PROJECT Nº 5

Baking Soda & Vinegar Rocket

AUTHORIZED AMA
STE(A)M PROGRAM

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INFO FOR PARENTS:

For this project, we recommend parents assume an active role in the assembly, construction, and launch of the Baking Soda & Vinegar (BSV) Rocket, because of the complexity of the instructions.

GOALS & OBJECTIVES

***Question:** What will children know and be able to do as a result of this project?*

Answer: Follow written and spoken instructions.

ENGAGE WITH BOTH FINE & GROSS MOTOR SKILLS

Fine Motor Skills: Children will be able to refine their use of scissors, simple building methods, taking measurements, etc. through the construction of the BSV Rocket in addition to the homemade sextant.

Gross Motor Skills: Children will be able to refine their ability to estimate height and distance by observing the "flight path" of the BSV Rocket.

UTILIZE MATH SKILLS

Through the construction and use of the homemade sextant, children will be able to accurately measure the height of the BSV Rocket's launch through a simple mathematical formula.

EXHIBIT CREATIVITY THROUGH ARTISTIC EXPRESSION

Children can have the opportunity to decorate their BSV Rocket through various media. If paint, craft paper, etc. are available, encourage the child to utilize these materials to express their creativity. Note that additional decorations will influence the BSV Rocket's ability to fly.

DETERMINE CAUSE & EFFECT

Children will have the opportunity to better understand how much baking soda and vinegar they use relates to the speed, height, and distance of the BSV Rocket's ascent.

***Question:** What previous knowledge do children need to have to successfully complete this project?*

Answer: It would be helpful, but not required, if the child:

1. Has some prior exposure to arts and crafts of some kind
2. Has some prior knowledge of rockets
3. Has some prior understanding of space travel.

***Question:** What are some guiding questions for this project?*

Answer: Guiding questions will help your child think creatively as they pursue this activity and encourage them to explore the topic further in the future.

1. Who was the first person to go to space?
2. What do you think space is like?
3. What do you think will happen if you add more baking soda? Less?
4. How high do you think your rocket can fly?
5. What would you change about the design of your rocket to make it fly higher?

SUPPLIES

INCLUDED:

- 3 PENCILS
- CORK
- PROTRACTOR
- LARGE STRAW
- WASHER
- STRING
- TAPE
- ROCKET FIN X3
- FLIGHT LOG

NEEDED:

- PLASTIC BOTTLE
- VINEGAR
- FUNNEL
- BAKING SODA
- PAPER TOWELS/ NAPKINS/ TISSUES
- MEASURING SPOONS & CUPS
- TAPE MEASURE
- PEN OR PENCIL
- CALCULATOR
- LAUNCHPAD, A 3 X 3 FOOT FLAT SURFACE

HOW TO BUILD YOUR HOMEMADE SEXTANT

1. Distribute the supplies for the homemade sextant: protractor, straw, tape, string, and washers.
2. Find the center of the flat side of the protractor and tie the string there, taping it to keep it secure. Tie the washer onto the other end of the string.
3. Tape the straw along the flat edge of the protractor so you can look through it. Voila, a homemade sextant!

HOW TO BUILD YOUR BSV ROCKET

1. Using tape, affix the pencils an equal distance apart around the soda bottle, creating a tripod. Make sure the bottle is upside down, with the mouth of the bottle facing the ground when you attach the tripod.
2. Attach the balsa fins to bottom of the pencils ensuring they are perfectly vertical when doing so. *(Optional: Paint the fins a day or two ahead of time using waterproof paint, such as acrylic.)*

LAUNCH PREP

1. Unfold a paper napkin, paper towel, or paper facial tissue. This will become the powder fuel packet (PFP).
2. Cut your PFP into 4 x4 inch squares.
3. Measure out baking soda and place in the center of each PFP. Tightly twist the PFP closed around the baking soda. We recommend starting with 1 tablespoon of baking soda per packet, but you should experiment with different amounts. Document these amounts by writing them down on your Flight Log. Consider numbering the packets to help keep track of them. Use as much or as little baking soda as you like, but remember that your

packet must be small enough to fit through the mouth of the bottle.

4. Gather all of your supplies: BSV Rocket, homemade sextant, Powder Fuel Packets, measuring cups, funnel, cork, and vinegar.
5. Go outside and choose a safe distance from any buildings, trees, or power lines to establish your launch pad. Measure a precise distance from the launch pad—10-15 feet—and mark this spot.

INITIATE LAUNCH

>>>WEAR EYE PROTECTION<<<

Measure out a precise amount of vinegar into the measuring cup and write the amount down on your chart. Pour the vinegar into the rocket. We recommend starting with 1 cup. Document the amount used by writing it down in your Flight Log.

Push a baking soda packet into the bottle, then quickly seal the bottle with the cork, turn it over, and run to the spot you marked earlier. The amount of time it takes for the chemical reaction to occur depends on how thick the paper towel/napkin is.

When the rocket blasts off, use the sextant to determine the rocket's angular distance. This can be done by watching the rocket rise through the viewing tube (straw) and when it reaches the highest point, check the angle on the protractor. Subtract this number from 90° and you will have the "angular distance."

Write down the angular distance, and repeat the launch as many times as you can! Experiment with different amounts of baking soda and vinegar to determine the perfect combination for the highest launch!

CALCULATE RESULTS

Use the Table of Tangents below to calculate the rocket's altitude.

The calculation for determining the altitude is simpler than you might expect!

Baseline x Tangent of Angular Distance = Altitude

Example: You stand 20 feet away from a launch, and the peak of the launch registers as 30°.

The tangent of 30° = .5773

The distance from rocket launcher = 20 feet

20 x .5773 = 11.546 feet in altitude.

TABLE OF TANGENTS

ANGLE	TAN(A)	ANGLE	TAN(A)	ANGLE	TAN(A)	ANGLE	TAN(A)	ANGLE	TAN(A)	ANGLE	TAN(A)
0.0	0.00	15	.2679	30	.5773	45	1.0000	60	1.7321	75	3.7321
1	.0175	16	.2867	31	.6009	46	1.0355	61	1.8040	76	4.0108
2	.0349	17	.3057	32	.6249	47	1.0724	62	1.8907	77	4.3315
3	.0524	18	.3249	33	.6494	48	1.1106	63	1.9626	78	4.7046
4	.0699	19	.3443	34	.6745	49	1.1504	64	2.0503	79	5.1446
5	.0875	20	.3640	35	.7002	50	1.1918	65	2.1445	80	5.6713
6	.1051	21	.3839	36	.7265	51	1.2349	66	2.2460	81	6.3138
7	.1228	22	.4040	37	.7535	52	1.2799	67	2.3559	82	7.1154
8	.1405	23	.4245	38	.7813	53	1.3270	68	2.4751	83	8.1443
9	.1584	24	.4452	39	.8098	54	1.3764	69	2.6051	84	9.5144
10	.1763	25	.4663	40	.8391	55	1.4281	70	2.7475	85	11.430
11	.1944	26	.4877	41	.8693	56	1.4826	71	2.9042	86	14.301
12	.2126	27	.5095	42	.9004	57	1.5399	72	3.0777	87	19.081
13	.2309	28	.5317	43	.9325	58	1.6003	73	3.2709	88	28.636
14	.2493	29	.5543	44	.9657	59	1.6643	74	3.4874	89	57.290

BSR FLIGHT LOG

FLIGHT NUMBER	AMOUNT OF BAKING SODA	AMOUNT OF VINEGAR	ALTITUDE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

NOTES: _____