

STEM



ROCKET SCIENCE STEM KIT

ACTIVITY BOOK



YOUR MISSION: KNOCK IT, ROCKET!

There are 2 asteroids flying dangerously close to the **International Space Station (ISS)**. The ISS holds a crew of 7 that needs to be evacuated as soon as possible! But, there is not a rocket ready for flight that is able to carry all 7 of the crew members.

The only option is to divert the path of the asteroids and “knock” them off course. You must act fast. You only have a few hours to build and launch your rocket to knock the asteroids off course.

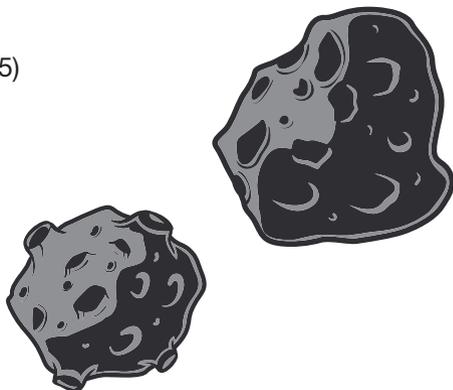
Can you help save the crew in time?

Here are the materials you have available to complete your mission:

- Rocket
- Recovery Parachute
- 2 different engines (B6-4, C6-5)
- Mini AltiTrak

STEM concepts covered:

- Altitude Tracking
- Gravity
- Thrust
- Drag
- Lift



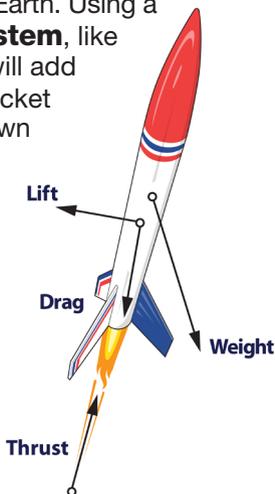
BACKGROUND INFORMATION

To begin, you need to be up-to-date on the STEM principles behind the mission.

FORCES OF FLIGHT

When you launch the rocket, the **thrust** from the engines will propel the rocket up toward your target.

Lift will help stabilize the rocket in the air. As you track the rocket with your Mini AltTrak, an altitude measuring device, you will measure the **altitude**, or height, that the rocket reaches. When you know the altitude, you will be able to determine if there is enough **force** from the engine to get your rocket to the asteroid. As the rocket starts to make its descent, **gravity** is going to pull it back to Earth. Using a **recovery system**, like a parachute, will add **drag** to the rocket and slow it down so it doesn't crash upon landing.



ROCKET ENGINES

To launch the rocket, you will need to use an **engine**. You have two different engines to use on your mission today. You must decide which engine to use for the closer asteroid and which to use for the one that is further away. Engines have special markings on them. They all start with a letter (A, B, C, etc). The letter shows how much **power** the engine has. With each consecutive letter, the engine doubles in power (so a B engine is double the power of an A). The number next to the letter tells you what the **average thrust** will be. The bigger the number, the faster the rocket will take off, but won't fly as high. The number listed after the dash represents the **time delay** in seconds. If there is a 4, then the rocket will coast in the air for 4 seconds before the ejection charge pushes out the recovery system. You will have to make the right choice when deciding on the engine and asteroid pairings.

Good Luck!

ACTIVITY 1: ALKA-SELTZER ROCKETS

As a Rocket Scientist, you need to understand how the mass of your rocket affects the forces of flight, like how much thrust is needed to overcome Earth's gravity. This simple experiment is a hands-on way to explore those same concepts by launching your own Alka-Seltzer rocket. By testing how added weight affects the flight, you'll start to think like a real rocket engineer - experimenting, predicting, and observing how mass impacts a successful launch.

Materials needed: Film Canisters, Alka-Seltzer tablets, paper towels, water, timer, pennies, tape, safety glasses

Directions:

- Wear safety glasses.
- Fill the canister half full of water.
- For Trial 1, drop 1 of the tablets into the canister, quickly seal the lid, set upside down on the table, and step back to observe.
- Clean and reset the canister half full of water.
- For Trial 2, tape some pennies on the bottom of the film canister. Then, drop 1 of the tablets into the canister, quickly seal the lid, set upside down on the table, and step back to observe.
- Compare the two launches and record your observations.

Parent tip: It can be helpful to hot glue the Alka Seltzer tablet to the lid to ensure there is time to get the lid securely on before flipping it upside down.

Which of the four forces of flight was most obvious in this activity? Why?

HYPOTHESIS: WHICH ALKA-SELTZER ROCKET WILL RESULT IN HIGHER ALTITUDE?

TRIAL	INDEPENDENT VARIABLE (MASS)	NUMBER OF PENNIES	DEPENDENT VARIABLE (ALTITUDE) <small>YOU CAN ESTIMATE ALTITUDE OR RECORD LAUNCHES ON A PHONE OR TABLET AND REVIEW TO SEE WHICH WENT HIGHER.</small>
1	NO ADDITIONAL MASS	0	
2	ADDITIONAL MASS (PENNIES)		

WAS YOUR HYPOTHESIS CORRECT?

WHAT OTHER VARIABLES COULD HAVE AFFECTED YOUR ROCKET'S FLIGHT?

ACTIVITY 2: EGG CARTON LAUNCH PAD

Materials needed:

- Empty egg cartons (any size — cardboard is easiest to cut)
- Cardboard pieces (from boxes, cereal cartons, etc.)
- Interlocking building bricks (any brand) or other small building toys (mini figures = astronauts!)
- Scissors or craft knife
- Markers, paint, or stickers for decoration
- Optional:
 - Aluminum foil (for “metal” details)
 - String or yarn (for zip lines or elevator systems)
 - Tape, glue, or hot glue gun (for faster building)
 - Flashlight or small LED (for “launch lights”)

Build Your Mini Launch Site

1. Make the Launch Pad

- Cut the bottom half of the egg carton into a flat piece.
- Flip it upside down so the “egg cups” become craters or booster supports.
- You can place a paper rocket or even a decorated Alka-Seltzer rocket on top as the “vehicle.”
- Decorate with foil to make it look like a real launch platform.

2. Build the Control Center

- Use a rectangular piece of cardboard as a base.
- Draw or glue on panels, buttons, countdown timers, and screens.
- Interlocking building bricks or recycled caps make excellent “buttons” and “levers.”
- Add a string “intercom” to connect to other rooms, or a walkie-talkie to simulate mission communication.

You can make this as simple or elaborate as you want - even turn it into a full Mission Control room!

FUN FACT:

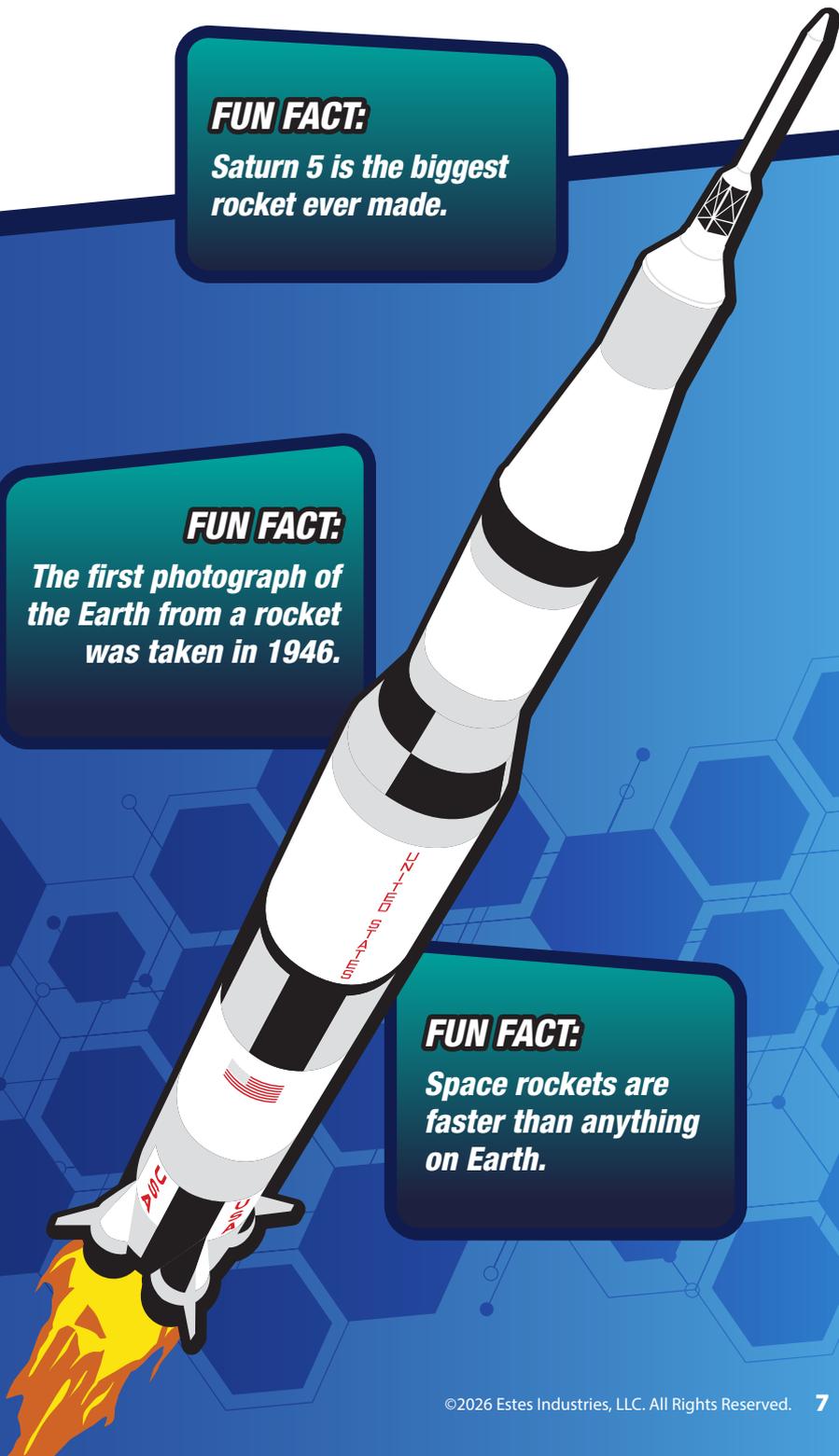
Saturn 5 is the biggest rocket ever made.

FUN FACT:

The first photograph of the Earth from a rocket was taken in 1946.

FUN FACT:

Space rockets are faster than anything on Earth.



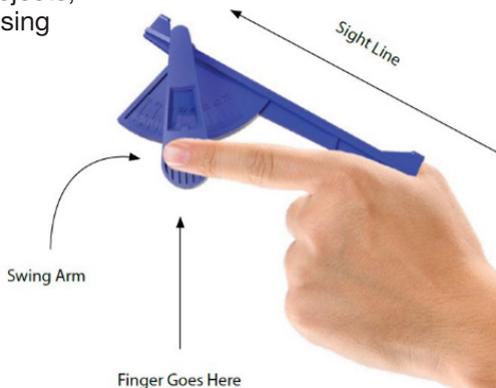
ACTIVITY 3: MEET THE MINI ALTI TRAK

In order to be sure that the rocket can reach the asteroid, we need to be able to measure its altitude. This activity will get you familiar with working with an altitude measuring device, the Mini AltiTrak!

Materials needed: Mini AltiTrak, tennis ball (or similar), pencil, calculator

Directions: For this activity, you will need a partner and to be outside.

- Look for tall objects in the distance like flag poles, roof tops, trees, or tall buildings.
- Measure and mark 46 meters from the object. This will be where you stand.
- Hold the Mini AltiTrak at arm's length and focus on the first object.
- Align the front and rear sites at the top of the object.
- Place your finger on the swing arm to hold it in place.
- Record the angle in degrees by looking at the Angle Scale on the Mini AltiTrak.
- Repeat with at least 2 other objects, or until you feel comfortable using the Mini AltiTrak.



Now try a moving target! Time for the tennis ball!



- Have your partner toss the tennis ball straight up into the air.
- Hold the Mini AltiTrak at arm's length and point it at the tennis ball.
- Follow the ball with your arm as it goes up.
- When it reaches the highest point, quickly put your finger on the swing arm to hold it in place.
- Record the angle in degrees by looking at the Angle Scale on the Mini AltiTrak.
- Repeat at least 2 times, or until you feel comfortable using the Mini AltiTrak.

Once you find the angle, find the tangent that corresponds with it on this table.

ANGLE	TAN(A)	ANGLE	TAN(A)	ANGLE	TAN(A)
25	.4663	47	1.0724	69	2.6051
26	.4877	48	1.1106	70	2.7475
27	.5095	49	1.1504	71	2.9042
28	.5317	50	1.1918	72	3.0777
29	.5543	51	1.2349	73	3.2709
30	.5773	52	1.2799	74	3.4874
31	.6009	53	1.3270	75	3.7321
32	.6249	54	1.3764	76	4.0108
33	.6494	55	1.4281	77	4.3315
34	.6745	56	1.4826	78	4.7046
35	.7002	57	1.5399	79	5.1446
36	.7265	58	1.6003	80	5.6713
37	.7535	59	1.6643	81	6.3138
38	.7813	60	1.7321	82	7.1154
39	.8098	61	1.8040	83	8.1443
40	.8391	62	1.8907	84	9.5144
41	.8693	63	1.9626	85	11.430
42	.9004	64	2.0503	86	14.301
43	.9325	65	2.1445	87	19.081
44	.9657	66	2.2460	88	28.636
45	1.000	67	2.3559	89	57.290
46	1.0355	68	2.4751	90	Infinite

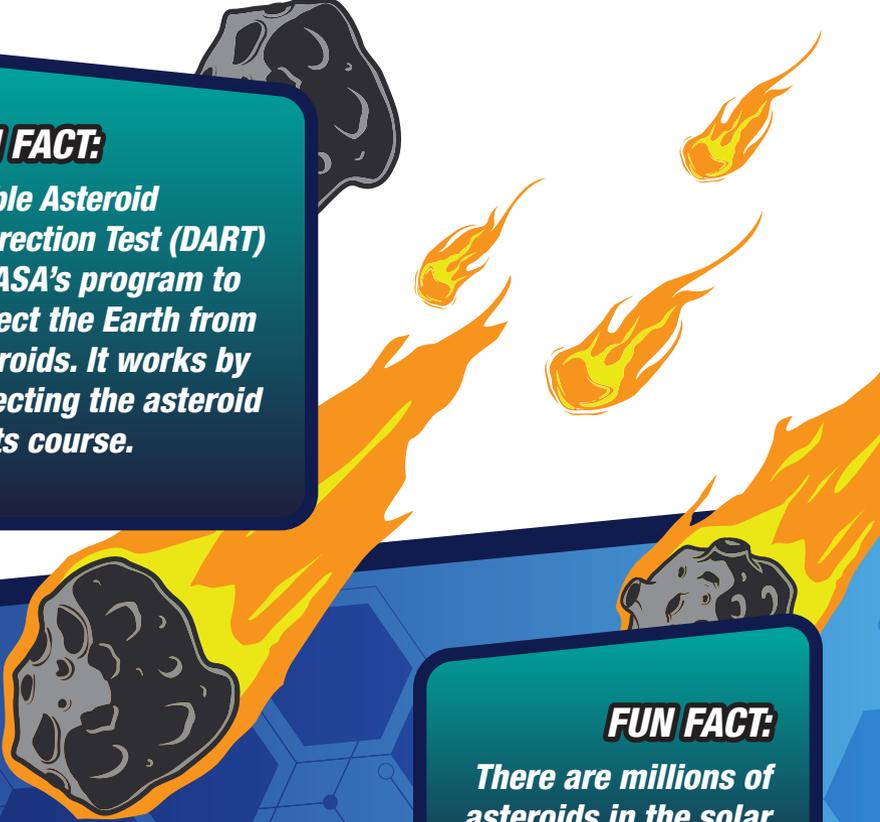
Next you will do some simple multiplication and record your answers on the chart below.

Angle tangent x Baseline = Altitude

Example calculation:

*30° angle reading
Use the chart to find Tangent = 0.58
Baseline = 46 meters
 $0.58 \times 46 = 26.7$ meters
The altitude is 26.7 meters*

OBJECT	BASELINE	ANGLE	TANGENT	ALTITUDE
	46 meters			
	46 meters			
	46 meters			
Tennis Ball #1	46 meters			
Tennis Ball #2	46 meters			
Tennis Ball #3	46 meters			



FUN FACT:

Double Asteroid Redirection Test (DART) is NASA's program to protect the Earth from asteroids. It works by deflecting the asteroid off its course.

FUN FACT:

There are millions of asteroids in the solar system.....millions!

FUN FACT:

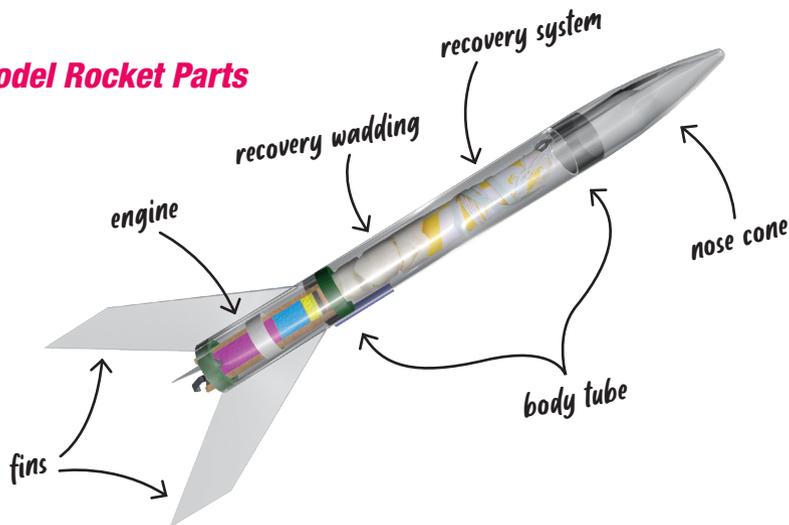
Asteroids can not only become moons of other planets, but also can have their own moon!

ACTIVITY 4: PREPARE FOR LAUNCH

Now that you know the mission, it is time to prepare your rocket. Be sure to follow these steps:

- 1. Unload** all the pieces of your rocket and follow the included instructions carefully to correctly build the rocket.
- 2. Prep** your rocket for launch by adding recovery wadding, folding your parachute, and inserting an engine.
- 3. Read** all the safety guidelines on the next page and get an adult to assist you with the launch.
- 4. Launch** and collect data.

Model Rocket Parts



ACTIVITY 5: SAFETY FIRST!

Review each of these regulations from the National Association of Rocketry before you launch and check off each box to show that you understand it.

www.nar.org/safety-information

MATERIALS

- Only use materials provided in the rocket kit.
- Do not tamper with rocket engines in any way.

LAUNCH SITE

- Launch in an open outdoor area (A engines = 100 ft x 100 ft; B = 200 ft x 200 ft; C = 400 ft x 400 ft).
- Launch only in safe weather conditions (winds less than 20 mph).
- Be sure there is no dry grass near the launch pad.
- Do not launch at targets, into clouds, or near airplanes.

LAUNCH

- Countdown before launch.
- Be sure everyone stands at least 15 feet away.
- Launch rod must be within 30 degrees of vertical.
- In case of misfire, wait 60 seconds before approaching the rocket.

RECOVERY

- Do not attempt to recover rocket from tall trees, power lines, or other dangerous places.

ACTIVITY 6: KNOCK IT, ROCKET!

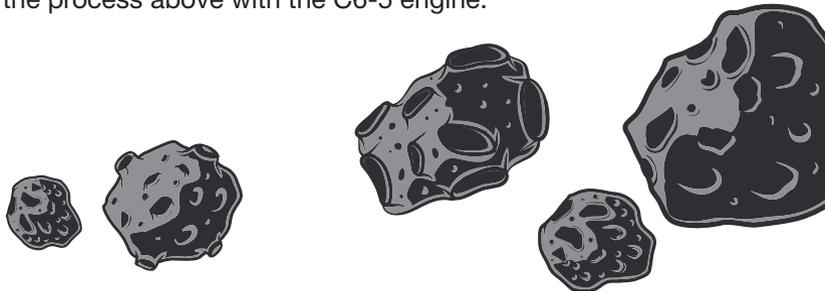
Ok, the moment of truth has come. You are prepared. You know how to use your equipment and you have brushed up on STEM concepts and vocabulary. It is now time for launch. You must choose which engine to use for the closer asteroid (at a lower altitude) and which engine to use for the asteroid further away (at a higher altitude). You got this!

Materials needed: rocket, engines, Mini AltiTrak, pencil

You are going to use the engines as the **independent variable**, which is the variable you change. The **dependent variable**, or the result achieved because of the independent variable, will be the altitude the rocket reaches. You will make a **hypothesis**, or an educated guess based on the information you have and decide which engine you think will result in a higher altitude.

Directions:

- Follow the instructions included to build your rocket.
- Find a large outdoor space and bring an adult with you for assistance.
- Launch your rocket with the B6-4 engine.
- Measure the angle of your rocket with your Mini AltiTrak and record in the table below.
- Repeat the process above with the C6-5 engine.



HYPOTHESIS: WHICH ENGINE WILL RESULT IN A HIGHER ALTITUDE?

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TRIAL	INDEPENDENT VARIABLE (THRUST)	BASELINE	ANGLE	TANGENT	DEPENDENT VARIABLE (ALTITUDE)
1	Engine B6-4	46 meters			
2	Engine C6-5	46 meters			

WAS YOUR HYPOTHESIS CORRECT?

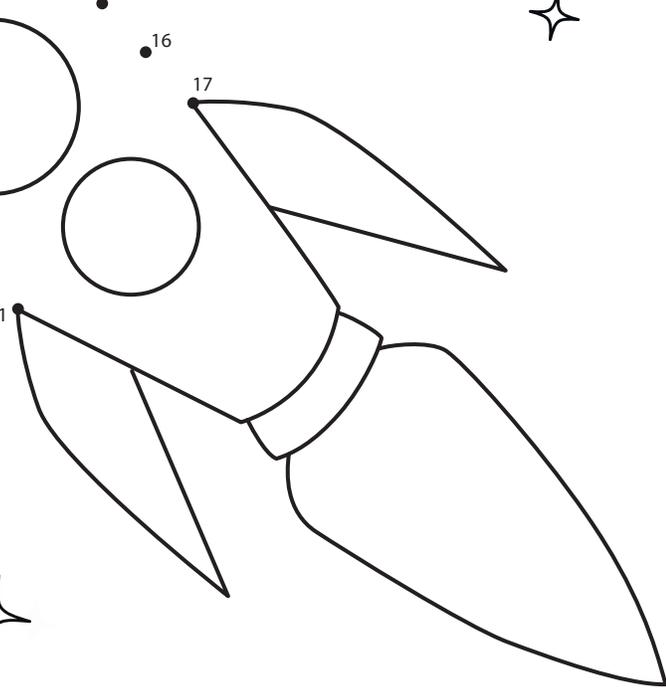
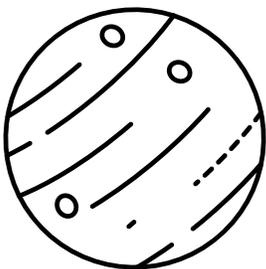
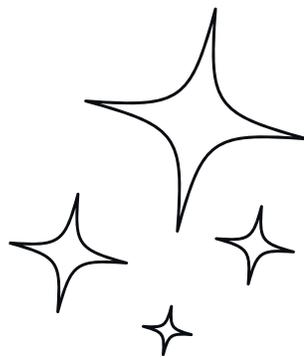
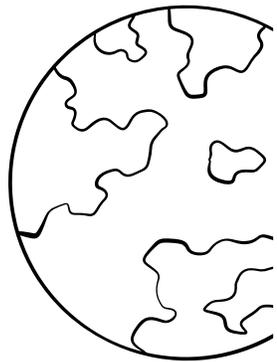
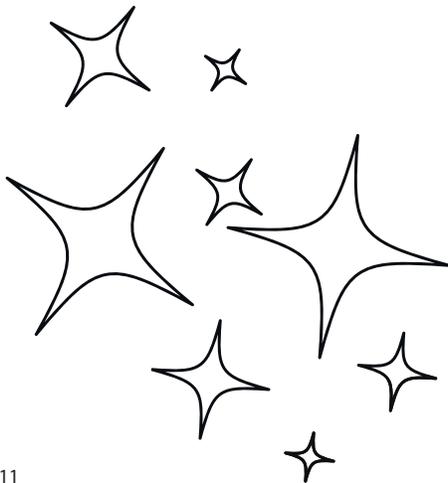
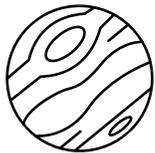
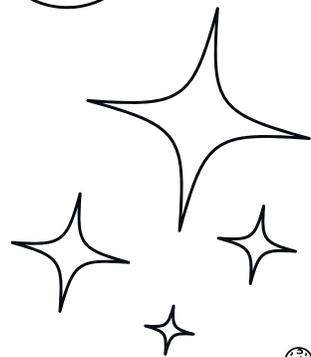
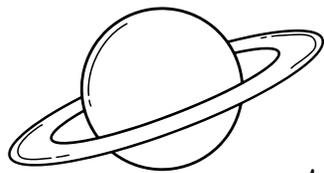
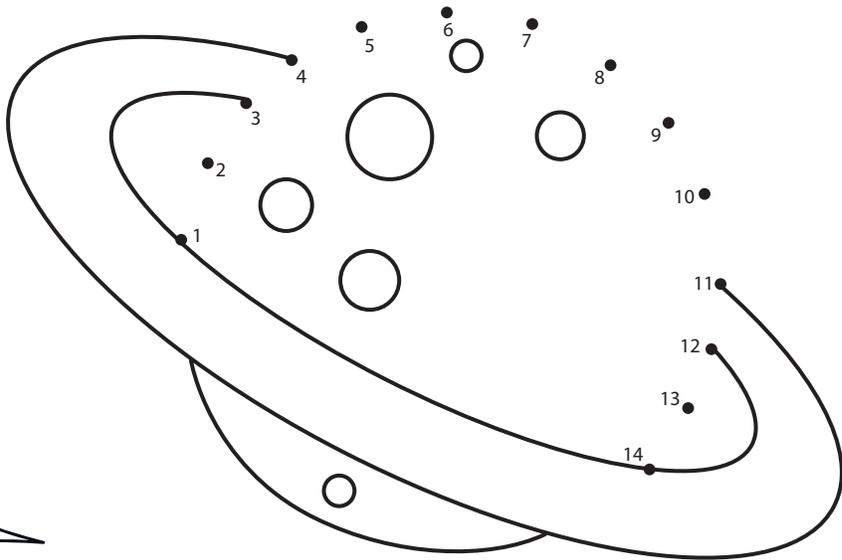
WHAT OTHER VARIABLES COULD HAVE AFFECTED YOUR ROCKET'S FLIGHT?

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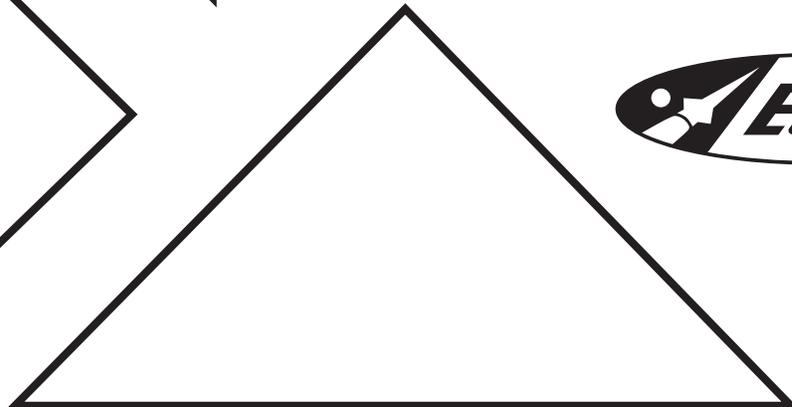
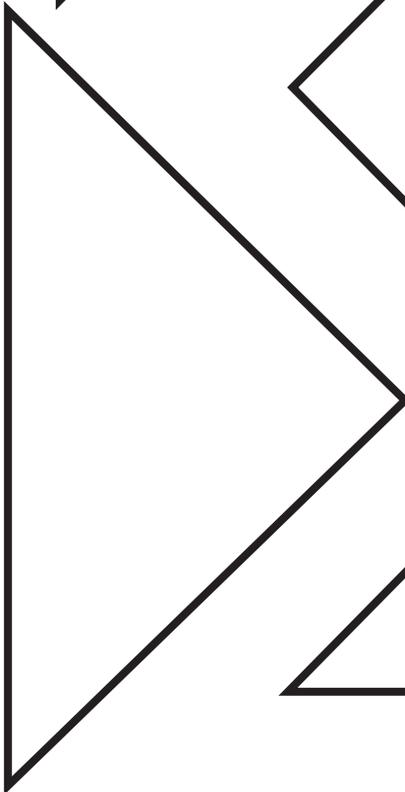
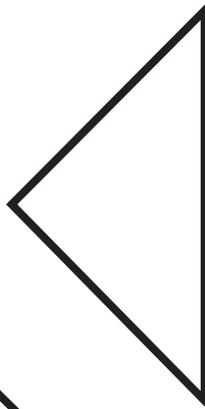
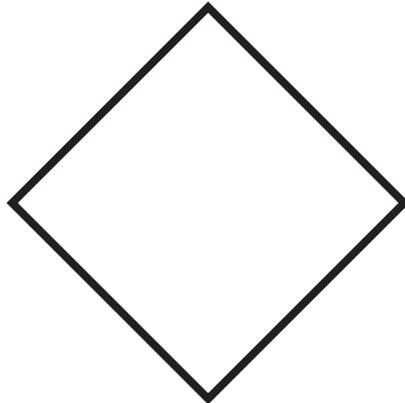
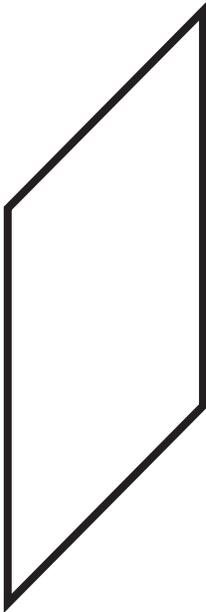
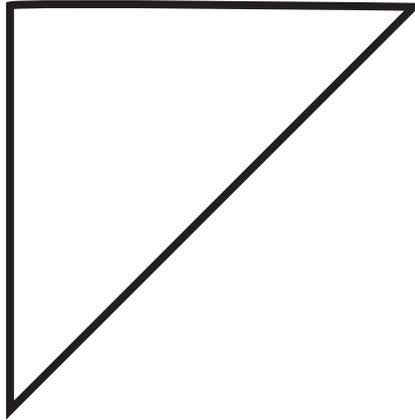
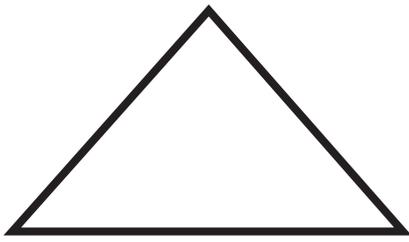


Need more engines? Order today at:
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Build Your Own Rocket

Use the shapes to create a rocket!!



Simply
COLOR
then
CUT



Need some ideas?

