Gabriel Staples

Copied out of my “Arduino Products to Purchase – Gabriel.odt” doc on 25 March 2017 2253hrs.

-Addendum and L298N additional research info (approx. pgs. 6~10) added on 26 Mar 2017-2140 hrs

* **Shopping List for Kevin Nufer for Scouts in Rockledge Ward.** 
  + Notes to Kevin:
    - Yellow = IS my recommended best buy for you (but I don’t need any at this time).
    - Green = NOT my recommended best buy for you (but I am buying this anyway for myself)
    - Cyan = IS my recommended best buy for you (and I am buying this too for myself)
  + Arduino Nanos WITH USB CABLES
    - Ebay search for “arduino nano usb” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=arduino+nano+usb&rt=nc&LH_BIN=1>
      * Ex: $2.86 - <http://www.ebay.com/itm/Hot-Mini-USB-Nano-V3-0-ATMEGA328P-Module-Board-USB-Cable-for-Arduino-LJ-/161813099349> x 1 per boy
  + Dupont Connectors
    - Ebay search for “dupont 20cm” - <http://www.ebay.com/sch/i.html?_odkw=dupont+20cm+male+to+male&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=dupont+20cm&_sacat=0>
    - M-M
      * ex: <http://www.ebay.com/itm/40PCS-Dupont-wire-jumper-cables-20cm-2-54MM-male-to-male-1P-1P-For-Arduino-BE-/122158688081> ($0.99) x 2 or so
    - M-F
      * ex: <http://www.ebay.com/itm/Arduino-Shield-40pcs-20cm-male-to-female-Dupont-cablesJumper-KY-/112122451039> ($0.99) x 2 or so
    - F-F
      * ex: <http://www.ebay.com/itm/40pcs-20cm-Dupont-Female-to-Female-Breadboard-Jumper-Wire-Raspberry-Pi-Arduino-/272375803104> ($0.99) x 2 or so
  + Female 0.1” headers
    - Ebay search for “2.54 40 10 header female” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=2.54+40+10+header+female&rt=nc&LH_BIN=1>
      * ex: <http://www.ebay.com/itm/10Pcs-2-54mm-40-Pin-Female-Single-Row-Pin-Header-Strip-KY-/112123384284> ($0.99 for 10 pcs) x 1 or 2
  + Medium Breadboards
    - Ebay search for “breadboard 400” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=breadboard+400&rt=nc&LH_BIN=1>
      * ex: <http://www.ebay.com/itm/Mini-DIY-Solderless-400-Contact-Breadboard-Bread-Board-Available-Test-Develop-/132127156897> ($0.99) x 1 per boy
  + Standard Servos (REQUIRES 5V 3A+ BUCK CONVERTER/UBEC SOLD SEPARATELY; SEE BELOW)
    - Ebay search for “standard servo” - <http://www.ebay.com/sch/i.html?_sop=15&LH_BIN=1&_from=R40&_sacat=0&_nkw=standard+servo&_pgn=2&_skc=100&rt=nc>
    - For comparison, the servo I showed you on my prop-powered Pinewood derby car the other day is the Airtronics 94102 servo that I bought in 1996 or so
      * (45g, 3.0 kg-cm torque at 4.8V) - <http://www.servodatabase.com/servos/airtronics>
    - Futaba S3003 (37g, 3.2 kg-cm torque at 4.8V)
      * $11 - <http://www3.towerhobbies.com/cgi-bin/wti0001p?&I=LXH288>
      * Ebay search for “s3003 servo” - <http://www.ebay.com/sch/i.html?_odkw=standard+servo&_sop=15&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=s3003+servo&_sacat=0>
        + \*\*\*\*\*Ex: $3.09 - <http://www.ebay.com/itm/Big-Torque-Futaba-S3003-Servo-Motor-for-RC-Helicopter-Robot-Align-/201606199373>
    - TowerPro SG-5010 (39g, 5.5 kg-cm torque at 5V)
      * $12 - <https://www.adafruit.com/product/155>
      * Ebay search for “sg 5010 servo” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=sg-5010+servo&rt=nc&LH_BIN=1>
        + \*\*\*\*\*Ex: $3.73 - <http://www.ebay.com/itm/High-Quality-SG-5010-Torque-Servo-Coreless-Servo-For-RC-Helicopter-LE-/272392275507>
    - TowerPro MG995 (METAL GEARS (aluminum [newer] or copper [older]); 55g, 9.4kg-cm torque at 4.8V)
      * <http://www.towerpro.com.tw/product/mg995/>
      * knockoff for $6.66 on Amazon - <https://www.amazon.com/Tower-MG995-Metal-Speed-Torque/dp/B0098M4R4Q>
      * Ebay search for “mg995 servo” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=mg995+servo&rt=nc&LH_BIN=1>
        + ex: $4.09 - <http://www.ebay.com/itm/Servo-MG995-Metal-Gear-High-Torque-Servo-For-HPI-XL-Helicopter-Car-Boat-/232037022203>
    - Continuous rotation servo (interesting)
      * ex: $6.70 - <http://www.ebay.com/itm/360-Degree-Continuous-Rotation-Servos-DC-Geared-Motor-for-RC-Robots-DS04-NFC-/351635973151>
  + Micro Servos (9g) (as required, 1 or 2 can run from the Arduino’s on-board linear 5V regulator, but for any more than ~2 of these it requires a SEPARATE 5V BUCK CONVERTER/UBEC, SOLD SEPARATELY)
    - Ebay search for “9g servo digital” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=9g+servo+digital&rt=nc&LH_BIN=1>
      * ex: $1.88 - <http://www.ebay.com/itm/9g-Digital-Servo-Motor-Gear-High-Speed-Torque-For-RC-Helicopter-Car-Airplane-HR-/252521990199>
  + DC Motors WITH GEARBOXES & wheels (REQUIRES H-BRIDGE SOLD SEPARATELY)
    - Ebay search for “robot motor arduino wheel” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=robot+motor+arduino+wheel&rt=nc&LH_BIN=1>
      * ex: $1.97 - <http://www.ebay.com/itm/New-Smart-Car-Robot-Plastic-Tire-Wheel-with-DC-3-6v-Gear-Motor-for-arduino-/122317977561>
  + L298N Dual H-bridge motor driver with large heat sink
    - Datasheet: <https://www.sparkfun.com/datasheets/Robotics/L298_H_Bridge.pdf>
    - Ebay search for “L298N” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=L298N&rt=nc&LH_BIN=1>
      * ex: $1.79 - <http://www.ebay.com/itm/Dual-H-Bridge-Stepper-Motor-Drive-Controller-Board-Module-For-Arduino-L298N-LC-/162227129149>
  + Stepper Motors WITH H-BRIDGES
    - Ebay search for “28byj-48” (be sure to choose one WITH INCLUDED H-BRIDGE) - <http://www.ebay.com/sch/i.html?_odkw=stepper+motor&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=28byj-48&_sacat=0>
      * ex: $1.57 - <http://www.ebay.com/itm/5V-ULN2003-28BYJ-48-4-Phase-Stepper-Motor-with-Driver-Board-for-Arduino-PI-PIC-A-/201010046635> – Note: even though it’s rated for 5V, it should be able to tolerate a little more without a 5V buck converter, ex: up to the 8.4V the robot’s battery supplies
      * IMPORTANT DRIVING INFO & RESOURCES CAN BE FOUND HERE: <https://www.adafruit.com/products/858>
  + Electromagnet (12V) (REQUIRES A SEPARATE DRIVER—EX: TRANSISTOR, TRANSISTOR BOARD, H-BRIDGE, RELAY, ETC)
    - 5.6lb holding force:
      * Ebay search for “electromagnet 5.6” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=electromagnet+5.6&rt=nc&LH_BIN=1>
        + ex: $2.30 - <http://www.ebay.com/itm/5-6lbs-DC-12V-Holding-Electromagnet-Lift-Solenoid-LW-/172365747485>
    - 11lb holding force (get this one if you want, instead of the 5.6lb one above—your call!):
      * Ebay search for “electromagnet 11” - <http://www.ebay.com/sch/i.html?_odkw=electromagnet+5.6&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=electromagnet+11&_sacat=0>
        + ex: $3.51 - <http://www.ebay.com/itm/Electromagnet-11-LB-DC-12V-Holding-Electromagnet-Lift-Magnet-Electric-Motor-DT-/262541155723>
  + Power driver (ex: FOR ELECTROMAGNETS):
    - Use the large L298N H bridges above. These are the best solution unless we want to breadboard our own logic-level MOSFETs (which cost about the same anyway) with flyback diode and resistor.
  + Boost Converters (for electromagnets 7.4V battery → 12V)
    - 12V (or adjustable) boost converter
      * Ebay search for “12v boost converter” - <http://www.ebay.com/sch/i.html?_odkw=bec+5v&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=12v+boost+converter&_sacat=0>
        + ex: $1.69, 3V~32V in, 5V~35V out, 4A max - <http://www.ebay.com/itm/141678637457>
  + 5V 3A+ Buck Converters (Switching regulators/UBECs) (MANDATORY FOR DRIVING STANDARD SERVOS, 2+ 9g MICRO SERVOS, ETC; OPTIONAL (I THINK) FOR STEPPER MOTOR, BUT WOULD BE A GOOD IDEA TO HAVE IT FOR THE STEPPER MOTORS TOO)
    - Ebay search for “buck converter 5a” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=buck+converter+5a&rt=nc&LH_BIN=1>
      * ex: $1.59 - <http://www.ebay.com/itm/Buck-Module-24V-12V-9V-5V-DC-to-DC-4V-38V-to-1-25V-36V-5A-Step-Down-Power-Supply-/271701783241>
  + Ultrasonic (“ping”) Sensors
    - Ebay search for “hc-sr04” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=hc-sr04&rt=nc&LH_BIN=1>
      * ex: $0.90 - <http://www.ebay.com/itm/1pcs-Ultrasonic-Module-HC-SR04-Distance-Measuring-Transducer-Sensor-for-Arduino-/141975951132>
  + Pulleys
    - Ebay search for “pulley robot” - <http://www.ebay.com/sch/i.html?LH_BIN=1&_from=R40&_sacat=0&_nkw=pulley+robot&_sop=15>
      * TAKE YOUR PICK. SORT BY “BEST MATCH” TOO FOR OTHER OPTIONS:
        + ex: $0.79 for 7pcs - <http://www.ebay.com/itm/7pcs-Plastic-Gears-Belt-Pulley-for-DIY-Robot-62A-132A-16-82A-182A-242A-102B-122B-/272496426546>
        + Another misc. option ($3.85) - <http://www.ebay.com/itm/Plastic-Gears-Pulley-Module-Robot-Parts-DIY-Necessary-Model-Toys-/172389745003>
  + Long Push Buttons
    - Ebay search for “6x6x15 tactile button” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=6x6x15+tactile+button&rt=nc&LH_BIN=1>
      * ex: 50pcs $2.55 - <http://www.ebay.com/itm/50x-Tactile-Push-Button-Switch-Momentary-Tact-6x6x15mm-4-pin-Through-Hole-NEW-/172431856245>
  + IR range finders
    - Ebay search for “ir distance sensor” ($3.72+) (lowest price first) - <http://www.ebay.com/sch/i.html?_sacat=0&_nkw=ir+distance+sensor&_sop=15&_frs=1>
    - Ebay search for “ir range” (best match) - (~$14 for what looks like a pretty nice one...) - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=ir+range&_sop=12>
  + 10k Potentiometers
    - Ebay search for “10k potentiometer” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&LH_BIN=1&_nkw=10k+potentiometer&_sop=15>
      * ex: $0.99 for 10pcs 10k trimmer pot - <http://www.ebay.com/itm/10-Pcs-6mm-10k-ohm-Horizontal-Pot-Variable-Cermet-Potentiometer-Trimmer-Resistor-/171747398851>
  + END
  + **Addendum 1:**
  + IR remotes (for consistency, I recommend you CHOOSE THE SAME TYPE AS WHAT THE ELEGOO ROBOT COMES WITH, AND MAKE SURE IT COMES \*WITH\* AN IR RECEIVER AND SENDER LED):
    - Ebay search for “nec ir remote” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=nec+ir+remote&rt=nc&LH_BIN=1>
    - Ebay search for “ir remote hx1838” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=ir+remote+hx1838&rt=nc&LH_BIN=1>
      * ex: $1.07 - <http://www.ebay.com/itm/HX1838-VS1838-Arduino-Infrared-IR-Wireless-Remote-Control-Sensor-Module-Kits-GM-/262136733321>
  + CR2025 button batteries for the IR remotes above:
    - Ebay search for “cr2025” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=cr2025&rt=nc&LH_BIN=1>
      * ex: $0.99 for 5 pcs - <http://www.ebay.com/itm/5X-CR2025-Batteries-3V-Coin-Cell-Button-For-Toys-Remote-Weigher-Boards-Ornate-/262648267086>
  + HC-06 4-pin bluetooth modules
    - Ebay search for “hc-06” - <http://www.ebay.com/sch/i.html?_from=R40&_trksid=m570.l1313&_nkw=hc-06&_sacat=0>
      * ex: $3.07 - <http://www.ebay.com/itm/HC-06-RS232-Wireless-Serial-Bluetooth-RF-Transceiver-Module-4-Pin-for-Arduino-/191022351189>
  + Extra Wheels (optional)
    - Ebay search for “wheel robot” (try sorting the results by Lowest Price First AND Best Match to get different results) - <http://www.ebay.com/sch/i.html?_sop=15&_from=R40&_sacat=0&_nkw=wheel+robot&rt=nc&LH_BIN=1>
      * ex: see the “belt transmission wheels,” “universal wheel smart car” caster wheels, etc.
  + TMP36 temperature sensors (-40C to 150C)
    - Ebay search for “tmp36” - <http://www.ebay.com/sch/i.html?_odkw=wheel+robot&_sop=15&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=tmp36&_sacat=0>
      * Most have $1.85 shipping cost, so maximize value by buying 5 at a time!
      * Ex: $1.21 + $1.85 shipping = $3.06 for 1 - <http://www.ebay.com/itm/TMP36GT9-ORIGINAL-Low-Voltage-Temperature-Sensors-New-/131750358119>
      * OR $4.49 for 5 - <http://www.ebay.com/itm/5PCS-TMP36GT9-Low-Voltage-Temperature-Sensors-Precision-Linear-Analog-Output-/272261604124>
  + Digital threshold microphone (outputs digital HIGH when there is absence of sound, and LOW when the threshold set by the potentiometer is exceeded by detected sound, for example)
    - Ebay search for “arduino microphone” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=arduino+microphone&rt=nc&LH_BIN=1>
      * ex: $0.74 - <http://www.ebay.com/itm/Microphone-Sensor-High-Sound-Sensitivity-Detection-Module-For-Arduino-DIY-3Pin-/262623486064>
  + LDR (photoresistor) (Model GL5516 below REQUIRES A 10K RESISTOR TO MAKE A VOLTAGE DIVIDER TO READ THE SENSOR)
    - GL5516 datasheet - <http://akizukidenshi.com/download/ds/senba/GL55%20Series%20Photoresistor.pdf>
    - \*\*\*\*\*More info, incl. how to hook up and read: (& $0.95 on Adafruit for 1) - <https://www.adafruit.com/product/161>
    - Ebay search for “ldr” - <http://www.ebay.com/sch/i.html?_odkw=arduino+microphone&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=ldr&_sacat=0>
    - Ebay search for “ldr gl5516” - <http://www.ebay.com/sch/i.html?_odkw=ldr&LH_BIN=1&_osacat=0&_from=R40&_trksid=m570.l1313&_nkw=ldr+gl5516&_sacat=0>
      * ex: $0.74 for 20pcs - <http://www.ebay.com/itm/20Pcs-Photoresistor-LDR-CDS-5mm-Light-Dependent-Resistor-Sensor-GL5516-Arduino-/262136737294>
      * ex: $0.99 for 30pcs - <http://www.ebay.com/itm/30PCS-Photoresistor-LDR-CDS-5mm-Light-Dependent-Resistor-Sensor-GL5516-Arduino-D-/112061701006>
  + 10k 1/2W resistors (REQUIRED FOR THE GL5516 LDRs ABOVE)
    - Ebay search for “10k resistor 100” - <http://www.ebay.com/sch/i.html?_from=R40&_sacat=0&_nkw=10k+resistor+100&rt=nc&LH_BIN=1>
      * ex: $0.97 for 100pcs - <http://www.ebay.com/itm/100pcs-1-4w-Watt-10K-ohm-10Kohm-Metal-Film-Resistor-0-25W-100000R-1-/141976458420>
  + END
  + **L298N Dual H-bridge motor driver with large heat sink ADDITIONAL RESEARCH AND EXPLANATIONS**
    - **Board Main Components Datasheets & specs:**
      * 1) ST L298N Dual H-bridge driver (Mutliwatt15 V plastic package) - <https://www.sparkfun.com/datasheets/Robotics/L298_H_Bridge.pdf>
        + Vs = 46V max input
        + I\_total = 4A max DC operation WHEN PARALLELING CH 1 AND 4 AND 2 AND 3 AS DESCRIBED BELOW, otherwise **2A max continuous per channel/H-bridge**

By logical deduction (looking at an H-bridge schematic), when using all 4 channels **separately** to drive unidirectional loads, **each channel can drive (source OR sink) up to 1A~2A DC simultaneously** as well (2A simultaneously per channel if you are balancing the complementary act of sourcing/sinking 1:1 on the 2 channels of each H-bridge, as would be done naturally while driving a single bidirectional load per H-bridge at 2A).

* + - * + Logic level, Vss = 5V w/78M05 Vreg

V\_IL (input LOW) = -0.3~1.5V

V\_IH (input HIGH) = 2.3~Vss = 2.3~5.0V

Ven\_L (enable LOW) = -0.3~1.5V

Ven\_H (enable HIGH) = 2.3~Vss = 2.3~5.0V

* + - * + Requires external flyback “bridge” diodes for switching inductive loads. Datasheet p. 7 recommends trr <= 200 ns (freq response >= 5MHz), w/Vf as low as possible, and 2A+ rating. Schottky diodes are preferred.
      * 2) 78M05 5V Linear Regulator (DPAK plastic package) - <http://www.st.com/content/ccc/resource/technical/document/datasheet/41/4f/b3/b0/12/d4/47/88/CD00000444.pdf/files/CD00000444.pdf/jcr:content/translations/en.CD00000444.pdf>
        + Vin = 35V absolute maximum rating
        + I ~ 1A max, depending on Vin - Vout
      * 3) M7 flyback diode x 8 (4 per H bridge) (DO-214AC [SMA] plastic package) - <http://www.kingtronics.com/pdf/M7-diode.pdf> or <http://diotec.com/tl_files/diotec/files/pdf/datasheets/m1.pdf>
        + Vrev (DC blocking voltage) = 1000V DC
        + VF = 1.1V
        + Imax = 1A
        + trr = 1500ns = 1.5us.
        + GS note on speed, trr: these are SMT silicone rectifier diodes (Chinese SMT equivalent of the 1N4007 silicone rectifier diode) and are cheap and have a somewhat slow recovery time, trr = 1.5us, but they’re good enough I suppose to suppress the bulk of the energy from inductive-induced voltage spikes. Here's a datasheet that shows trr = 1500ns --> freq response = 666.7kHz for the M7: <http://diotec.com/tl_files/diotec/files/pdf/datasheets/m1.pdf>. This is \*significantly\* better than a 1N4007 (<https://global.oup.com/us/companion.websites/fdscontent/uscompanion/us/pdf/microcircuits/students/diode/1n4004-general.pdf>), which has a trr = 30us --> freq response = 33.3kHz. Therefore, a 1N4007 diode is 20x \*slower\* than an M7 diode. So, even though the M7 is by no means a fast diode, it is nowhere near as slow as the 1N400x series either (see my comment I posted below this answer here: <http://electronics.stackexchange.com/a/149473/26234>).
    - Board driving capability & Info:
      * Datasheet Fig 7 (pg 7): the H-bridges can be paralleled for higher current output (ex: 4A to a single motor, instead of 2A), by paralleling channel 1 with channel 4 and channel 2 with channel 3.
      * L298N Board has 3 x jumpers:
        + 1 bridges ~12V input to the 78M05 input leg
        + 1 bridges ENA to 5V output from 78M05 (Enabling H-bridge output A)
        + 1 bridges ENB to 5V output from 78M05 (Enabling H-bridge output B)
      * L298N datasheet p7: “Turn-On and Turn-Off: Before to Turn-ON the Supply Voltage and before to Turn it OFF, the Enable input must be driven to the Low state.”
      * **A dual H bridge has 4 inputs and 4 outputs. The L298N is designed to let you drive inductive OR resistive loads, and the board includes 8x 1A M7 666.7kHz flyback diodes to snub out voltage spikes. You can drive the following with one of these dual H bridge boards, and/or mix and match as able:**
        + **4x unidirectional loads (sourcing OR sinking current through the H-bridges, with the other end connected to Vin or GND) (ex: DC motors moving in only one direction, solenoids/electromagnets, etc)**
        + **2x bidirectional loads (ex: DC motors in forward OR reverse)**
        + **1x stepper motor**
        + **Mix and match: ex: 1x bidirectional load and 2x unidirectional loads**
        + **Max current is 2A max per channel, as described in more detail above, with 46V max input. For anything > ~12~24V input, however, you must remove the jumper that jumps Vin to the 78M05 regulator, so as to not burn it up, and use your own separate switching or multi-stage regulator to supply Vss with 5V to set the logic level on the L298N manually yourself.**
  + END