**Rocketry Curriculum**

#### Overview

This curriculum spans 6 weeks in total, with 2 days per week, 2 hours per day. The program focuses on introducing middle schoolers to the fundamentals of rocketry, including physics, aerodynamics, and engineering principles, and is also partly designed to be a simulation of being a team member in TARC.

**Day 1: Introduction to Rocketry**

* Overview of rocketry:
  + History of rockets and space exploration.
* Basic rocket components:
  + Body tubes, fins, nose cone, engine, altimeter
  + Discussion of how each component contributes to flight.
  + Science behind the altimeter
* Start building beginner rockets
  + How to use epoxy
  + Making motor mounts and attaching shock cord
  + Cutting fin slots in tubes

**Day 2: Computer Aided Design (CAD)/OnShape for 3D printing (July 21)**

* How to use CAD:
  + Optimal CAD workflow
  + Basic ways of designing a component
* Design beginner rockets in CAD
  + Nose cone, fins, transition
  + All components will be 3D printed
* Continue building beginner rockets
  + Attach launch lugs
  + Tying parachute to shock cord
  + Using cyanoacrylate glue to reinforce body tubes

**Day 3: Basic Physics of Rocketry (July 27)**

* Newton’s laws of motion:
  + Explanation and examples of each law.
  + Application to rocket flight.
* Rocketry Terminology
  + CP, CG, Apogee, Thrust Curve, etc.
  + Thrust, drag, lift, and weight.
* How these forces interact during launch and flight
* Continue building beginner rockets

**Day 4: Launch Day (July 28)**

* Launch their beginner rockets at launch site
* Feedback session
* Discuss future action items/ideas to improve design

**Day 5: Motors + OpenRocket (August 3)**

* Rocket Motors Lesson
  + Hobbyist motor nomenclature
  + Science behind how a motor works
  + Solid vs liquid propulsion
  + Core burning vs end burning
* OpenRocket Lesson
  + Comprehensive overview on OpenRocket’s capabilities
  + Compete for the best OpenRocket design
* Start building low-power rocket

**Day 6: Advanced Rocket Construction August 4)**

* Model rockets vs NASA rockets
* How to paint a rocket
* Designing jigs to aid construction
* Materials to bring to a launch
* Design considerations for parachute packing
  + Parachute packing
  + Nomex vs dog barf
* Continue building low-power rocket

**Day 7: Build Day (August 10)**

* Brief introduction to computational fluid dynamics
* Finalize low-power rocket construction
* Prepare for launch day

**Day 8: Launch Day (August 11)**

* Launch low power rockets
* Feedback session
* Future action items and discuss TARC simulation

**TARC SIMULATION PREPARATION FOR GRAND FINALE:**

**Day 9: TARC Simulation DAY 1**

* Design a TARC Rocket on OpenRocket
* Review our TARC guidelines and competition rules
* Start building OpenRocket Design

**Day 10: TARC Simulation DAY 2**

* Design 3D printed parts
* Continue building OpenRocket Design

**Day 11: TARC Simulation DAY 3**

* Hand back 3D printed parts
* Finish Building Final Rocket Design
* Write a 1 Page Report Summary on what they learned.

**Day 12: TARC Simulation Grand Finale**

* Launch all Rockets
* Score each launch
* Celebrate with parents

Things to Order:  
[Lifetime Launch System - Estes Rockets](https://estesrockets.com/products/lifetime-launch-system) ($80)

[Bambu Lab P1P 3D Printer | Bambu Lab US](https://us.store.bambulab.com/collections/p1-series/products/p1p) ($499)

[Bambu Smooth PEI Plate For X1 Series/P1 Series/A1 | Bambu Lab US](https://us.store.bambulab.com/products/bambu-smooth-pei-plate?variant=41586448433288) ($30)

[J-B Weld 8271 KwikWeld Professional Size Steel Reinforced Epoxy Twin Pack - 10 oz.: Amazon.com: Industrial & Scientific](https://www.amazon.com/J-B-Weld-8271-Professional-Fluid_Ounces/dp/B01J5N8AGS/ref=sr_1_3?crid=J9LAL2CNMW9U&dib=eyJ2IjoiMSJ9.ekQJH1vfd78csK3kyhYhxzmK1nsXuoI5426uVeDE8e-pQ8rzITlvaQ68MPao4W2xXlhSSovMX7_AbBbAjCCtdm7uVyJ1T_uU7TX26JPjZRWMbCw0Nu3JFRG5G3zaltVQKZvj0oclJm9A_Z8iYJJFUBcmWSEOiCyOG98nnvTfU1K2Lz4Nza3CYjrOXTP8D46prniu6QD3gA_83JZifd18YV-FFmTXo1NBoz0OXMhhovw.Ku5E-UBO3kViG6ULDJk3piGJx-lU51IBtafU14oekGA&dib_tag=se&keywords=jb+weld+epoxy+kwik&qid=1720387976&sprefix=jb+weld+epoxy+kwi%2Caps%2C185&sr=8-3) ($18.15)

[Amazon.com: Loctite 1364076 Super Glue Easy Squeeze Gel, .14 oz, Super Glue Liquid : Industrial & Scientific](https://www.amazon.com/Loctite-1364076-Super-Squeeze-Liquid/dp/B0006HUJCQ/ref=sr_1_3?crid=JSL248LUQE49&dib=eyJ2IjoiMSJ9.tRBy14KnovO5MXIjc-Sq_oMBLWqXBztoT6MirMLQkA6LFjLNkNHjrKXKQASq3qPyvHrBlIOzyQ18nva3DW6PRNhm5FBpRZohY6IYziu_9ASC_FmTpdavSMB15UrzKrc-kRSR9IyQJO-XRfUODstkbCXT3J582dyZj6CQkUUhGhY5_9okuCI2cF8bARnObkYIoJSO2gru7uAdapDuIMDK7LAIl-wW-FxgUkEVk9AIW9o.DBvzopDxXeo_Xj2xNC1gNrVE0ueFRmTIb___afn6FwM&dib_tag=se&keywords=super%2Bglue&qid=1720388006&sprefix=super%2Bgl%2Caps%2C176&sr=8-3&th=1) ($3.64)

[Blast-Off® Bulk Pack - Estes Rockets](https://estesrockets.com/products/blast-off-bulk-pack) ($79.99)

[E16-6 Engines (29 mm) - Estes Rockets](https://estesrockets.com/products/e16-6-engines?_pos=19&_fid=dbd2d2c1a&_ss=c) ($25.49)

[E12-6 Engines - Estes Rockets](https://estesrockets.com/products/e12-6-engines?_pos=6&_fid=0adb97295&_ss=c) ($26.49)

[Amazon.com: Jetmore 10 Pack Exacto Knife, Stainless Steel Exacto Knife Set, Sharp Precision Hobby Knife Craft Knife Kit for Pumpkin Carving, DIY, Art, Cutting, Stencil : Arts, Crafts & Sewing](https://www.amazon.com/10-Pack-Precision-Utility-Scrapbooking-Jetmore/dp/B086DNBN9L/ref=sr_1_11?crid=1U79OH8YM7QXU&dib=eyJ2IjoiMSJ9.RT19rEFcv9K0ErR135neCbv7B7Iw_HuxBvedp3LJdFmJPGSueqR2NUXmUOMLHoTDrA9BU_HLg7nrrk5bDGfyk_cBTm9wxWd0wCmvgtLarcWfP07jzbIu6Yp8Izf7-_Vi7EsdJ5r8vvMluK2L3_49hsQGBSgq1Vih53FR9Owqf-LAXc68FptN6BMrTlX30spWuQNtQCt8DG8UpmqRWEO8BzO6dzHXzZigyzz_8eOoIkM.PNHQROtbe5qbluEpfMUqxruj2UKqy11AOYeM9VyKtos&dib_tag=se&keywords=xacto+knives&qid=1720388428&s=financial&sprefix=xacto+knive%2Cfinancial%2C216&sr=1-11) ($8.99)

[4 Rolls Premium Painters Tape, Blue Tape, Masking Master Tape, Paint Tape for Multi-Purpose, Painting, Painter's, DIY Crafts Arts (88yd =0.94IN\*22yd\*4) Decoration Labeling No Residue, Easy Removal: Amazon.com: Tools & Home Improvement](https://www.amazon.com/Painters-Painting-Adhesive-Decoration-Labeling/dp/B0BPS5QB4D/ref=sr_1_3?crid=RXO39TT599WZ&dib=eyJ2IjoiMSJ9.x3y5tkLgwyvD21NYAA65JjKeLcNEyZP9Z5O1srLJyvatumitxFcXD-__N4CinWPA-izGj-5TVO1NuXze4jwWxyZAMz6qj8mydUYp50DZsp4rmCWpMQ_xw_SD6Iw_KcHgKDcvHY9dful5WKHBxJLbmXOMz5I-HOHmIKY2iSTE2jgljrfdFibWXiJb_yBf1_aO_IzMSlQ1yneOAhafNxJm1SXfF4iO9SLoEog4dR_kJ6g.duSVxLLO4GyfKqmQhszbpEvgRY_b9s8A7h5aMP8Sj_U&dib_tag=se&keywords=blue+tape+and+masking+tape&qid=1720388458&s=financial&sprefix=blue+tape+and+masking+tap%2Cfinancial%2C151&sr=1-3) ($5.99)

[DUIJINYU 9 Rolls Masking Tape Bulk 0.6 Inch - Narrow White Painters Tape General Purpose for Packing Crafting DIY Home Office 3/5 Inch x 22 Yards: Amazon.com: Tools & Home Improvement](https://www.amazon.com/DUIJINYU-Rolls-Masking-Tape-Bulk/dp/B0D2Q6BQV8/ref=sr_1_18?crid=1LL2P2EC735L8&dib=eyJ2IjoiMSJ9.KRBS-JXaHeOX_VQ0c6HJv7mSvk4Z-YniNpcrq-Zha5YVm4akgvnRh6FMoKqpoCTDDraQd7bASurg6b4LvsNNr1Xh4SvBTOObOLGdJHUsP8W8buPpnCeXBY9I1Nz5wu45JdZfKRlpPBiwon5Siz0NpOhWpw-fJWGCPabr0EgPuanjf_O0ueJt24mFUkoPR-l9U8UPfUWh73-g_woYoPUaGfSIR3f4mHQGli5ISsZHOBs.nn4HJFEyDx8sBuFrZBji_0JUh1msrnjry11GBbEryFQ&dib_tag=se&keywords=masking+tape&qid=1720388478&s=financial&sprefix=masking+tap%2Cfinancial%2C151&sr=1-18) ($6.99)

[Sand Paper, 48 PCS Sandpaper, 120 to 5000 Assorted Grit Sandpaper Sheets, 9 x 3.6 Inch Premium Wet Dry Sandpaper for Wood Furniture Finishing, Metal Sanding, Automotive Polishing - Amazon.com](https://www.amazon.com/YXYL-Sandpaper-Furniture-Automotive-Assortment/dp/B08NPM9B5L/ref=sr_1_7?crid=3U50JWCHU39D&dib=eyJ2IjoiMSJ9.imacQWq93dlxFowq_ZFzS8FsoUcEkDPikuvLnseIYGofHPuKfOj9fs-afkCmqUavSipf8BubMmO9ZDJ4Fldo1l9o4fQIuGw2z0J6z37-Q1IZaeJ_ahQaeMCIjYjMZl6u9cppwR4U0nCIWl9B2x69hPY4yNlJX-phjAWERVfNsrSiB2m1aku7hzi44XAmKbRFB6Gz08dtVxd56LMbMQLE1veU73Yon4rjVSPnLV4k9dNDUL9MHHpCqvkT4A51zKYFeFni1umQNiAzSYpTAjrMQR3yzqtaBtkypMfmd9c8_eU.sZzr5grBxIGMWyP6oGmnUF0z231KFAypHbSQZKjd-Rg&dib_tag=se&keywords=sand+paper&qid=1720388775&sprefix=sand+pa%2Caps%2C165&sr=8-7) ($7.57)

**TARC Sim Criteria:**

* Altitude: 650 FT
* Time: 35 - 40 seconds
* Mass: 550 g
* One Egg (enclosed in an egg casing)
* Both pieces should come down together, attached and held together by a shock cord.
* Altimeter must be beeping when the rocket is retrieved.
* No flight computer or pyrotechnics (other than the motor) may be used.
* Motor must be a type D or E motor.
  + The students can choose which motor.