WATER-ROCKET VEHICLE COMPETITION

While promoting Space Propulsion Awareness, the Water Rocket Competition serves to familiarize students with the basic principles of rocketry, design engineering, and manufacturing engineering. Students will design and manufacture a water rocket using a 2-Liter bottle as the pressure vessel. The rocket must be capable of launching from the SECME Water Rocket Launcher given specific launch criteria. Additionally, each team will develop a patch design, technical report, and technical drawing. The team's complete success will not solely be judged on rocket performance, but the combined effort of the team. For resources on how to build a water rocket visit www.secme.com

The Mission: *The mission is to design a Water Rocket Vehicle capable of staying aloft for the longest amount of time (measured in seconds).*

MISSION SUCCESS and Safe Flying! *** Remember you will never be a winner unless you try and if you try your best, you have already made it to the bullseye :-) ***

Design and Contest Rules (ALL):

1. Each design team must consist of three (3) students.
2. **Technical Paper (Middle and High School ONLY), Patch Design, and Completed Entry Form must be submitted to the District Office no later than Wednesday, December 14, 2016**
3. At check-in the day prior to the competition the following must be submitted:
   - ✓ **Pre -registered completed entry form**
   - ✓ **Technical Drawing (Middle and High School ONLY)**
   - ✓ **Operating Rocket (meeting specifications)**

****Note: At this time each entry must pass a visual inspection and height requirement in order to be eligible to compete. Entries that fail inspection will be given ONE opportunity to make modifications to pass inspection, prior to the beginning of the water rocket launching competition.**

An overall winner will be judged, upon the following criteria (based on 100%)

MIDDLE AND HIGH SCHOOLS

Hang time of Rocket - 45%	**Technical Report - 25%**
Patch Design - 15%	**Technical Drawing - 15%**

ELEMENTARY SCHOOLS (Based on 110 Points

Hang time of Rocket - 70%	**Patch Design - 30%**	**Written Report – Bonus - 10%**

Final Hang time Score Calculation

$$Final\ Score = \left(\frac{team\ hangtime}{\max hangtime}\right) \times 100$$

Important Definitions:

HANG TIME …is defined as the time from when the rocket leaves the launch pad until the time it reaches the ground or strikes an object.
This measurement will be taken using a stopwatch by at two or three qualified judges; the average of the judges' times will be used as the final **"hang time".**

Max hang time… maximum hang time recorded during the competition

The objective of the contest is for each team to launch a rocket propelled by water and air and for it to stay aloft for the maximum amount of time (measured in seconds). The launch angle, which can be adjusted from approximately **90 degrees (90º)**, will be kept the SAME for all rockets launching during a particular competition. Each rocket will be launched using **12 ounces** of water and at **70 psi** of air pressure.

Middle/High: The maximum final Middle/High school Water Rocketry score should between 0-100.

- Maximum hang time score: (1) x 100 = 100 x 45% = 45
- Max patch design score: 100 x 15% = 15
- Max technical report score: 100 x 25% = 25
- Max technical drawing score: 100 x 15% = 15

Maximum final score for four parts: 45 + 15 + 25+ 15 = 100 (final scores should range from 0-100).
Final scores more than 100 will be disregarded.

Elementary: The maximum final elementary Water Rocketry score should between 0-110.

- Maximum hang time score: (1) x 100 = 100 x 70% = 70
- Maximum patch design score: 100 x 30% = 30
- Maximum written report score: 100 x 10% = 10

Maximum final elementary score must range from 0-110).

Construction and Operation Requirements (ALL):

1. The pressure vessel must be ONE (1) clear plastic, 2-liter bottle (i.e., **NO** colored/tinted bottles allowed for the pressure vessel), See Diagram 1.
2. Water and air pressure will be the sole source of propellant.
3. **Do not use the following materials to construct you rocket…!!!**
   a. **Metal**
   b. **Glass**
   c. **Hard plastics**
   d. **Spikes**
   e. **Antennas of any kind**
   f. **Rocks**

These materials are dangerous and could cause harm to the operator and those present in the presence of the water rocket launch.

NOTE: * * * USE OF THESE MATERIALS WILL AUTOMATICALLY DISQUALIFY THE TEAM FROM THE COMPETITION * * *.

4. On the bottom of the rocket***, leave 7.5 cm from the throat of the exit plane clear of any coverings*** (paint, markings, drawings, etc.), see Diagram 1.
5. The maximum total height of the rocket is **76.0 cm**. See Diagram 1.
6. The nose-cone tip must have a minimum radius of **1.5 cm.** See Diagram 2.
7. The fins may extend to the throat exit plane. See Diagram 2.
   Note: ****No forward-swept types of fins are allowed to be used on the rocket.*
8. The maximum fin-width distance from the bottle is 10.0 cm (or 16.5 cm from the center of the bottle axis), see Diagram 3.
9. The use of parachutes is NOT allowed.

PATCH DESIGN CRITERIA (ALL):

What is a Patch?

A Patch is a creative display that reflects the dedication and mission of the team. This symbolic picture must comply with the following rules:

1. Each entry is to be prepared and submitted by the SECME School Teams who will be participating in the Water Rocket Design Competition.
2. Patch designs must be submitted on **13" X 13" poster board**.
3. All entries must contain the team name and follow the theme of this year's SECME competition.
4. A short (less than 1-page) explanation of the symbols of the patch must be included on the back of the patch **(Refer to example on next page)**
5. All teams participating in the Water Rocket Competition must be prepared to display their patch prior to the launch of their rocket.
6. Patches must be **hand-made** original work.
7. Only Ink pens, pencils, markers, or paint may be used.

NOTE: Any Patch Design deemed inappropriate will be pulled from the competition.

THE PATCH DESIGN WILL BE JUDGED ON:

I. PAPER SIZE REQUIREMENT (0 – 10 points): Correct patch size is 13"x13"
II. SECME THEME (0 – 15 points): Incorporation of SECME's competition theme (and team name)
III. APPEARANCE (0 – 20 points): Attractiveness and neatness of the patch
IV. CREATIVITY (0 – 25 points) Uniqueness of the information depicted
V. EXPLANATION OF PATCH (0 – 30 points) Description which explains each part or idea of the patch (on the back of the patch)

Total: (0 – 100 points)

EXAMPLE PATCH DESIGN

Explanation of Patch

The propelled rocket represents the school system, supported by the educators and students, following a path towards excellence. The radiant five 8-point stars symbolize the enrichment of Science, Engineering, Communication, and Mathematics, whereas, the seven 4-point stars represent for the seven Universities that founded SECME. The three distinct contrails steaming behind the rocket, symbolize the support offered through SECME, Universities, and Industry partners. The ring before the rocket depicts the student's path through the SECME program, returning full circle to support the efforts of the program. As we have entered the new millennium, the sun over the horizon symbolizes of the induction of the new Water Rocket Design Competition into the SECME Programs. Accuracy, the focus of the contest, is represented by the target created by the outer ring, deep space, and the earth. The border is supported on the left and right by symbols, respectively, for water and compressed air, which are the fluids used to propel the rockets.

HOW TO BUILD THE WATER ROCKET

Note: These build instructions are basic suggestions and is **NOT** the only (or necessarily the best) way to design you rocket

Materials and Tools Needed:

1. Pressure Vessel (**Clear** 2-Liter Bottle)
   ****Note:* Be certain that your clear, 2-liter bottle is free of scratches, nicks, dents, and discoloration.**

2. Adhesive**,**Caution: Hot Glue Guns weaken walls of Pressure Vessel.**

3. Foam mounting tape (approximately 1/16 thick, 2-sided adhesive)

4. Carpet tape (thin 2-sided adhesive)

5. Clear packing tape is **HIGHLY RECOMMENDED FOR CONSTRUCTING ROCKETS**

6. Use adhesive to bond fins, nose cone, and other allowed materials onto the water rocket

7. Cutting utensils (Scissors, Hacksaw Blade, Utility Knife, etc.)

8. Markers, spray paint, stickers, etc. for decoration of the rocket (No water color paint).

9. Safety First: Children should be supervised **at all times** while constructing their Water Rockets

10. For Fin Construction:
    Balsa and Bass Wood, Plastic, Foam Board, 1/4” to 1/2” thick Styrofoam, Plastic Plates, and/or PE (2L) Bottle Material

SECME ENGINEERING DESIGN COMPETITION GUIDELINES:
WATER ROCKETRY WRITTEN REPORT REQUIREMENTS

ELEMENTARY SCHOOL DIVISION

As a part of the Design Competition, the team is required to write a Written Report describing the design, construction, and operation of the Water Rocketry. The main body of the report should be a maximum of 1-2 pages. **YOUR WRITTEN REPORT SHOULD BE A REFLECTION OF THIS YEAR'S EFFORTS BY YOUR TEAM. EVIDENCE OF PLAGLARISM OR RE-SUBMISSION OF PREVIOUS YEARS' REPORTS WILL RESULT IN DEDUCTION OF POINTS OR ZERO SCORE.**

STRUCTURE (0 - 25 pts):

1. Cover page (0 - 5 pts)
    a. Title of the Written Report (SECME Engineering Design Competition: Water Rocketry Written Report)
    b. Competition Division (Elementary School Division)
    c. Team Name
    d. Each individual team member's name and grade
    e. Team's school name & address
    f. School System/District name
    g. School Coordinator's name
    h. Date (date of competition)

2. Double-spaced text (0 - 5 pts)
3. 8½" × 11" white paper with one-inch borders at the top, bottom, and on each side (0 - 5 pts)
4. 12 pt. standard font, computer typed (0 - 5 pts)
5. Report is neat and thorough; pages are numbered and in order (0 - 5 pts)

CONTENT (0 - 50 pts):

1. Writing includes an original, age-appropriate introduction (0 - 10 pts)
2. Writing includes ideas that are fully developed, fully supported, and describe the design, construction and operation of the car and age-appropriate (0 - 10 pts)
3. Writing is logical and coherent as a whole and age-appropriate (0 - 15 pts)
4. Writing includes an original, age-appropriate close (0 - 15 pts)

MECHANICS, SPELLING & GRAMMAR (0 - 25 pts):

Written Report reflects the team's pride by being submitted as error-free as possible

1. Writing is free of (age-appropriate) punctuation errors (0 - 5 pts)
2. Writing is free of (age-appropriate) spelling errors (0 - 8 pts)
3. Writing is free of (age-appropriate) sentence errors (misplaced sentence parts, subject/verb agreement, sentence fragments, run-ons, etc.) (0 - 12 pts)

PLEASE NOTE: Late written reports **will not** be accepted. **Late** written reports will receive a **zero score**.

ACCEPTABLE FONTS:

Arial	This is an example of 12 point Arial font
Calibri	This is an example of 12 point Calibri font
Courier New	This is an example of 12 point Courier New font
Times New Roman	This is an example of 12 point Times New Roman font

SECME ENGINEERING DESIGN COMPETITION:
WATER ROCKETRY WRITTEN REPORT EVALUATION
Elementary School Division

Team Name			
School Name			
District		**State**	
Student Name #1		**Grade**	
Student Name #2		**Grade**	
Student Name #3		**Grade**	
Judge's Name		**Date**	

STRUCTURE (0 – 25 pts): Points

- ☐ Cover Page (0 – 5 pts) _____/5
- ☐ 8 ½" x 11" white paper w/ 1" margins (0 – 5 pts) _____/5
- ☐ 12 pt./Standard Font/Computer Typed (0 – 5 pts) _____/5
- ☐ Double-spaced Text (0 – 5 pts) _____/5
- ☐ Report is neat and thorough; pages are numbered and in order (0 – 5 pts) _____/5

STRUCTURE TOTAL (*max 25 pts*) _____/25

CONTENT (0 – 50 pts):

- ☐ Writing includes an original, age-appropriate introduction (0 – 10 pts) _____/10
- ☐ Writing includes ideas that are fully developed, supported and describe the design, construction and operation of the car (0 – 10 pts) _____/10
- ☐ Writing is logical and coherent as a whole (0 – 15 pts) _____/15
- ☐ Writing includes an original, age-appropriate close (0 – 15 pts) _____/15

CONTENT TOTAL (*max 50 pts*) _____/50

MECHANICS, SPELLING & GRAMMAR (0 – 25 pts):

- ☐ Writing is free of punctuation errors (age-appropriate) (0 – 5 pts) _____/5
- ☐ Writing is free of spelling errors (age-appropriate) (0 – 8 pts) _____/8
- ☐ Writing has correct subject/verb agreement and free of sentence errors, misplaced sentence parts, sentence fragments, run-ons, etc. (age-appropriate) (0 – 12 pts) _____/12

MECHANICS, SPELLING & GRAMMAR TOTAL (*max 25 pts*) _____/25

OVERALL TOTAL (*max 100 pts*) _____/100

Judge's Notes: