

Teaching Chemistry Using *October Sky*

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INTRODUCTION

Novels and movies can be used as tools by teachers to demonstrate applications of the scientific method, to provide real-life examples of science being used by individuals, and to show the impact a teacher can have on students. The movie *October Sky*, based on the novel *Rocket Boys: A Memoir*, illustrates the trials, tribulations, and triumphs associated with science and engineering.

HOMER HICKAM, JR.

The movie *October Sky* and the novel *Rocket Boys: A Memoir* chronicle the life of Homer Hickam, Jr., from 1957 to 1960 in Coalwood, West Virginia. On October 4, 1957, the Soviet Union launched Sputnik marking the beginning of the space race and forever changing Homer's life. Hickam's new aspiration focused on building rockets.



Welch Daily News, (local newspaper) frontpage article on Sputnik launch. (above)
Source: <http://www.coalwoodwestvirginia.com/sputnik.htm>
Image of Sputnik. (right)
Source: <http://www.coalwoodwestvirginia.com/sputnik.htm>



The novel and movie describe Homer's assembly of a group of his friends, called the Rocket Boys, and documents the successes and failures of the group. Encouraged by their high school science teacher, Ms. Riley, Homer and the Rocket Boys entered and won a gold medal at the National Science Fair in 1960. Homer eventually realized his dream and became a NASA engineer and astronaut trainer.

BODY OF KNOWLEDGE

After their initial attempts at building rockets, the Rocket Boys quickly learned that they would need to know more to be successful. Ms. Riley obtained an important book for Homer that contained the scientific and engineering basics of rocket building. She told Homer, "all I've

done is give you a book. You have to have the courage to learn what's inside it." The mentoring and support from Ms. Riley was important to the Rocket Boys' success and especially to Homer whose father discouraged their endeavors.

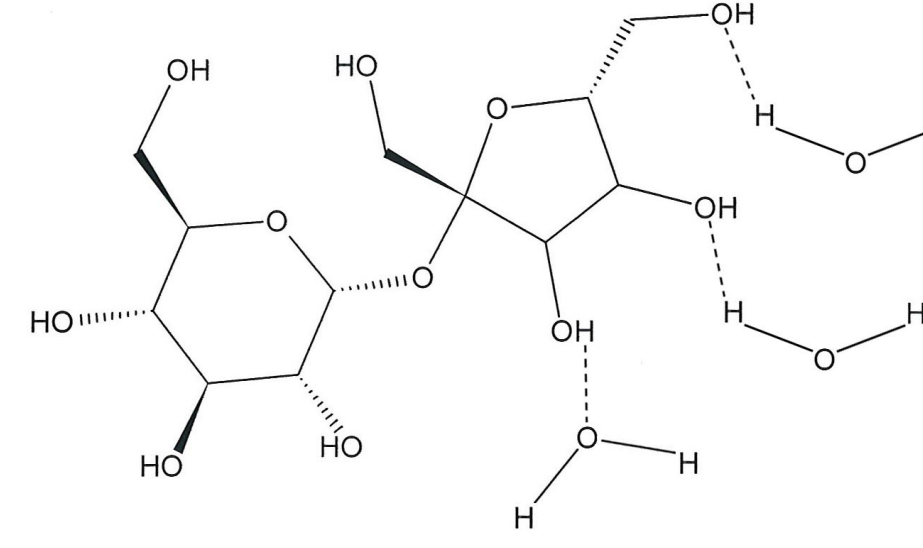
One of the other Rocket Boys, Quinten, kept detailed records of each trial so that the group could learn from their successes and failures. Quinten knew that it was vital to build what he termed a body of knowledge.



Ms. Frida Riley teaching chemistry. (above)
Source: <http://www.reinvent.k12.wv.us/~SFILE/msriley-1.jpg>

DEVELOPMENT OF ROCKET PROPELLANTS

Homer and the Rocket Boys needed a propellant for their rocket. Homer's initial attempt to launch a rocket used fireworks as a propellant. This resulted in a small explosion and the destruction of Homer's mother's rose garden fence. The next propellant system used charcoal, sulfur, and saltpeter. After several failed attempts, the Rocket Boys realized that the mixture was not homogeneous enough to allow for even combustion. To improve homogeneity, the components were carefully ground and mixed with a binding agent, glue. Still, these steps did not lead to even combustion. The next improvement was inspired by a classroom demonstration of the reaction of potassium chlorate with sugar performed by Ms. Riley. The movie depicts this experiment in a scene set in the chemistry lab when Quinten puts a small amount of the chemicals in a flame causing a bright flash as the reaction occurs. This demonstration led to the preparation of a propellant system called Rocket Candy, named for the odor of burnt sugar generated by the reaction. Homer and the Rocket Boys were unable to obtain potassium chlorate; instead, they substituted potassium nitrate and mixed it with sugar to create Rocket Candy.



Structure of Sucrose and Water (above)

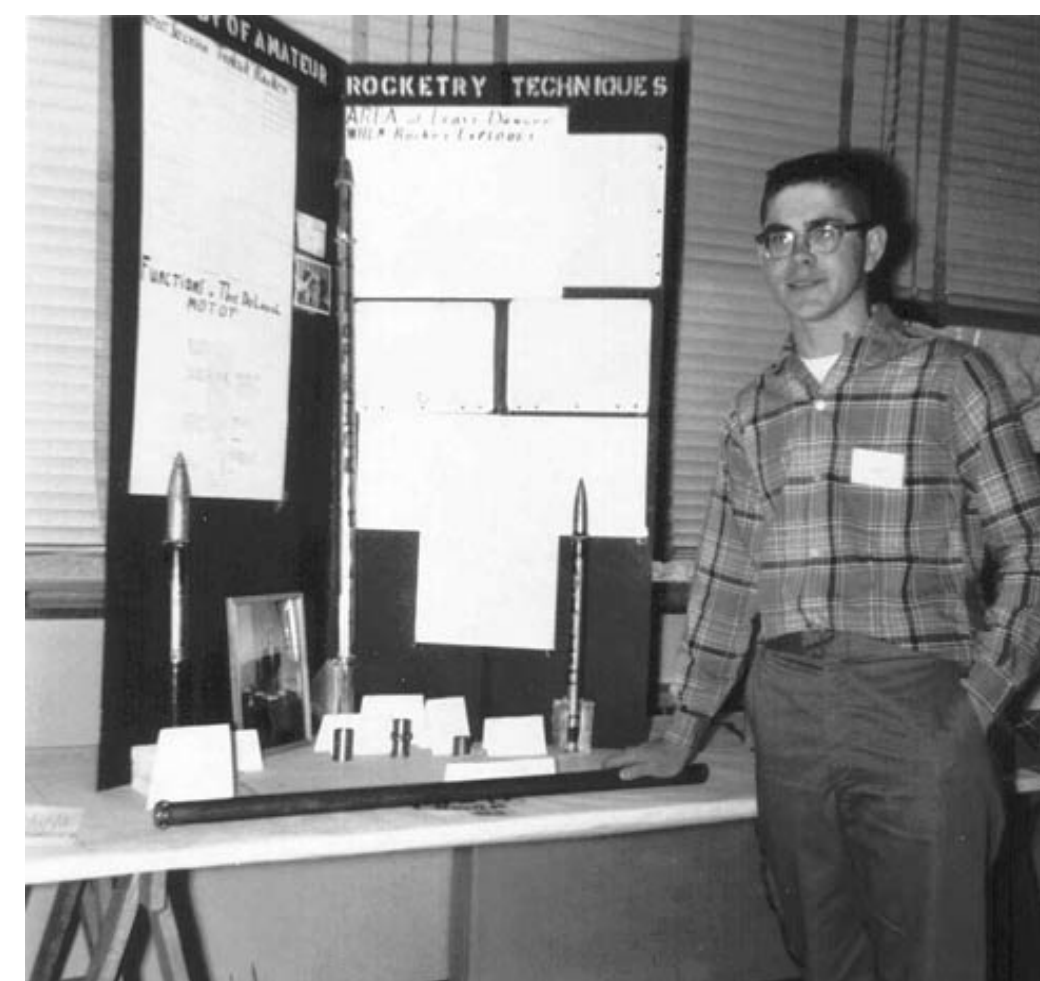
After the Rocket Boys maximized the potential of Rocket Candy, a more powerful propellant system was developed. Inspiration again came from a classroom chemistry demonstration, this time of the reaction of powdered zinc with sulfur. Problems of incomplete combustion plagued the Rocket Boys. The answer was to obtain a small amount of simply distilled ethanol. The use of ethanol as a binder allowed a greater amount of zinc and sulfur to be packed into the rockets, which led to launch altitudes of 33,000 feet.

Rocket Boys with Auk rocket mock-up. (right)
(L-R) Homer "Sonny" Hickam, Jr., Quentin Wilson, Roy Lee Cooke, O'Dell Carroll.
Source: <http://www.homerhickam.com/students>



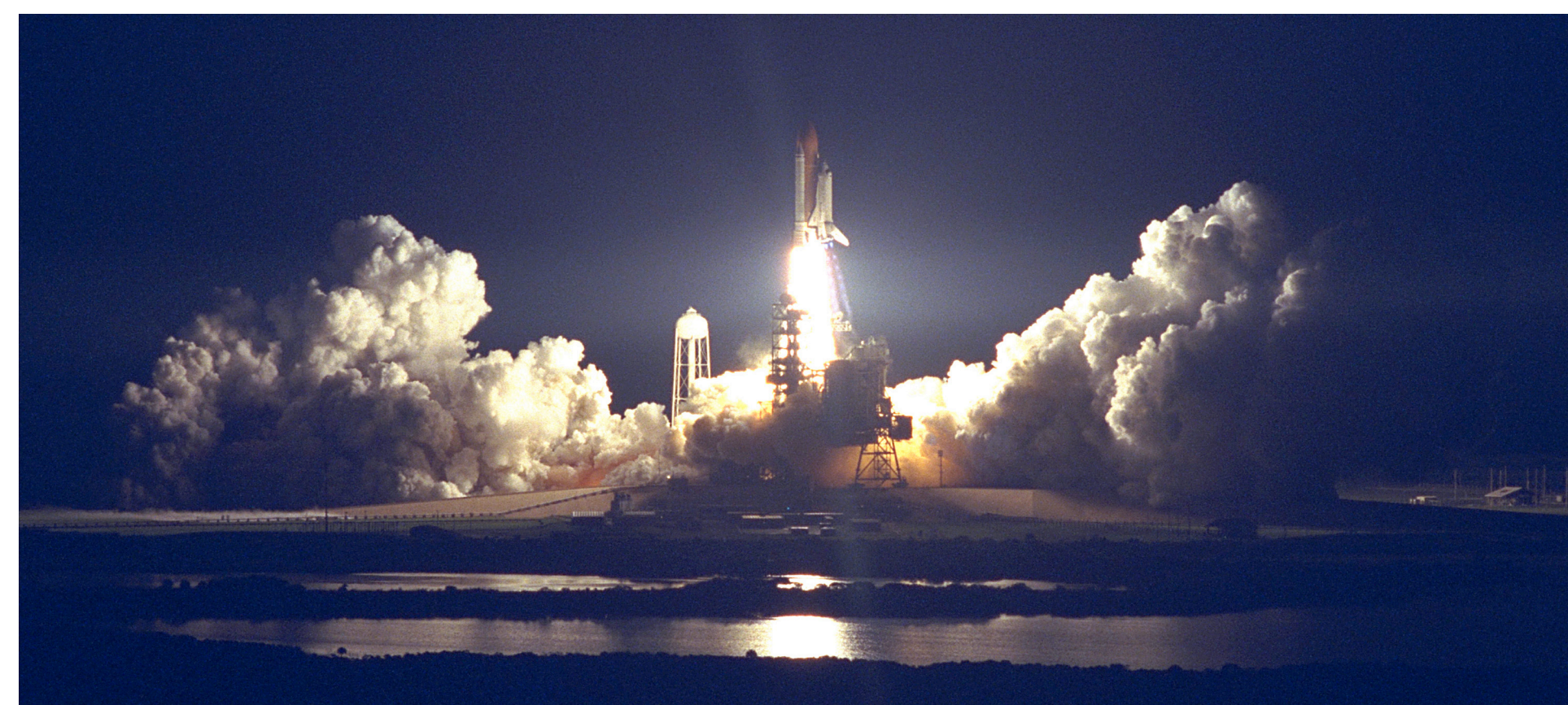
SUPPORT FROM COALWOOD

In addition to encouragement from Ms. Riley and Homer's mother, the Rocket Boys gained support from other people in Coalwood. The elementary school teachers in Coalwood, known as the Great Six, supported the boys. Many of the local miners took an interest in the rocket launches and considered them the best spectator sport in town after the cancellation of the football season at Big Creek High School. The most important group that supported the Rocket Boys was the machinists who worked for the coal company. Homer and his team realized that they would need the help of these skilled workers to prepare the rockets. The machinists provided the needed expertise to determine the best materials to create effective rockets, they taught the Rocket Boys the skills necessary to fabricate rockets, and, when asked, completed some of the work themselves. The Rocket Boys entered science fairs and were very successful. After winning local and regional competitions, they were chosen to compete in the National Science Fair; however, only one student was allowed to represent the group. The Rocket Boys selected Homer to represent them at the fair. During the fair, the rocket parts



Homer Hickam, Jr. representing the Rocket Boys at the National Science Fair, 1960. (above)
Source: <http://www.homerhickam.com/newletters/coalwood2.shtml>

on display were stolen. The people of Coalwood settled a strike and sent replacements of the missing materials. After winning a gold medal at the National Science Fair, the Rocket Boys decided to launch their remaining rockets for the enjoyment of Coalwood residents. At this point, Homer's father finally showed support for the group and took part in launching rockets.



Space Shuttle liftoff showing ignition of solid rocket boosters. (above)
Source: <http://grin.hq.nasa.gov/index.html>

SPACE SHUTTLE PROPULSION

The solid rocket boosters used by NASA space shuttles are similar to those prepared by Homer and the Rocket Boys. During liftoff, the Space Shuttle is propelled by two solid rocket boosters. The boosters are prepared by mixing an organic polymeric binder, an oxidant, and a reductant in large vats. The design of the vats is borrowed from the baking industry. The resultant propellant is loaded equally into the two solid rocket boosters and cured to ensure uniform performance during liftoff. Both propellant systems contain an oxidant, a reductant, and an organic binding material. Homer also used baking equipment procured from his mother's kitchen to mix the propellants. Both the Space Shuttle's solid rocket boosters and the Rocket Boys' rockets were ignited electrically. The basic design of both is remarkably similar. The major difference between the systems is the use of a catalyst in the shuttle solid rocket boosters. Table 1 shows the composition of solid rocket boosters. Table 2 compares the Rocket Boys' propellant system with the solid rocket boosters of the space shuttle.

Material	Purpose	Percent by Mass
Ammonium perchlorate	Oxidizer	69.8%
Aluminum powder	Reductant	16.0%
Iron (III) oxide	Catalyst	0.20%
Polybutadiene acrylic acid acrylonitrile	Binder	12.4%
Epoxy	Curing agent	2.0%

Table 1. Composition of Solid Rocket Boosters

Type of Mixture	Organic	Oxidant	Added Reductant
Gunpowder	Charcoal	KNO ₃	Sulfur
Rocket Candy	Sugar	KNO ₃	None
Zincoshine	Ethanol	Sulfur	Zinc powder
Solid Rocket Booster	Polymer and Epoxy	NH ₄ ClO ₄	Aluminum powder

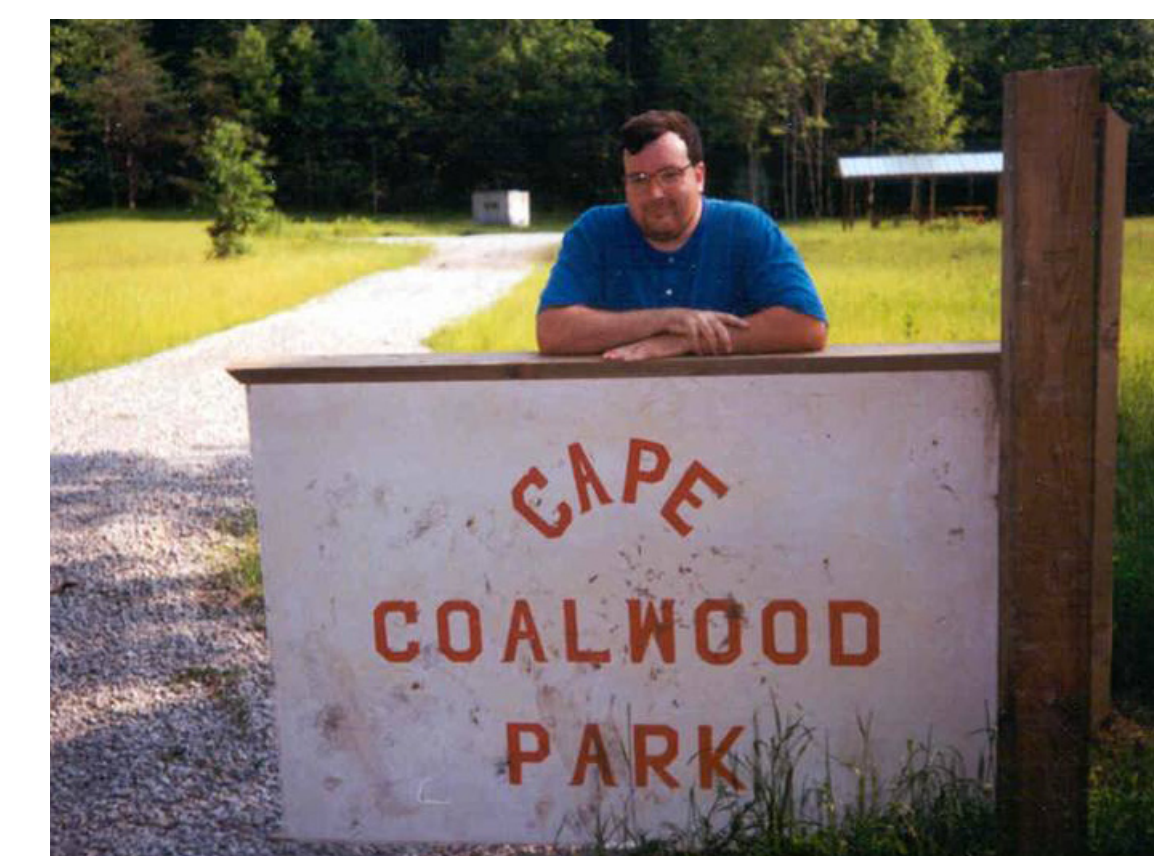
Table 2. Comparison of Fuel Oxidant Mixtures

CONCLUSION

The movie *October Sky* and the novel *Rocket Boys: A Memoir* tell the story of a group of high school students who developed an interest in science and engineering. The Rocket Boys succeeded in building and launching rockets because of community support, educational resources, and demonstrations provided by their chemistry teacher, Ms. Riley. The movie and book also describe how the boys documented their rocket launch trials, troubleshooted their failures, and succeeded in building and launching rockets. The composition of the propellant systems used by the Rocket Boys are comparable to those of the solid rocket booster used by the space shuttle. The activities documented in the movie *October Sky* and in the novel *Rocket Boys: A Memoir*, provide real-life examples to call upon when teaching science.

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Photograph of author James G. Goll. (above)
Source: James G. Goll private collection.

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