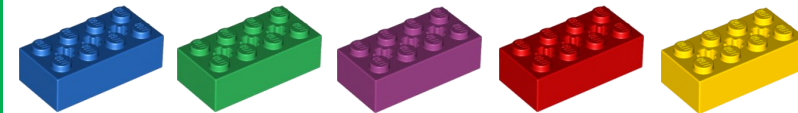
Brick with Bow,
2x6
Qty. 4



Round Brick with Cross
Hole, 2x2
Qty. 4



Brick with Cross Hole, 2x4
Qty: 10 (2 ea: Red, Green, Magenta, Yellow, Blue)



Round Plate with
Cross Hole, 2x2
Qty. 4



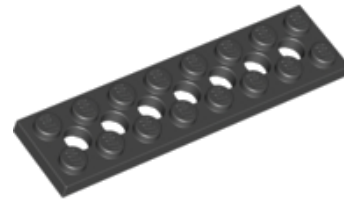
Minifigures
Qty. 2



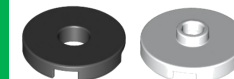
Decorative Tiles, Round
Qty. 6 (2 ea.)



Plate with Holes,
2x8
Qty. 4



Round Plate with 1
Stud, 2x2 Qty. 2
Round Tile with
Hole, 2x2 Qty. 4



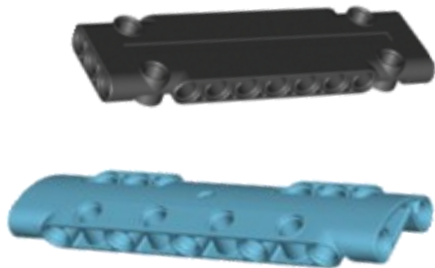
Wire Clip w/Cross Hole
Qty. 12 (2 ea. Blue, Green,
Magenta, Azure, Yellow,
Red)



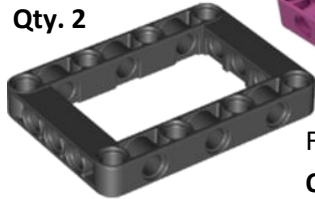
Tray 3

Panels

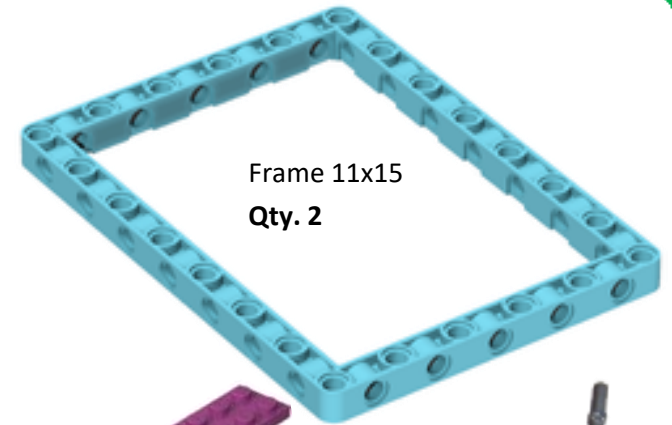
Qty. 2 Flat 3x11 Black
2 Bowed 3x11x2 Azure



Frame 5x7
Qty. 2

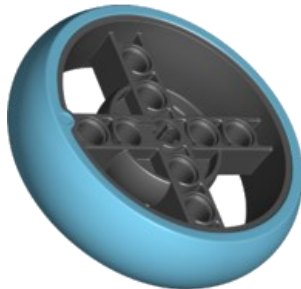


Frame 7x11
Qty. 2



Frame 11x15
Qty. 2

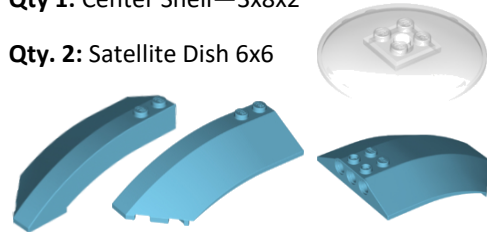
Wheel 88 Diameter
Qty. 4



Qty 1 ea: L&R Shell—3x8x2

Qty 1: Center Shell—3x8x2

Qty. 2: Satellite Dish 6x6



Beam 3x5 with Wheel Cup & Wheel Ball (assembled)

Qty. 1

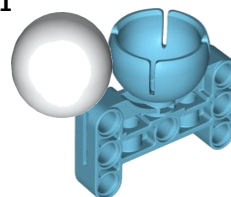
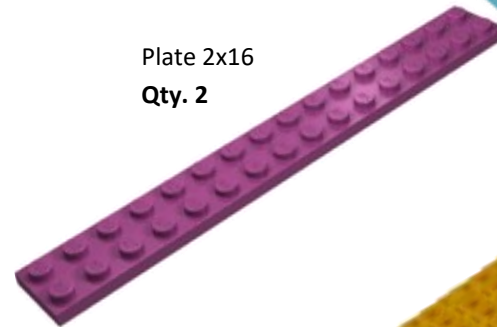


Plate 2x16
Qty. 2



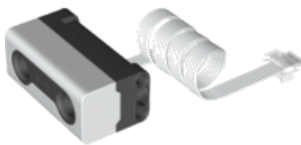
Flex Hose 19M
w/3.18 Stick
Qty. 2



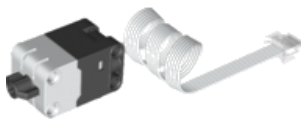
Medium Motor
Qty. 2



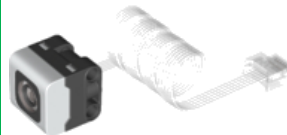
Distance Sensor
Qty. 1



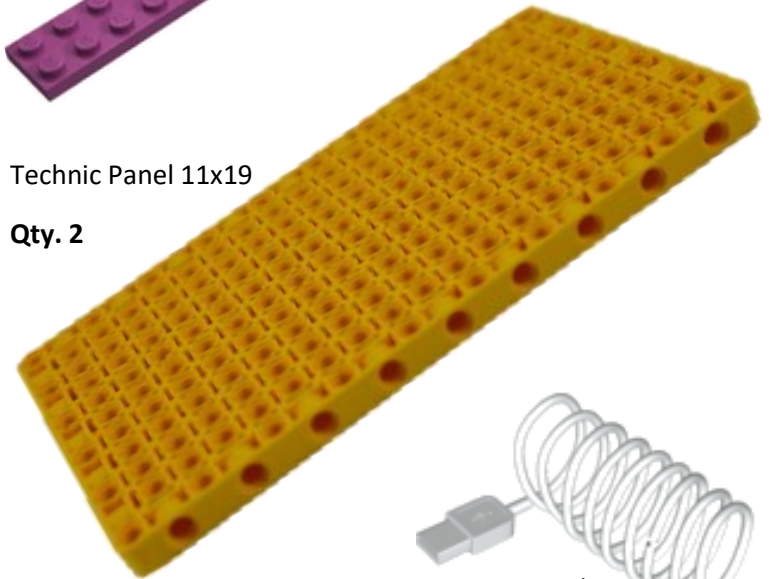
Force/Touch Sensor
Qty. 1



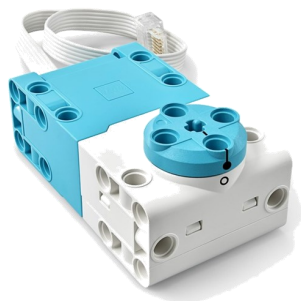
Color Sensor
Qty. 1



Technic Panel 11x19
Qty. 2



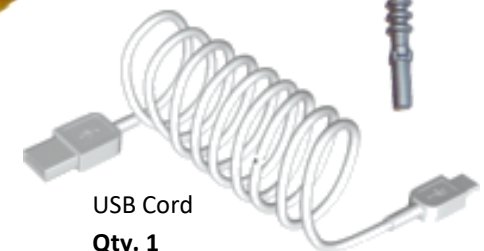
Large Motor
Qty. 1



SPIKE Large
Hub w/Battery
Qty. 1



USB Cord
Qty. 1



Appendix B

Option 2: SPIKE Prime Base Kit + Expansion Set



Tray 1

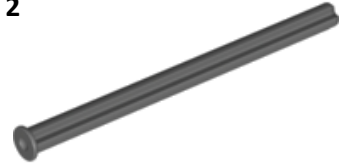
Axle, 4
with End Stop
Qty. 4



Axle, 5 with End Stop
Qty. 2



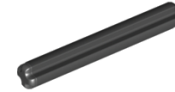
Axle, 8 with End Stop
Qty. 2



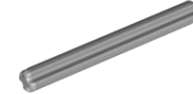
Axle, 3
Qty. 22



Axle, 4
Qty. 8



Axle, 5
Qty. 8



Axle, 6
Qty. 4



Axle, 7
Qty. 4



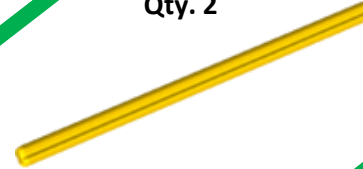
Axle, 8
Qty. 4



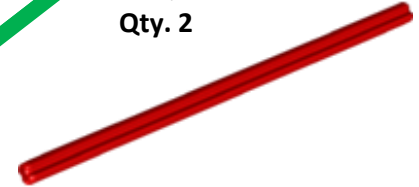
Axle, 9
Qty. 4



Axle, 11
Qty. 2



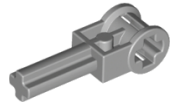
Axle, 12
Qty. 2



Tube, 1
w/Cross Axle
Qty. 4



Catch
Qty. 6



Half Bushing
Qty. 16



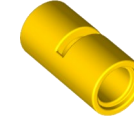
Bushing
Qty. 22



Tube, 1
Qty. 4



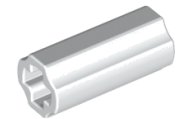
Tube, 2
Qty. 8



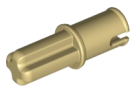
Axle Extender, 2
Qty. 4



Axle Extender, 2
Qty. 6



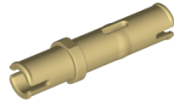
Connector Peg/
Cross-Axle 1+1
Qty. 20



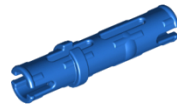
Connector Peg
with Friction/
Cross Axle 1+1
Qty. 24



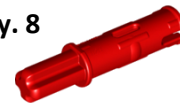
Connector Peg, 3
Qty. 8



Connector Peg
with Friction, 3
Qty. 46



Connector Peg with
Friction/Cross Axle
2+1
Qty. 8



Connector Peg with
Friction/Cross Axle
1+2
Qty. 10



Connector Peg with
Friction/Cross Hole
2+1
Qty. 16



Connector Peg with
Friction/Cross Hole
2+1
Qty. 6



Connector Peg,
1½
Qty. 16



Connector Peg
Qty. 12



Connector Peg with Friction
Qty. 150



Axle, 2
Qty. 16



Tray 2

Bevel Gear,
12 Tooth
Qty. 4



Bevel Gear,
20 Tooth
Qty. 2



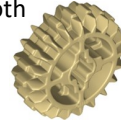
Double Bevel
Gear, 12 Tooth
Qty. 4



Double Bevel
Gear, 20 Tooth
w/Hole
Qty. 2



Double Bevel
Gear, 20 Tooth
Qty. 4



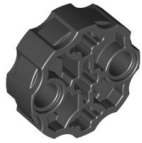
Double Bevel Gear, 28
Tooth
Qty. 4



Double Bevel Gear, 36
Tooth
Qty. 4



Barrel 3x3
Qty. 4



Gear Rack, 13
Qty. 2



Gear Rack, 7
Qty. 2



Rim, Narrow Cross
Qty. 2



Tire, Low Narrow
Qty. 2



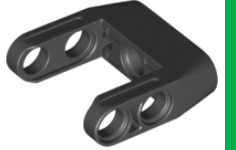
Tire, 30.4x4mm &
Hub/Pulley Qty. 2
each



Cross Block Fork,
2x2
Qty. 4



Beam 3m w/Fork
Qty. 2



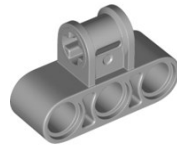
Cross Block 90°
Qty. 16



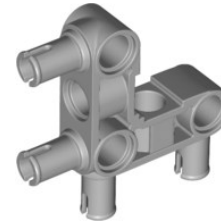
Cross Block, 2x1
Qty. 4



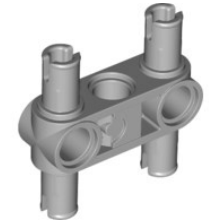
Cross Block, 3x1
Qty. 8



Angular Beam
with 4 Connector
Pegs, 3x3
Qty. 10



Beam with 4
Connector
Pegs, 3
Qty. 22



Catch with
Cross-Hole
Qty. 6



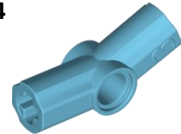
Angle Connector 1,
0°
Qty. 4



Angle Connector 2,
180°
Qty. 4



Angle Connector 3,
157.5°
Qty. 4



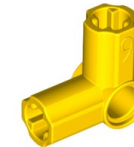
Angle Connector 4,
135°
Qty. 4



Angle Connector 5,
112.5°
Qty. 4



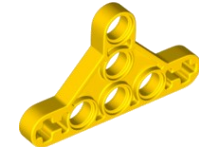
Angle Connector 6,
90°
Qty. 16



Wire Clip w/Cross Hole
Qty. 2 ea. (Blue, Green,
Magenta)
Qty. 4 ea. (Azure,
Red, Yellow)



Technic Triangle
Qty. 4



Double Con-
nector Peg
with Hole, 3
Qty. 2



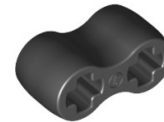
Track Rod 6m
Qty. 2



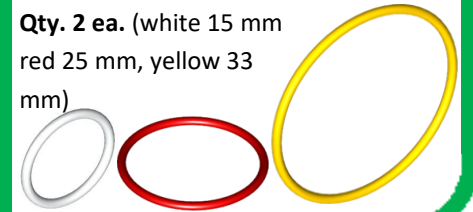
Ball w/Friction Peg
Qty. 4



Rubber Damper with Cross Holes, 2
Qty. 4

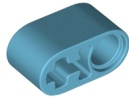


Rubber Bands
Qty. 2 ea. (white 15 mm
red 25 mm, yellow 33
mm)



Tray 3

Beam with Cross Hole
Qty. 4



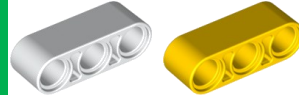
Double Cross Block
Qty. 8



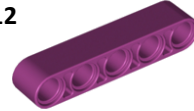
Cross Block, 3
Qty. 12



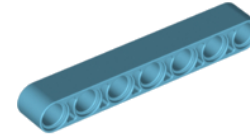
Beam, 3
Qty. 4 White
12 Yellow



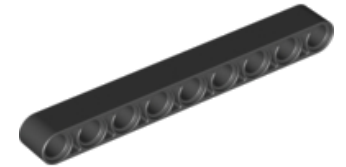
Beam, 5
Qty. 12



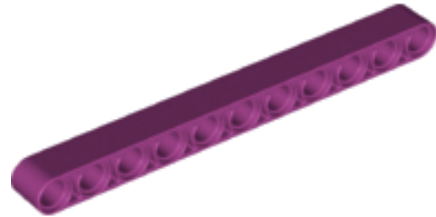
Beam, 7
Qty. 12



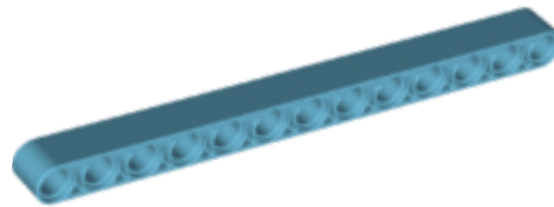
Beam, 9
Qty. 12



Beam, 11
Qty. 10



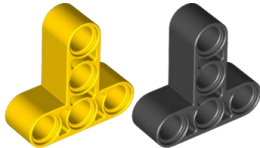
Beam, 13
Qty. 10



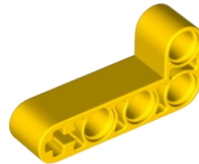
Beam, 15
Qty. 12



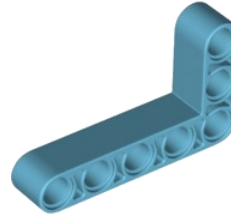
T-Beam, 3x3
Qty. 4 Black, 4 Yellow



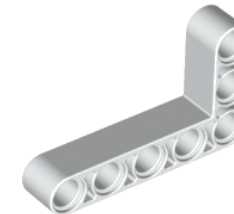
L-Beam, 4x2
Qty. 12



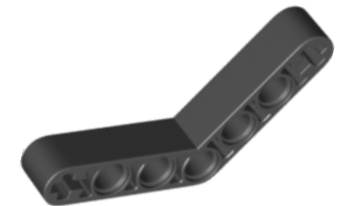
L-Beam 3x5
Qty. 8



L-Beam 3x5
Qty. 6



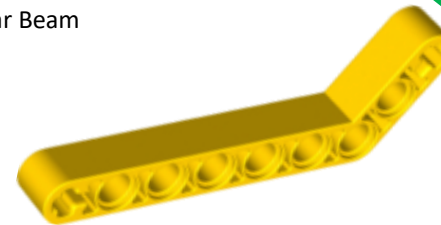
Angular Beam 4x4
Qty. 8



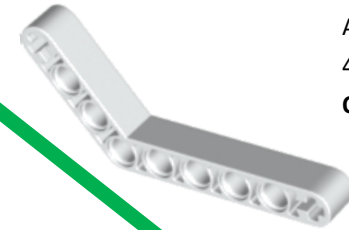
Double Angular Beam 3x7 45°
Qty. 8



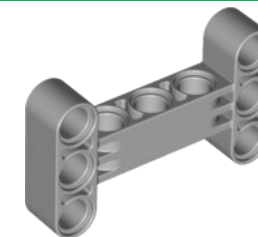
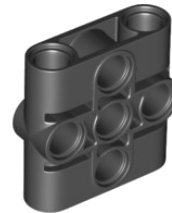
Angular Beam 3x7
Qty. 6



Angular Beam 4x6
Qty. 2



Connector Beam 1x3x3
Qty: 4 Black
10 Magenta



I-Frame, 3x5
Qty. 8

Animals & People:

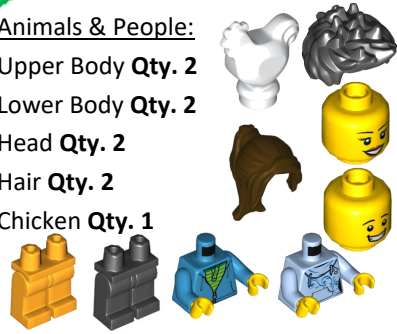
Upper Body **Qty. 2**

Lower Body **Qty. 2**

Head **Qty. 2**

Hair **Qty. 2**

Chicken **Qty. 1**



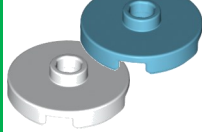
Decorative
Tiles, Round
Qty. 6 (2 ea.)



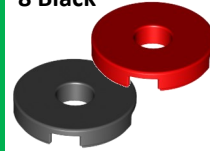
Bion Eye
Qty. 2



Round Plate
with 1 Stud,
2x2
Qty. 2 White



Round Tile with
Hole, 2x2
Qty. 2 Red
8 Black



Tray 4

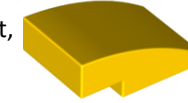
Round Plate with
Cross Hole, 2x2
Qty. 4



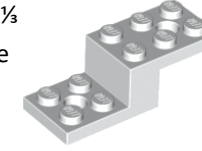
Roof Tile,
1x2x½
Qty. 4



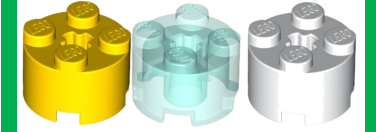
Brick with Half
Bow and Cut,
2x3
Qty. 4



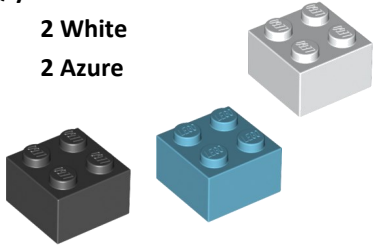
Brick 1x2x1½
with Double
2x2 Plates
Qty. 2



Round Brick with Cross Hole,
2x2
Qty. 4 White
4 Yellow
2 Transparent Light Blue

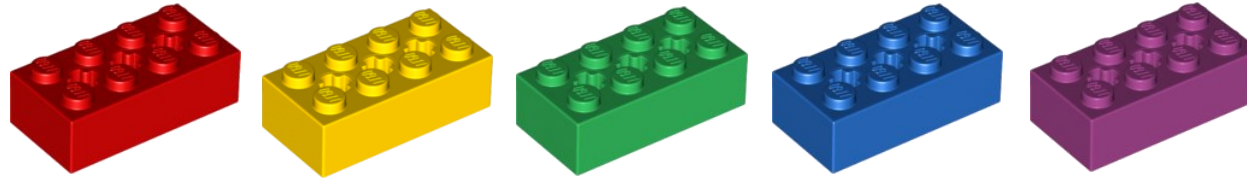


Brick, 2x2
Qty. 2 Black
2 White
2 Azure

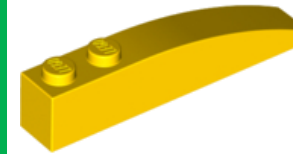


Brick with Cross Hole, 2x4

Qty: 4 Red **4 Green** **4 Magenta**
4 Yellow **4 Blue**



Brick with
Bow, 1x6
Qty. 4



Brick with Bow,
2x6
Qty. 4



Flex Hose 19M
w/3.18 Stick
Qty. 2



Plate 2x16
Qty. 2

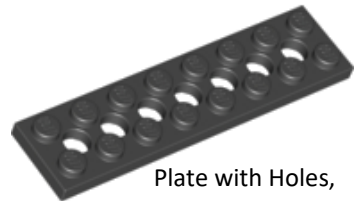
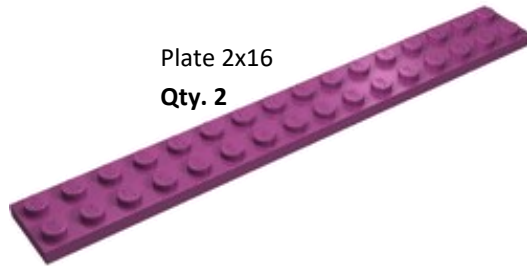
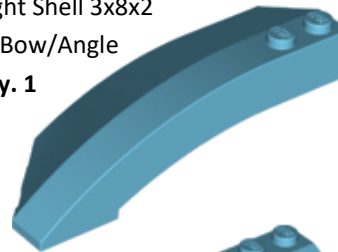
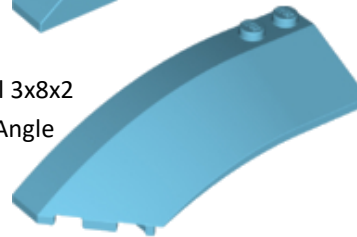


Plate with Holes,
2x8
Qty. 4

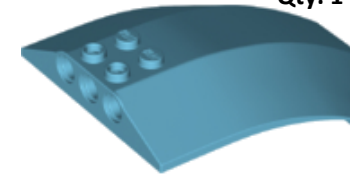
Right Shell 3x8x2
w/Bow/Angle
Qty. 1



Left Shell 3x8x2
w/Bow/Angle
Qty. 1



Shell 6x8x2
w/Bow/Angle
Qty. 1



Satellite Dish
6x6
Qty. 2



Axle, 32
Qty. 2



Panels

Qty: 2 Flat 3x11 Black
2 Bowed 3x11x2 Azure
4 Bowed 3x7x2 Black

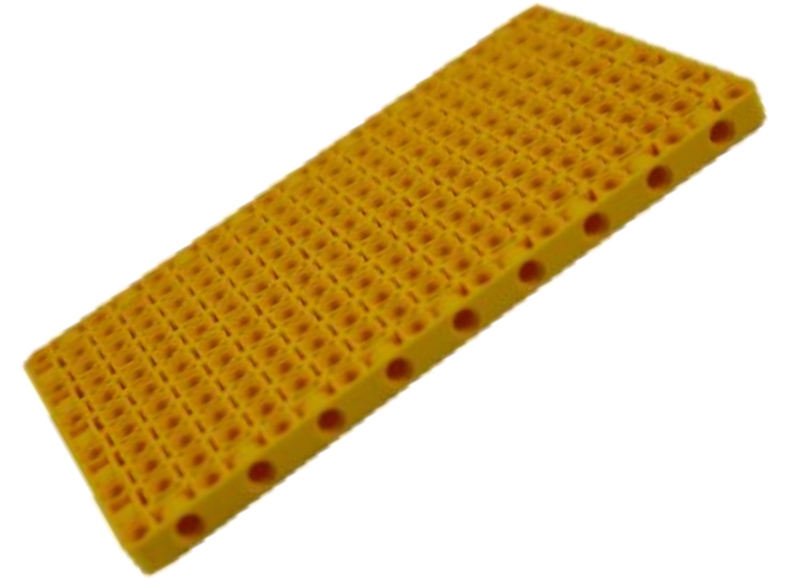


Tray 5

Gear Rack
1/4 Circle 11x11
Qty. 8



Technic Panel
11x19
Qty. 2



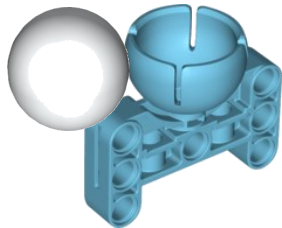
Frame 7x11
Qty. 6



Frame 5x7
Qty. 10

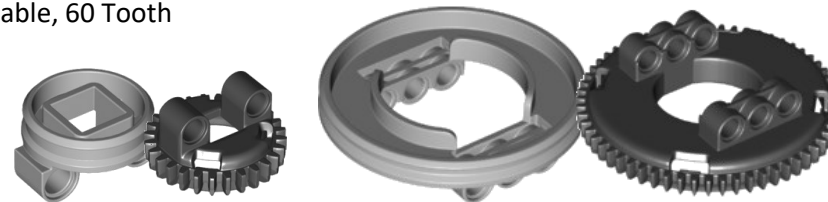


Beam 3x5 with
Wheel Cup & 19
Dia. Wheel Ball
(assembled)
Qty. 2

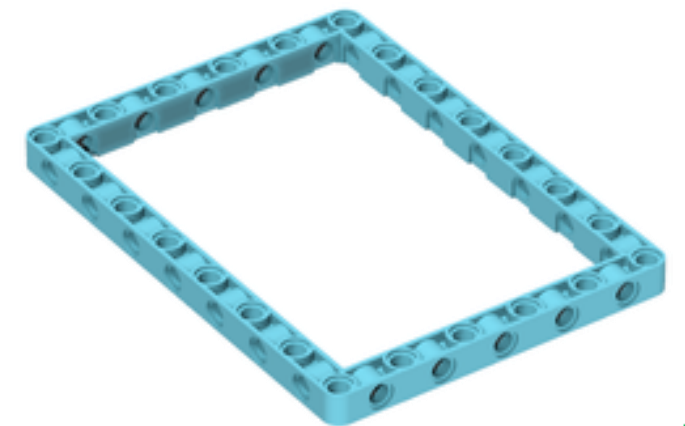


Turntable Assemblies

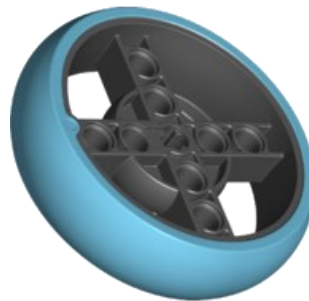
Small Turntable, 28 Tooth
Large Turntable, 60 Tooth
Qty. 2 ea



Frame 11x15
Qty. 4

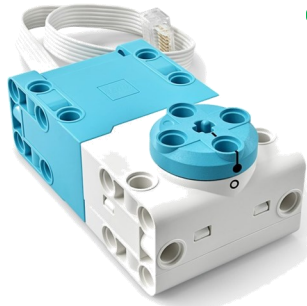


Wheel
56 diameter
Qty. 4



Tray 6

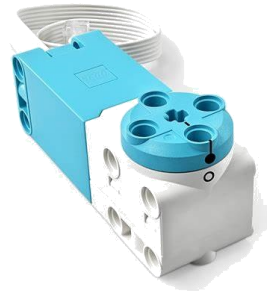
Large Motor
Qty. 2



USB Cord
Qty. 1

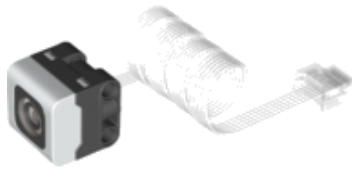


Medium Motor
Qty. 2



Wheel 88 Diameter
Qty. 4

Color Sensor
Qty. 2



Force/Touch Sensor
Qty. 1



SPIKE Large
Hub w/Battery
Qty. 1



Distance Sensor
Qty. 1

