



SPORT ROCKETRY

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**NATIONAL SPORT
LAUNCH 2022**

**THE AMERICAN
ROCKETRY
CHALLENGE**

*by Trip Barber, NAR 4322,
NAR TARC Manager*



Shady Side Academy - Pittsburgh, PA
Photo by Scott McIntosh.

ROCKET



THE AMERICAN ROCKETRY CHALLENGE



**1st place winners
Newport High School, Bellevue, WA.**
Photo by AIA.

The American Rocketry Challenge (TARC) is the NAR's premier STEM (science, technology, engineering, and math) program for young people and the largest rocket competition in the world. 2022 was its 20th anniversary year but it was not the 20th Finals, thanks to COVID. Last year in order to minimize COVID risk from travel and a large gathering, TARC had a "distributed" Finals held in 10 different locations around the U.S. with local sections hosting a few teams at each site; and the Finals in 2020 had to be canceled altogether due to COVID. So the big event held on May 14, 2022, at the beautiful Great Meadow site in The Plains, Virginia, was the 19th Finals and 18th single-site Finals in the program's 20th year of operation. However you want to count things, it was great to see so many eager and bright young rocketeers and dedicated NAR range crew volunteers back together again in person, all in one place.

The sustained success of TARC is a tribute to the dedication of the NAR volunteers nationwide who work with student teams to teach them rocketry, and to the strong financial support of the U.S. aerospace industry through the NAR's TARC co-sponsors, the Aerospace Industries Association (AIA). AIA is the trade organization that represents the interests of the whole U.S. aerospace industry in Washington. The AIA side of the competition is to run all of the registration, program administration, publicity, and corporate fund-raising that makes the "machine" work, and this year a new director for TARC at AIA, Katrina Hill, took over and really raised their support to a new level. The TARC program has a proven record of success in making young people excited about rocketry and about going into the aerospace profession. These young people are the future of our hobby, of the NAR, and of the U.S. aerospace industry. TARC is all about "paying forward."

TARC has enrolled 14,427 teams of 6th through 12th grade students (over 85,000 young people) over its history. 722 teams, made up of 4,257 students, entered the TARC 2022 program from



**1st place Newport High School Team
prepares to launch.**
Photo by Newport HS.

41 states plus the District of Columbia. 373 of these teams submitted reports of local qualification flight attempts in 2022, and the 100 top-scoring of these teams were invited to the National Finals at Great Meadow Outdoor Center in The Plains, Virginia, (45 miles west of Washington, D.C.) for a head-to-head competition to select the national champion.

TARC is a “challenge” program, where student teams are given a specific set of flight mission performance objectives and design constraints and then have to go



HPR rocket commemorating Joe Egan at liftoff.
Photo by Glenn Feveryear.



2nd place winners, also from Newport High School, Bellevue, WA.
Photo by Glenn Feveryear.

through the design-build-fly aerospace engineering process to meet these with their own original model rocket design. Success requires a yearlong process of learning, building, then eventually lots of practice flying, usually with failures along the way. Every successful TARC team has one or more dedicated adults—teachers, NAR rocketry mentors, and/or parents—supporting that long and often challenging process. Each year we publicly recognize one teacher and one mentor at the Finals as representatives of all the hundreds who deserve this recognition. This year we called out Dr. Maqsuda Afroz from Cesar Chavez High School in Houston, Texas, as the out-

standing teacher and Bob Ekman, the NAR mentor supporting the Explorer Post 1010 teams from Rockville, Maryland, for the last 17 years as the outstanding mentor. You can read about their inspiring dedication to their students and teams in the accompanying text boxes.

The TARC 2022 Challenge

This year’s challenge required teams to design, build, and fly a rocket to take two eggs to a flight altitude of 835 feet and recover them safely and unbroken within a

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Chris Kidwell checks
a team's score.

Photo by Scott McIntosh.



Nazareth Academy, Philadelphia, PA

Photo by Scott McIntosh.

window of between 43 and 46 seconds from liftoff to landing. The eggs were required to be flown “sideways,” which meant that the payload section had to have a diameter greater than the length of an egg (up to 59 millimeters), which is bigger than a T-70 tube. The rockets also had to use body tubes of at least two different diameters in their structure, so some sort of transition was also needed. And all sections of the rocket had to remain tethered together during recovery. As always, rockets had to be single-staged, weigh no more than 650 grams at liftoff, use no more than 80 N-sec of rocket motor total impulse, and be at least 65 centimeters in length.

Teams in TARC 2022 had to persevere through many challenges beyond rocket design. COVID restrictions were still in place in many school systems, limiting team gatherings. Weather is always a challenge somewhere, but the increasing incidence of high fire risk conditions across the country further limited flying opportunity for many teams. When the scores of the teams that persevered through all these challenges were tabulated, a combined

best-two-of-three flight score of 47.58 or lower on local NAR-observed qualification flights was required this year to make the cut to get one of the 100 score-based Finals invitations. This was a bit higher than in pre-COVID years, reflecting the reduced flying opportunity that many teams experienced. The 100 invited teams, coming from 27 states, had to raise the travel funds to attend the Finals and commit to attending within two weeks of their invitation, or yield their spot to one of the 20 alternates. This year we used only one alternate; every other team found a way to raise the money and get school permission to come to the Finals.



**Camas (WA) High School
preps their model.**

Photo by Scott McIntosh.



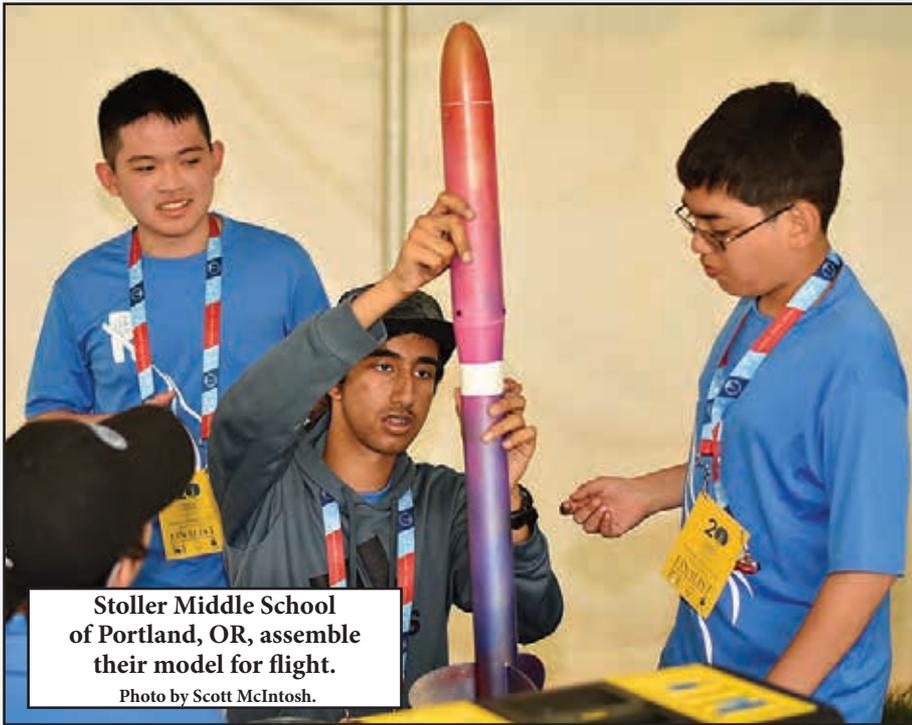
East Fairmont (WV) Middle School.

Photo by Neil Michels.

The TARC 2022 Finals

TARC Finals weekend began on Friday May 13 with an opportunity for student teams to either take a tour of Aurora Flight Sciences—an aerospace company founded by long-time NAR leader Dr. John Langford that is now part of Boeing—or tour the aircraft and spacecraft collection at the Udvar Hazy Center of the Smithsonian National Air and Space Museum. Both of these activities were subscribed to full capacity and made for a memorable day for the teams. In previous years teams had also had an opportunity to visit and display their rockets at the U.S. Capitol then meet individually with their members of Congress, but the extremely tight new security protocols that are now in place at the Capitol unfortunately made this impossible in 2022.

Meanwhile on Friday 40 NAR volunteers were working hard all day out at the flying site under the leadership of Adam Martin setting up the equipment, banners, and signs needed to support the next day's flying. On Saturday an additional 75 NAR volunteers joined these 40, providing the full range crew that ran the Finals. These NAR volunteers travel at their own expense and work from dawn to dark without fly-



Stoller Middle School of Portland, OR, assemble their model for flight.
Photo by Scott McIntosh.

this founding generation of TARC staff finally has to step back.

At the Finals each student team is pre-assigned days in advance a specific launch pad and a “launch window” time slot within which they must make their first flight. There were two NAR launch ranges, one with 24 pads and the other with 18, that loaded and launched these flights sequentially in 45 minute “rounds.” One range was run by former NAR Presidents Ted Cochran and Mark Bundick and the other by Estes Industries owner John Langford and Tom Lyon. First competition flight lift-off was at 8:30 AM on Saturday May 14, and over the next four hours all the teams made their first flights in five rounds. 90 of the 100 teams had fully qualified first flights.

The Finals teams were challenged to display their understanding of rocket science by being given slightly different flight performance goals than the ones they flew against in the qualification flights that got

ing any rockets of their own, just to support the students. Each year at the Friday evening assembly where we gather all the NAR range crew for training, then gather all the TARC teams to do their registration and brief the next day’s flight weather and range procedures, we recognize those NAR volunteers who are on the NAR Finals team for the 10th time. This year 4 more joined this circle; in fact 52 of the 115 NAR volunteers this year were doing it for the 10th or greater time. 19 were doing it for the 17th or 18th time. This depth of NAR experience and dedication is what makes the TARC Finals run so smoothly, and after a three-year pause since the last in-person Finals this institutional memory was critical to the success of the 2022 Finals. Going forward, the NAR needs more new people to volunteer for Finals range crew in order to provide the long-term continuity when



Picking the right egg.
Photo by Scott McIntosh.

them to the Finals. Based on a coin toss at the Friday evening team briefing session, the first-round flight goal was 25 feet lower in altitude (810 feet) and one second lower in duration than the goals in qualification flights. The 42 top-performing teams from the first rounds of flights to this goal were then given the opportunity to make a second flight to a goal that was 50 feet higher in altitude and two seconds more in duration than the first flight. Top places were then decided based on the sum of the two flight scores, with the lowest numerical score winning (like in golf!). The weather was gray and misty most of the day, with an occasional rain shower, but it was good

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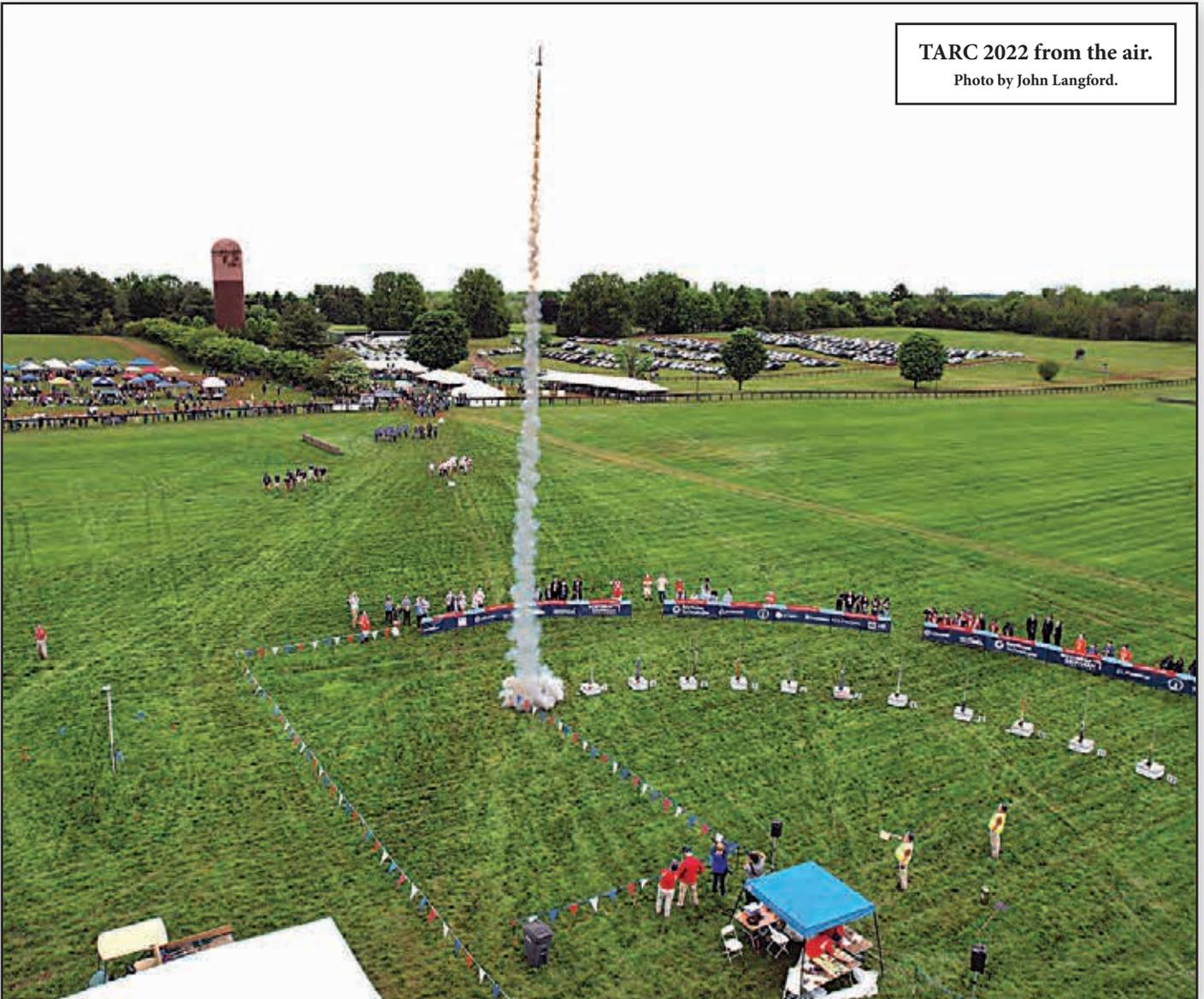
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TARC 2022 from the air.

Photo by John Langford.



TARC 2022 Special Competition Awards

| Competition Category | Team Name | City | State | Prize |
|--|--|---------------|-------|---------|
| Presentation Competition | | | | |
| 1st Place | Cary Academy | Cary | NC | \$3,000 |
| 2nd Place | Northville High School | Northville | MI | \$1,500 |
| Marketing Competition | | | | |
| 1st Place | SATO Academy | Long Beach | CA | \$3,000 |
| 2nd Place | Christian Home Educators of Cincinnati | Morrow | OH | \$1,500 |
| Best Dressed Team | STARBASE Louisiana 2.0 - Team 1 | Barksdale AFB | LA | \$500 |
| Rocket Building Competition | | | | |
| Best Craftsmanship | Webster City High School | Webster City | IA | \$500 |
| Most Creative Design | CAP Brackett Composite Squadron 64 | La Verne | CA | \$500 |
| Best TARC Rocket Craftsmanship | Jamesburg Presbyterian Church | Jamesburg | NJ | \$500 |
| Boeing Team Spirit Award | Stone Memorial High School | Crossville | TN | \$500 |
| Most Innovative Approach to Mission | STARBASE Los Alamitos | Los Alamitos | CA | \$500 |

**John Langford RSO's
a launch.**

Photo by Glenn Feveryear.



enough to fly—and at least there was no wind or thermal activity to disrupt flight durations!

When the 42 second TARC competition flights were flown and scored, the winner of TARC 2022 and \$20,000 in prize money, plus \$1000 for their school, was one of the two teams from Newport High School from Bellevue, Washington, with a two-flight score of 13. Second place (and \$15,000) went to the other Finals team from that same high school, with a score of 14! Although the program has had two teams from the same school make the top 10 before, this is the first time that TARC has had a one-two finish by teams from the same school. These two teams did not use complex onboard control systems, their models were pure free-fliers. They just did lots of test-flying with data-taking and learned how to adjust things to get the exact performance that they wanted.

The young people who come to the TARC Finals are polite, determined, and always demonstrate great sportsmanship. This year one team stood out from all the rest in the program's history in sportsmanship. The team from American Youth Soccer Association in Granada Hills, Calif., was called to the stage at the awards ceremony to receive the 8th place trophy and prize money and they immediately declined, saying that there must be a mistake, that they did not actually earn the score that was announced. After some investigation it turned out that they were correct; we had made a data-entry error in the score recording system, and they were actually in 28th place, with no prize money. We recognized them well after the fact with the first-ever "Outstanding Sportsmanship" award and a cash prize, but this is just an example of how great the young people are who are part of TARC.

The top ten finishing teams split a significant fraction of the overall program prize pool of \$100,000. This pool also covered cash prizes for several other types of

National Events Needs Your Help!



Beginning in 2023, National Events is planning two National Sport Launch (NSL) events. However, help is needed finding suitable HPR launch sites in the east half of the country. Please email Nationalevents@NAR.org to express your section's interest in hosting an NSL or with any leads to possible hosts.

achievement, listed in the results box. In addition to these cash prizes, the 1st place TARC team got a free trip to London, England; more about this later in the article. Next year the winning team will get a trip to Paris, France.

The top 25 teams were also awarded the opportunity by NASA to participate in next year's NASA Student Launch program, a program (supported by the NAR) that gives university teams and these select TARC teams a rigorous year-long design-build-fly challenge involving a large high power rocket and a complex payload.

Other Finals Activities

In between the first set of 100 flights and the set of 42 second flights there was, as always, a pause while first flight results were tabulated and the teams that earned a second flight got their rockets ready and checked in. This pause, and another pause later in the day after the last TARC flights and before the award ceremony, provided an opportunity for the NAR to fly some large high-power rockets to demonstrate another aspect of the hobby to the students and spectators. Long-time NAR high-power flier Ben Russell runs this demonstration, and this year he lined up a dozen great



Madison (WI) West High School at the Pad.

Photo by Neil Michels.

flights including: a NASA Student Launch program high-power rocket flown by the team that finished second in TARC 2021 and earned the opportunity to move on to this NASA program this year; several scale models including a big Saturn V flown by Tim Bookwalter; and a rocket with a deployable instrument payload flown by a team in the CANSAT student program that is run by NAR member and Navy space

systems engineer Ivan Galysh.

The most memorable high-power demonstration flight, however, was a "tribute rocket" flown to honor the late Joe Egan. Joe was the brilliant lawyer, MIT nuclear engineer, and enthusiastic rocketeer who led the legal battle that NAR and TRA had to wage between 2000 and 2009 in federal court against the U.S. Bureau of Alcohol, Tobacco, Firearms, and Explosives (BAT-

TARC 2022 Flight Results

| Place | Team Name | City | State | Rocket Mass* | Rocket Length* | Motor | Flight 1 Score | Flight 2 Score | Total Score | Student Prize | Award to School |
|---------------------|--|------------------|-------|--------------|----------------|-------|----------------|----------------|-------------|---------------|-----------------|
| 1 | Newport High School - Team 2 | Bellevue | WA | 611 | 80 | F70-7 | 2.00 | 11.00 | 13.00 | \$20,000 | \$1,000 |
| 2 | Newport High School - Team 1 | Bellevue | WA | 610 | 91 | F70-7 | 2.00 | 12.00 | 14.00 | \$15,000 | \$1,000 |
| 3 | All Saints Episcopal School | Haslet | TX | 528 | 92 | F32-6 | 6.12 | 11.00 | 17.12 | \$12,500 | \$1,000 |
| 4 | Spring Grove Area Intermediate School Team 2 | Spring Grove | PA | 619 | 88 | F59-6 | 13.00 | 6.80 | 19.80 | \$10,000 | \$1,000 |
| 5 | Coleman High School | Coleman | TX | 650 | 75 | F79-7 | 10.12 | 10.00 | 20.12 | \$7,500 | \$1,000 |
| 6 | Creekview High School - Team 3 | Canton | GA | 647 | 76 | F59-7 | 17.20 | 7.00 | 24.20 | \$3,500 | \$500 |
| 7 | Camas High School | Camas | WA | 622 | 89 | F51-5 | 9.00 | 16.16 | 25.16 | \$2,500 | \$500 |
| 8 | Young Engineers in Action | Hawaiian Gardens | CA | 577 | 73 | F79-5 | 19.64 | 10.00 | 29.64 | \$2,500 | \$500 |
| 9 | Thomas Jefferson High School - Team 9 | Alexandria | VA | 468 | 84 | F39-9 | 7.00 | 26.80 | 33.80 | \$2,500 | \$500 |
| 10 | Tharptown High School | Russellville | AL | 488 | 69 | F39-6 | 1.00 | 34.12 | 35.12 | \$1,500 | \$500 |
| Best Rookie: | | | | | | | | | | | |
| | Geffen Academy at UCLA | Los Angeles | CA | 647 | 92 | F67-6 | 17.88 | 26.00 | 43.88 | \$2,500 | \$0 |

*First flight mass in grams, length in cm

FE) when this agency tried to impose very onerous and unnecessary regulations on the sale, storage, and use of high-power hobby rocket motors. This nine-year legal battle finally led to a complete defeat of BATFE in 2009 for being (in the federal judge's words) "arbitrary and capricious" in their regulatory actions, and our victory restored the freedom to fly that we enjoy today. Joe Egan's passion for the hobby and legal skills made this victory possible, but unfortunately he passed away from cancer in 2008 at age 54 shortly before the final legal judgement was released.

When Joe Egan died he left behind a collection of large high-power rocket parts



Thomas Jefferson High School returns with their rocket in hand.

Photo by Avis Cawley.

that were going to be his next personal project to build and fly. His daughter Jenny kept them for 13 years, and late in 2021 got in contact with the NAR and asked if we would complete this rocket and fly it in Joe's memory and honor. Of course we said yes and picked up the parts—only to find that there were a "few" things missing before they could be made into a flightworthy rocket. We put the word out looking for help and got whatever was needed volunteered, immediately, by people who knew Joe and what he did for us all. Rick Boyette contributed and fiberglassed an 11.4-inch main body, John Lyngdal had plywood fins and rings laser-cut and added a 10-foot parachute, Mark Hayes at Stickershock made some very appropriate commemorative stickers, Trip Barber added recovery electronics and built the model, then Nathan Tocus spent 35 hours putting a spectacular finish and paint job on the beast.

When this tribute flew at the mid-day high-power demonstration at the TARC Finals, former NAR and TRA Presidents Mark Bundick and Ken Good, who had worked closely with Joe for most of the le-

gal case, Joe's legal partner in our case Marty Malsch, and Joe's family all gathered to watch. We read a moving tribute to Joe on the public address system and Jenny Egan pressed the launch button. The 27-pound rocket's majestic flight on a J800 in front of the huge TARC crowd was a fitting tribute to a man who saved our hobby.

There was more to the "Finals" competition in TARC 2022 than just the flying at Great Meadow on May 14. There were two other online events held just before the Finals that provided an opportunity to learn and win for teams, independently of whether they attended the flying Finals: the Presentation Competition and the Marketing Competition. Both offered cash prizes of \$3000 for the winners and \$1500 for second place.

The Presentation Competition (described on the TARC website at: rocketcontest.org/presentation-competition) challenged teams to explain the technical details of their design-build-fly process for TARC in a maximum of 20 slides with speaker notes. The top five based on preliminary judging against a set



Tim Bookwalter's Saturn V demo flight at liftoff.

Photo by Scott McIntosh.

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Outstanding Teacher:

**Dr. Maqsuda Afroz,
Cesar Chavez High
School, Houston, Texas**

Dr. Afroz has been understanding and has motivated us to keep pushing forward. Coming back from virtual learning has been a tremendous change for us but despite this, Dr. Afroz has been willing to be by our sides through every obstacle the entire year. Her willingness to assist both students and staff members is recognized by everyone in the school. The late afternoons spent working after school and countless Saturday morning trips to launch sites are only a small testament to some of the ways in which Dr. Afroz has gone above and beyond to support our team during the American Rocketry Challenge.

Dr. Afroz was able to create a safe and fun environment within the club where we always enjoyed being there and trying to fix our rockets. Throughout our participation in this challenge, Dr. Afroz has actively encouraged us to try our best in creating our rockets with precision and utmost craftsmanship. By teaching us that, in flight, any discrepancy could mean failure for our rocket, we were influenced to continuously improve our designs. This has instilled in our team the value of perseverance and commitment in reaching our goals.

of specific criteria were then invited to do a live (online) 15-minute presentation followed by a 10-minute question and answer session with an NAR judging panel led by former NAR President Ted Cochran in early May, before the Finals. This replaced the shorter and less demanding in-person presentations that only Finals teams could be part of in 2019 and prior. This online format for presentations gave teams the opportunity to explain in far greater

technical detail how they approached the TARC challenge, and they were impressive. The winning entry of the 19 submitted was from Cary Academy in Cary, N.C. They demonstrated a truly remarkable level of understanding and application of aerospace engineering techniques, using a computational fluid dynamics program in addition to RockSim to refine their design, then developing a computer-based electronic control system to both drive servos



Showing the Eggs and Altimeter at Returns.
Photo by Glenn Feveryear.



**Vanuaird School
Colorado Springs, CO.**
Photo by David Bellhorn.



**Victory Christian High School
(Charlotte, NC) prepping.**

Photo by Alan Williams.

to release their parachute in order to control duration, and to control altitude with variable-drag servo-driven flaps. Their presentation is posted at the bottom of the NAR website TARC page.

The Marketing Competition (described

on the TARC website at: rocketcontest.org/marketing-competition) challenged teams to create two-minute promotional videos to show their work and to help get others excited about rocketry, STEM, and aerospace. These were evaluated by a panel of

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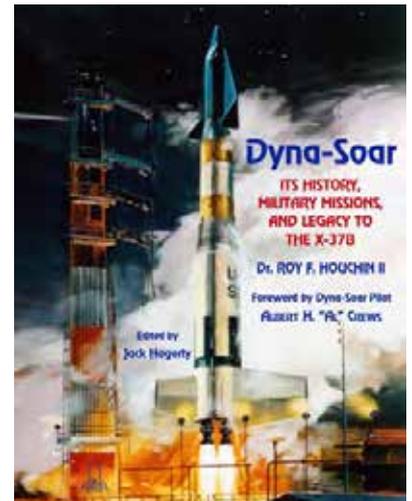
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aerospace industry professionals on the basis of strength of message, creativity, and video editing and technical skills, with bonus points for outreach efforts. The winning entry was “Firebreather Rocketry” team’s “Challenge the Skies” video from SATO Academy in Long Beach, Calif. You can watch their inspiring video on YouTube at: <https://youtu.be/vdNMCeNONqg>.

All teams at awards ceremony in Farnborough.

Photo by Trip Barber.



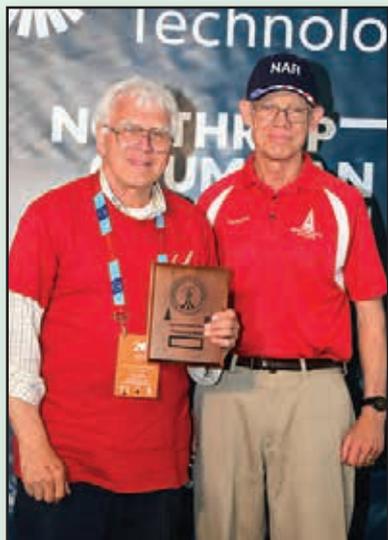
The International Rocketry Challenge

The TARC 2022 winners from Newport High School had to start planning their international travel with AIA’s assistance as soon as they walked off the stage at the TARC Finals, because in mid-July they were going to be headed off to London as guests of Raytheon Technologies, to fly in the International Rocketry Challenge at the Farnborough International Air Show, the world’s biggest air show, against the teams that won national TARC-like competitions in the UK, France, and Japan. This international travel and rocket-flying opportunity has been part of the grand prize for TARC winners for the last fifteen years (although not the last two, due to COVID). NAR President John Hochheimer runs this international part of the TARC rocketry program, and has since it

began. Getting rocket motors and launch equipment shipped in, coordinating with airshow authorities for permission to fly close to big expensive airplanes, and finding appropriately-sized eggs in a foreign city are all a challenge, but John has figured it out. The kids don’t see all this backstage work; for them it is a magical once-in-a-lifetime experience. Not only do they get to fly their rocket in front of the whole world aerospace professional community, they also get to have meals there with the U.S. military pilots who are flying at the show and tour their aircraft, and after they have done their rocket flying they get to tour a really interesting foreign city.

The international competitors this year were:

- Tonbridge School in the UK (founded in 1600!), three 11th grade boys who were the best of the 102 teams that had entered UKAYROC
- Friends School in Japan, three 11th grade girls who were the best of the five teams that competed in Japan



Outstanding Mentor:

**Bob Ekman,
Explorer Post 1010,
Rockville, Maryland**

Bob Ekman has organized and led as a volunteer a regional program called Explorer Post 1010, sponsored by the Rockville Science Center, that involves 40 students a year from multiple high schools in the region who share an interest in advanced STEM programs such as robotics, unmanned aerial systems, and rockets. His teams in this program have been part of TARC since 2005, and he has brought 17 of them to the national Finals over those 17 years, including one that took 2nd place last year. Bob had teams in both TARC and the NASA Student Launch programs this year.

The American Rocketry Challenge (TARC) for 2023

- Altitude goal 850 feet—but it will be either 825 feet or 875 feet for the first flight at the Finals
- Duration goal 42-45 seconds for the section with egg payload
- Payload one Grade A Large egg of 55-61 grams, any orientation
- No specific requirements for body tube diameter or rocket shape but must be able to contain an egg of up to 45mm diameter
- Single stage, must recover in two separate sections (one with egg and altimeter, one with motor), each by parachute
- Same minimum length of 650mm, maximum liftoff mass of 650 grams, and total impulse limit of 80 N-sec as in previous years

- College Jeanne d'Arc in France, four 8th grade girls who were the best of the 32 teams that competed in France
- Newport High School, Bellevue, Wash., a team of ten students (eight boys, two girls) made up of one 12th grader, seven 11th graders, and two 9th graders.

The international program score is the combination of rank in a presentation competition (1/3 of the score) and rank in the flying competition (2/3 of the score). Each team had to do a ten-minute presentation (in English) on Thursday, July 21, before a panel of three international aerospace judges who then questioned them for ten minutes. The English requirement is stressful for the teams from France and Japan, but both did a very good job. The U.S. team did a brilliant presentation and was first in this by a wide margin—but the



U.S. team launch crew at Farnborough.
Photos by Trip Barber.



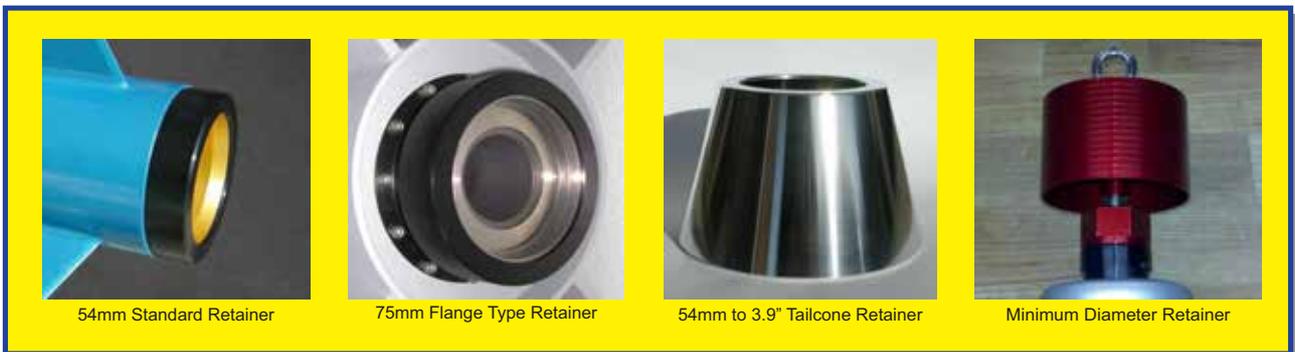
Rockets on the pads.

Japanese girls were second. It was all going to come down to the flying the next day.

Flying day was Friday, July 22. This was the last day of the air show and the only day that it is open to public spectators; it is primarily an industrial trade show where multi-billion dollar aircraft sales are made. There was quite a crowd to watch as three students from each team zoomed out to the center of the airfield in a caravan of airfield security vehicles and the whole airfield was shut down while they quickly set up and flew. The weather was perfect (for England, i.e. it was not raining but it was cloudy and breezy) and all the flights worked perfectly. The international competition is one flight

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The Japanese team won the IRC 2022 competition.
Photo by Trip Barber.

ners were the girls from Japan, who placed first in flight score and second in presentation score; Newport High was 2nd in flight score when their normal motor used in their dozens of test flights decided to give them 60 feet less altitude performance than usual, giving them second place overall. This is the first time in the program's history that the Japanese team has won, and their whole delegation was both a bit surprised and truly thrilled.

The Road Ahead

At each year's Finals the challenge for the next year's TARC program is announced at the end of the award ceremony. The TARC 2023 challenge is described in the accompanying text box; the detailed rules and registration materials are available on the event website (rocketcontest.org) and registration opened earlier than ever before, on May 18, 2022. It will remain open until December 1, 2022.

Many of the top Finals finishers were teams from schools with long-standing successful TARC programs, who had learned what it took to win. There was no magic in their success, it was based on hard work that started early, included lots of practice flying (25 flights or more) with rigorous data-taking to establish relationships between their rocket's characteristics, the weather, the resulting flight performance, and a real understanding of these relationships. Their teachers and mentors have taught the students how to succeed and the students have added the dedication and hard work to apply these lessons. Any team—even first-year teams—can do this if they go into TARC understanding that it is not as easy as it looks, if they start early in the program year, and if they have supportive adults behind them (teachers and/or parents) to help with logistics and an NAR mentor who can help them get their basic rocket skills right. We need more NAR mentor volunteers who are willing to go work with TARC teams in their area. If you are interested in doing this, please contact Trip Barber at ahbarber@alum.mit.edu.

TARC continues to succeed each year because of the dedication of NAR volunteers nationwide who serve as local mentor advisors for student teams; who volunteer as official flight observers for teams' qualification flights; who run NAR section ranges supporting teams' flying; and who come to the Finals to be part of the NAR range crew. Thank you to all those in the NAR who support the premier program for sustaining our future.

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only and the rockets are collected, eggs inspected, and altimeters read by the judges—the students rush off the airfield and do not know how they did until the award ceremony later that day.

The international award ceremony was held on the main auditorium stage of the Air Show, with European Space Agency astronaut Matthias Maurer (recently returned from six months on the ISS), AIA CEO Eric Fanning, and other VIPs there to congratulate the winners. This year's win-

