



UNIT 4

Transportation Technology: Visualizing Rocketry

Unit Overview



I. Introduction

Rocketry provides an excellent opportunity to use visualization to enhance technological literacy. In addition, the technological concepts can be extended by looking more closely at the scientific and mathematical basis of these concepts and creating visualizations that demonstrate these principles and concepts.

There will be two parallel design activities: one will be to design and execute visualizations supporting the technological basis of rocketry while the other will be to design, construct, test, and launch a model rocket within the given design parameters. The Introductory projects will focus on the visualizations while the Intermediate activities will focus on the physical model rocket. For each introductory project, there will be the opportunity to create and use a visualization to help support the parallel activity. Each project will make use of one or more different types of visualization techniques and technologies. By making use of multiple projects of this activity, there will be an opportunity to explore a range of visualization application areas.

For the model rocket design, construction, and launching, the National Association of Rocketry's (NAR) Model Rocket Safety Code should be adhered to closely. This code

should be reviewed prior to the start of design, and relevant sections should be revisited as the students progress through their activity. See the website in the [Resource Index](#).

II. Unit Learning Goals

- Students will develop an understanding of the scientific and technological basis for aeronautical principles associated with rocketry.
- Students will use visualization techniques to communicate about the principles of rocket flight.
- Students will design, build, and test a model rocket using graphic and model construction techniques.

III. Unit Connections to ITEA's Standards for Technological Literacy

This unit is centered on Information and Communication Technologies of the Designed World–Standard 17 and Transportation Technologies–Standard 18. The following matrix identifies the Standards for Technological Literacy that are addressed by the projects within the unit. Project extensions and advanced level projects may cover additional standards.

Unit 4	Transportation Technology: Visualizing Rocketry																			
Target Standards for Technological Literacy																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Introductory Level Projects																				
Project 1-Comparing vehicle systems		X									X	X							X	
Project 2-Representing forces acting on a rocket			X								X	X				X			X	
Project 3-Representing the effect of wind											X	X							X	
Project 4-Multimedia visualization of the stages of flight											X	X							X	
Intermediate Level Projects																				
Project 5-Rocket design refinement			X						X	X			X						X	
Project 6-Rocket construction and testing										X	X	X							X	
Project 7-Rocket launching and performance evaluation			X											X					X	

IV. Navigating the Unit

All four of the Introductory activities focus on the creation of visualizations that communicate different aspects of the principles of rocketry. Though they are meant to be done in sequential order, Project 1 can be done at any point in the sequence. If you complete the activities in sequential order, you can stop after any project with no substantial loss of continuity. The level of graphic sophistication does not necessarily increase as you go through these four activities. However, if the students do complete these activities in sequential order, you can demand a higher level of technique by the time you reach Projects 3 and 4. With minor modification, any or all of these activities can be done using 2D animation or 3D modeling and animation software.

The focus of the Intermediate level activities is the design, construction, and testing of a model rocket. These Intermediate level projects should be done in sequential order. However, Project 5 can be skipped and pre-designed rockets or rocket kits can be used. It is possible to move right into the Intermediate projects without completing the Introductory projects, but the scientific and technological principles behind the rocket's performance will not be well integrated into the class activities.

The advanced level will provide the opportunity to engage in an advanced research and design project. It will encompass multiple standards, determined by the project description developed by the student and instructor.

V. Projects

Introductory Projects

[Project 1: Comparing Vehicle Systems](#)

This project provides an opportunity for students to learn about vehicle systems in general and rocket systems in particular. Students will produce 2D graphics that compare and contrast the system components of a prototypical rocket to other vehicle systems.

[Project 2: Representing Forces Acting on a Rocket](#)

In this project, students will create visualizations representing the forces on the rocket during flight. Students will identify the forces acting on the rocket and represent them graphically in a series of 2D static graphics.

[Project 3: Representing the Effect of Wind](#)

This project will represent the effects of wind on the direction of the model rocket. One of the primary effects discussed is the principle of weather cocking. Students will use 2D static or dynamic graphics to represent this principle.

[Project 4: Multimedia Visualization of the Stages of Flight](#)

This project allows students to integrate the rocketry principles explored in earlier projects into a multimedia visualization of the stages of flight. Students will create a 2D or 3D dynamic visualization, merging the information being presented in a thrust x time graph of a model rocket engine combustion with a rocket in flight.

Intermediate Projects

Project 5: Rocket Design Refinement

In this project, students will use 2D and 3D graphic tools to create virtual prototypes of possible rocket model designs. These graphic representations will be used as part of the design process to help determine the best rocket design.

Project 6: Rocket Construction and Testing

In this project, students will build a rocket based on their design in Project 5. Part of the construction process will be testing the final model to make sure that it will be stable in flight.

Project 7: Rocket Launching and Performance Evaluation

In this project, students will launch and track the rocket. Measurements can be taken of wind speed and direction, and launch characteristics such as maximum height, time to apogee, hang time, and touchdown location. This data collected during the launch will allow students to graphically explore relationships between wind speed and direction and launch data. In addition, the performance of their rocket design can be evaluated by looking at the relationship between the launch data and the physical characteristics of the rocket designs.

Advanced Projects

Students will complete an independent project through the use of visualization tools by researching a new topic dealing with visualizing rocketry or by expanding on topics covered in this unit. The objective of the advanced level is for students to further their skills in integrating research, problem solving through the design brief approach, and presentation. It is up to the teacher to work with students to negotiate the topic, time allocated to the project, and design constraints.

VI. Unit Resources

The Resource index document contains a listing of all resources associated with the Unit. Included are relevant web site links, books, and other publications. Listed in the document are additional files found in the Resources folder under each Unit folder on the CD-ROM. Also included are the Glossary, Evaluation rubric, Lecture PowerPoint slides, and Unit test questions.