

Elementary Rocket Curriculum Basics

Rockets are largely *engagement* events with the potential for design activities and simple experiments. Because of the safety considerations when using rockets they are usually approached in the upper elementary or middle school curriculum. They can be used to illustrate Newton's second law (action/reaction), introduce a space travel unit, or be used as a design activity with connections to aerodynamics and propulsion. Failed launches provide excellent opportunities to debrief and redesign. The real appeal is that students are amazed to watch the rockets they have built blast off!

Rocket Systems

Rockets are actually very simple in theory. They have a sleek body which houses a *propulsion system* (also called interchangeably engines or motors). Usually, a rocket needs some sort of 'trigger' to get the engine going and a launch pad to keep the rocket on track until it gains enough speed to be *aerodynamic* and more stable as it flies. A useful option for rockets is a *recovery system* which allows some or all of the rocket to fall gently back to earth for re-use. For classroom use, all rocket systems should follow the 'K.I.S.S' (Keep It Simple and Safe) maxim.

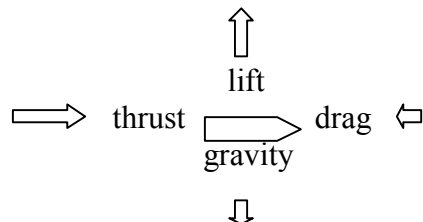
Curriculum point: The idea of a 'system' may need to be introduced to younger students. The obvious connection is to an 'ecosystem', but any set of interconnected processes would work. You could start by asking students how their heating system works.

Curriculum connections: Having students do a bit of research on the ancient origins of rockets will yield a very long history spanning many countries, notably China. In the modern era, how have rockets impacted society positively (ex. space exploration) and negatively (ex. warfare).

Brainstorm: Find out what students know about different types of propulsion. There is quite a range which includes air, chemical, water, nuclear, photon, magnetic rail, and springs.

Aerodynamics

The study of decreasing the effects of the forces on an object moving through air is called *aerodynamics*. There is an interplay between the four forces of gravity, drag, thrust(propulsion), and lift.



These terms may be common for upper elementary/middle school students, but the simple force diagram may need to be explained and should be learned.

Curriculum connections: What other common devices or objects design around these forces? Examples could include racing cars, footballs, Frisbees, and kites.

Design Possibilities

There are natural limits to rocket design based on launch pad requirements, materials, propulsion capacity, and basic stability requirements. That being said, students can still design for:

- A. number and placement of fins
- B. size of engine, amount of water ‘fuel’, air pressure
- C. recovery systems
- D. aerodynamics
- E. overall weight/size of rocket
- F. payload
- G. ‘coolness’ – decoration

Elementary students can do a great deal with water propulsion systems using plastic soda bottles and a variety of fin/nosecone adaptations. The main thing with pressure systems is that the propulsion bottle must remain intact from cuts, melting, or scratches to avoid failures.

Middle school students can try their hand at building rockets which use chemical propulsion systems from commercial suppliers like Estes. The rockets themselves can be made with very simple materials like notebook paper, or with commercially available balsa and cardboard supplies. The time needed to cut and glue various components must be included in your curriculum planning, but the ‘hands on’ aspect is a valuable one.

Experimental Possibilities

In terms of measurable elements of rocket performance, there are quite a few you can gear your design process for:

- A. maximum altitude
- B. time aloft
- C. accuracy of recovery system
- D. payload lift capacity

All you need is data paper, a stopwatch, several *clinometers*, and a long tape measure to sort out the objective accomplishments of your rocket flights.

High Power ‘Adult’ Rocketry

Rockets requiring various training and licensure are the next step for adults. The NAR lists information on these programs for rockets which require air clearance to launch!