

MAPLE Fly-Handling Robot Bill of Materials									
Last updated: 12/3/2017									
	Color code:	Off-the-shelf Customized	3d-printed Laser cut	Waterjet Machined					
		Alt. source							
Structural	Qty	Price	Ext. Price	Source	Part #	X/Y only	LLT?	Notes	Alternate source
40mm sq x 1120mm Extrusion	2	\$29.90	\$59.80	http://us.misumi-ec.com	HFSB5-4040-1120	*			
20mm x 40mm x 410mm Extrusion	4	\$6.84	\$27.36	http://us.misumi-ec.com	HFSB5-2040-410	*			
20mm x 40mm x 370mm Extrusion	2	\$6.17	\$12.34	http://us.misumi-ec.com	HFSB5-2040-370	*			
20mm x 40mm x 1120mm Extrusion	2	\$18.70	\$37.40	http://us.misumi-ec.com	HFSB5-2040-1120	*			
20mm sq x 370mm Extrusion	2	\$3.25	\$6.50	http://us.misumi-ec.com	HFSB5-2020-370	*			
Wide corner bracket	8	\$3.38	\$27.04	http://us.misumi-ec.com	HBLFSDK5	*			
Narrow corner bracket	8	\$2.85	\$22.80	http://us.misumi-ec.com	HBLFSSW5	*			
Sheet metal brace	8	\$10.50	\$84.00	http://us.misumi-ec.com	SHPTCUL5-SET	*			
Spacer stick	1	\$4.00	\$4.00	http://tapplastics.com	1/4" thick acrylic sheet, cut from 8" x 2.75"	*			
Laser cutting		varies							
End panel	1	\$8.00	\$8.00	http://tapplastics.com	1/4" thick acrylic sheet, cut from 8" x 16"	*			
Laser cutting		varies							
Work surface	1	\$50.00	\$50.00	http://tapplastics.com	1/4" thick acrylic sheet, cut from 16.5" x 46"	*			
Laser cutting		varies							
		Subtotal:	\$339.24						
Motion									
Motor bracket	2	-	\$9.19	OnlineMetals.com	6061-T6 Al, 1/4" thick - 8" x 8"	*			
Waterjet cutting / machining		varies							eMachineShop.com
Idler pulley bracket	2	-		OnlineMetals.com	6061-T6 Al, 1/4" thick - included w/above	*			
Waterjet cutting / machining		varies							eMachineShop.com
NEMA 17 stepper	2	\$11.50	\$23.00	RobotDigg.com	MNEMA17-60	*	Y		https://www.amazon.com/Torque-Current-Stepper-Motor-Extruder/dp/B00PNEQP1G/
X axis rail	2	\$81.30	\$162.60	IGUS.com	AWUM-12 @ 1116mm length	*			
X axis bearing	4	\$51.93	\$207.72	IGUS.com	OJUM-06-12	*			
Drilling & tapping									
Y axis	1	\$49.37	\$49.37	IGUS.com	WS-10-120 @ 453mm length	*			
Drilling & tapping									
Y upper plate	1	-	\$34.56	OnlineMetals.com	6061-T6 Al, 1/8" thick - 12" x 18"	*			
Waterjet cutting / machining		varies							eMachineShop.com
Y lower plate	1	-	\$12.16	OnlineMetals.com	6061-T6 Al, 3/16" thick - 8" x 8"	*			
Waterjet cutting / machining		varies							eMachineShop.com
Y bearings	4	\$5.25	\$21.00	IGUS.com	WJ200UM-01-10	*			
Belt clamp	2		\$0.00	3d printed		*			Shapeways.com
Belt tensioner	2		\$0.00	3d printed		*			Shapeways.com
X axis limit switch holder	1		\$0.00	3d printed		*			Shapeways.com
Pulley, motor	2	\$1.80	\$3.60	RobotDigg.com	GT2-20T-5B-6	*	Y		https://www.amazon.com/Qunqi-Aluminum-Timing-Pulley-Printer/dp/B011MR6OR0/
Pulley, idler	8	\$1.80	\$14.40	RobotDigg.com	GT2-20T-8B-6	*	Y		2x https://www.amazon.com/CycleMore-Aluminum-Pulleys-Printer-Reprap/dp/B016ZRJGBK/
Idler bearing	8	\$2.00	\$16.00	McMaster.com	6679K11	*			
Z axis plate	1	-		OnlineMetals.com	6061-T6 Al, 1/8" thick - included w/above	*			
Waterjet cutting / machining		varies							eMachineShop.com
T brackets	1	-	\$20.16	OnlineMetals.com	6061-T6 Al, 3/8" thick - 6" x 12"	*			
Waterjet cutting / machining		varies							eMachineShop.com
Drag chain plate	1	-		OnlineMetals.com	6061-T6 Al, 1/8" thick - included w/above	*			eMachineShop.com
Waterjet cutting / machining		varies							eMachineShop.com
X axis drag chain	6	\$16.05	\$96.30	McMaster.com	4516T48 (6' total)	*			
Y axis drag chain	2	\$12.47	\$24.94	McMaster.com	4516T46 (2' total)	*			
Y axis drag chain mount	1		\$0.00			*			Shapeways.com
GT2 belt	1	\$15.00	\$15.00	RobotDigg.com	GT2-6-OPEN_10Meters	*	Y		2x https://www.amazon.com/Meters-pitch-wide-Timing-printer/dp/B00F2IQNX8/
Z slides	3	\$317.20	\$951.60	IGUS.com	SLN-D740679-2	*	Y		
Z mount	3	-		OnlineMetals.com	6061-T6 Al, 1/8" thick - included w/above	*			eMachineShop.com
Waterjet cutting / machining		varies							eMachineShop.com
4mm spacer	10	\$1.25	\$12.50	McMaster.com	93657A404	*			
2mm spacer	6	\$1.36	\$8.16	McMaster.com	93657A402	*			
1/4" spacer	4	\$8.72	\$34.88	McMaster.com	94639A569	*			
Shoulder bolt, Y carriage, 25mm	4	\$5.82	\$23.28	McMaster.com	90265A145	*			
Shoulder bolt, idler pulleys	4	\$5.49	\$21.96	McMaster.com	90265A144	*			
		Subtotal:	\$1,762.38						
Manipulation									
Manifold block	2	15.16	\$30.32	Clippard.com	M-E10M-02	*			
Solenoid valve	4	\$24.68	\$98.72	Clippard.com	E210C-2W012	*			
Tubing	50	\$0.21	\$10.50	McMaster.com	50315K68 - 25' red, 25' blue	*			
Tube fittings	10	\$2.58	\$25.80	McMaster.com	7880T389 - Nickel-plated brass	*			
Object manipulator manifold	1	varies		Machined		*			eMachineShop.com or 3d printed
Organism manipulator manifold	1	varies		Machined		*			eMachineShop.com or 3d printed
Vacuum cup	1	\$6.25	\$6.25	McMaster.com	5427A628 - 1/8 NPT, Male	*			
Luer lock fitting	1	\$5.24	\$5.24	McMaster.com	51525K23 - Impact resistant	*			
Organism manipulator switch holder	1		\$0.00	3d printed		*			Shapeways.com
Fly needle	1	\$3.41	\$3.41	McMaster.com	6710A61	*			
0.042" dispenser needle	1	\$12.18	\$12.18	McMaster.com	75165A553	*			
0.028" dispenser needle	1	\$12.15	\$12.15	McMaster.com	75165A682	*			
		Subtotal:	\$204.57						
Electronics									
SmoothieBoard	1	\$162.97	\$162.97	https://shop.uberclon.com	Smoothieboard 5x-xM	*			
Smoothie USB cable	1	\$4.99	\$4.99	Amazon.com	B00NH11K1K	*			
Camera USB cable	1	\$9.99	\$9.99	Amazon.com	B00HNF00S8	*			

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Ribbon breakout PCB	1	\$29.15	\$29.15	OSHPark.com	https://oshpark.com/shared_projects/rHsVOK		These two PCBs are custom, but can be ordered from OSHPark.		
Smoothieboard ribbon PCB	1	\$109.00	\$109.00	OSHPark.com	https://oshpark.com/shared_projects/TI6vEC		Unfortunately, OSHPark.com will only build PCBs in quantities that are multiples of 3.		
Electronics components	see next sheet		\$111.62						
		Subtotal:	\$427.72						
Vision									
Camera mount	1		\$0.00	3d printed					
Camera	1	\$359.00	\$359.00	TheImagingSource.com	DFM 72BUC02-ML		Y	Shapeways.com	
Lens holder	1	\$16.80	\$16.80	TheImagingSource.com	TLH 10-2				
Lens	1	\$28.00	\$28.00	TheImagingSource.com	TBL 9.6-2 C 3MP				
LED ring	1	\$9.80	\$9.80	Amazon.com	B00MJSJFPW				
		Subtotal:	\$413.60						
Fasteners & Misc. HW									
Nuts for extrusion	2	\$19.32	\$38.64	http://us.misumi-ec.com	HNKK5-5		*		
Post-assy extrusion nuts, M5	1	\$29.70	\$29.70	http://us.misumi-ec.com	PACK-HNTASN5-5		*		
M6 x 16 round head hex screw	1	\$5.57	\$5.57	McMaster.com	92095A238		*		
M5 x 10 SHCS	2	\$8.15	\$16.30	McMaster.com	91292A124		*		
M5 x 6 SHCS	2	\$4.63	\$9.26	McMaster.com	91292A189		*		
M5 x 20 SHCS	4						*		
M5 x 25 shoulder bolt	4	\$5.53	\$22.12	McMaster.com	90265A145		*		
M5 x 20 shoulder bolt	4	\$5.22	\$20.88	McMaster.com	90269A144		*		
M3 x 25 SHCS	1	\$6.40	\$6.40	McMaster.com	91292A020		*		
M3 x 20 mm threaded rod	1	\$7.33	\$7.33	McMaster.com	93805A631		*		
M3 x 20 SHCS	1	\$6.00	\$6.00	McMaster.com	91292A123		*		
M3 x 14 low profile screw	2	\$5.80	\$11.60	McMaster.com	92095A168		*		
M3 x 12 SHCS	1	\$4.40	\$4.40	McMaster.com	91292A114		*		
M3 x 8 SHCS	1	\$4.00	\$4.00	McMaster.com	91292A112		*		
M3 washer	1	\$1.62	\$1.62	McMaster.com	93475A210		*		
M3 nut	1	\$5.55	\$5.55	McMaster.com	91828A211		*		
M2 x 8mm pan head screw	1	\$4.52	\$4.52	McMaster.com	92000A015		*		
M2.63 x 12mm for plastics	1	\$14.33	\$14.33	McMaster.com	99397A356		*		
M1.91 x 12mm for plastics	1	11.66	\$11.66	McMaster.com	99397A077		*		
Zip tie mount	1	8.53	\$8.53	McMaster.com	7582K11		*		
Spacer for camera	1	7.77	\$7.77	McMaster.com	94639A464		*		
M2.5 x 10mm SHCS	1	4.94	\$4.94	McMaster.com	91292A014		*		
M3 x 12 mm Shoulder screw	2	2.66	\$5.32	McMaster.com	90265A122		*		
M3 spacers for PCBs	10	0.48	\$4.80	McMaster.com	95947A008		*		
M5 flat washer	1	2.57	\$2.57	McMaster.com	93475A240		*		
M5 nyloc nut	1	5.98	\$5.98	McMaster.com	93625A200		*		
		Subtotal:	\$259.79						
Tools & Consumables									
Epoxy	1	\$54.96	\$54.96	McMaster.com	75045A65		*		
M5 x 0.8 tap	1	\$6.67	\$6.67	McMaster.com	8305A16		*		
1/4-28 tap	1	5.35	\$5.35	McMaster.com	2521A681		*		
M3 x 0.5 tap	1	6.09	\$6.09	McMaster.com	8305A12		*		
M2.5 x 0.45 tap	1	9.59	\$9.59	McMaster.com	8305A11		*		
Letter O drill bit	1	3.84	\$3.84	McMaster.com	30595A446		*		
		Subtotal:	\$88.50						
		Total Parts Cost:	\$3,495.80						