TEACHER'S GUIDE FOR

IN SEARCH OF SPACE:

INTRODUCTION TO MODEL ROCKETRY

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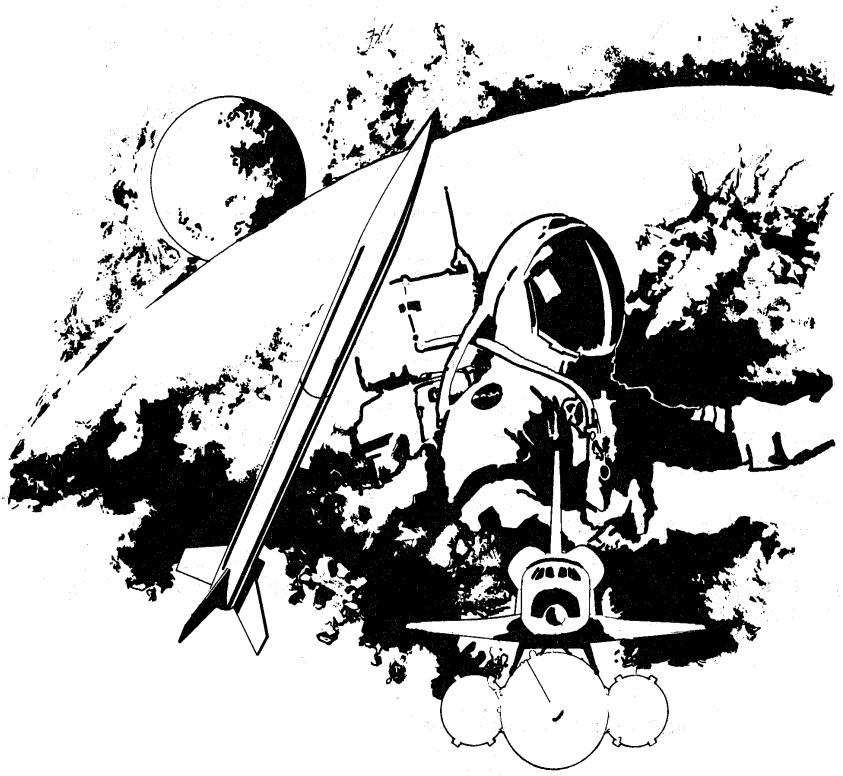

EST 9024

LESSON PLAN

GENERAL CONSIDERATION

This software product may be used for independent study. It is excellent for review for those who were absent when the material was originally presented or for those who need reinforcement of the information.

While the disk may be used as the only presentation made of the information, this is not recommended for a group situation. The software is designed for individual use.

To plan presentation of the material to the entire class, consider at least the following:

1. How much time can you allocate? One week is suggested.
2. How many copies of the disk will be available? The ideal situation is one disk per computer.
3. What information do you want the students to know? You may not wish to study the engine classification system and/or the structure of the model rocket engine, for example. Everyone should know the flight profile, model rocket parts and their functions and the safety code.

Once you have determined these parameters, allocate the available time. The following suggestions are based on a one week unit, one class period per day and one computer and disk per student or team of not more than three students.

SUGGESTED DAILY SCHEDULE

Monday

A. Introduce Model Rocketry
B. Review how to use the computer and disks, if necessary.
C. Give specific instructions on what to do today. Use of the Introduction and Model Rocket Flight Profile programs is suggested. Use the Model Rocket Flight Profile poster. Students learn using the software.

Tuesday

A. Review Monday's information.
B. Give specific instructions for today. Use of Parts of a Model Rocket program is suggested. Use the Parts of a Model Rocket poster.
C. Students learn using the software.

Wednesday

A. Review what has been learned so far.
B. Give specific instructions for today. Use of Model Rocket Engines is suggested.
C. Use the Model Rocket Engine poster.
D. Students use the appropriate programs to learn.
E. Teacher or students start selecting model rocket kits and engines to build and launch. This step may be done earlier. Limit the power of the engine which may be used if you have a small launch area and/or if wind is likely to be a problem. Allow two weeks or more from the time the order is placed until the kits are to be used if you order by mail. Allow one week if you purchase from a local store and you have informed the store's manager at least two weeks in advance about what you will need and he/she has agreed to help.
F. Students learn using the software.

Thursday

A. Review what has been learned so for.
B. Give specific instructions for today. Use of Model Rocket Engine Classification program is suggested.
C. Pass out a copy of the Model Rocketry Safety Code to each student with instructions to study, understand and learn it before class tomorrow.

Friday

A. Review as needed.

B. Let each student complete the Safety Code Review. Take down all posters and remove any other items which may provide information before they start. Let each student finish the review by him/herself. Those who get 20 of the 25 questions right will have an opportunity to see a "bonus" program. This bonus is a Tech Tip™ program on multi-staging. Take the students' orders for model rocket kits and engines or fill out your class order and mail the single combined order today or Saturday or take it to the store. Plan on building and launching on specific days in the near future. Announce these days now and include these activities in your lesson plans for those days.

OBJECTIVES

Select from this list those objectives which you want your class to meet.

1. Learn the stages in the flight of a model rocket.
2. Learn how the operation of the model rocket engine controls the various stages in the flight of a model rocket.
3. Learn the parts of a model rocket.
4. Learn how the operation of the model rocket engine controls the various stages in the flight of a model rocket.
5. Learn the parts of a model rocket engine and the function of each part.
6. Learn the rules in the Model Rocketry Safety Code.
7. Gain an appreciation of the importance of careful planning in maximizing the performance of a model rocket.
8. Understand the relationships between parts and functions for a model rocket.
9. Understand the relationship between parts and functions for a model rocket engine.
10. Understand the relationship between type of model rocket engine and height reached by a model rocket flight.
11. Experience success at gaining understanding through individual efforts.
12. Gain insight into cause and effect relationships through observation of small, safe, functioning devices to which the student can readily relate.
13. Experience the pleasure of using what has been learned.
14. Cooperate in a meaningful way with others in a project of mutual interest.

SUGGESTIONS

A model rocket can be an awe-inspiring device for a youngster. It is a real rocket. It flies. He/she can make one. And it will work! There aren't too many things which a youngster can build by himself/herself which really work as impressively as a rocket. Use their natural interest to pursue your own goals.

While the youngsters are so "turned on" by the rockets, supply them with the information and ideas you select. They will be a very receptive to these, if you supply them properly. In fact, the students may want to learn more and do more with rockets than you have time for! Capitalize on this high motivation to get each one to do his/her best. Get them thinking!

You need not stop with this basic coverage. Model rocketry offers much more. Use it, and the useful publications made available by Estes Industries, to help the youngsters learn how a "real" rocket works (and model rockets are real rockets.), how to cooperate to achieve a major goal, about the aerodynamic forces operating on flying objects, how to determine how high a rocket really went, how to make rockets stage automatically in midair and much more. Estes Industries has available other computer software to help your student (and you!) learn and understand these things and much more.

Maximum value is derived from this unit when the youngsters actually build and launch their own model rockets. The theories they have been studying suddenly become "real". They are suddenly in control of a real rocket, and their efforts determine the "success" or "failure" of the rocket. They can succeed in a series of short-term goals. There is much positive reinforcement of the concept, perhaps a new one to some, that he/she can succeed in school.

MODEL ROCKETRY SAFETY CODE

1.CONSTRUCTION - My model rockets will be made of lightweight materials such as paper, wood, rubber, and plastic, without any metal as structural parts.

2. ENGINES - I will use only pre-loaded factory-made NAR Safety-Certified model rocket engines in the manner recommended by the manufacturer. I will not alter or dismantle model rocket engines or their ingredients in any way or attempt to reload these engines.

3. RECOVERY - I will always use a recovery system in my rockets that will return them safely to the ground so that they may be flown again. I will use only flame-resistant recovery wadding in my rockets.

4. WEIGHT LIMITS - My model rocket will weight no more than 1500 grams (53 oz.) at lift-off, and the engines will contain a total of no more than 125 grams (4.4 oz.) of propellant. My model rocket will weigh no more than the engine manufacturer's recommended maximum lift-off weight for the engines used or will use the engines recommended by the manufacturer for my rocket.

5. STABILITY - I will check the stability of my model rockets before their first flight, except when launching models of already proven stability.

6. PAYLOADS - My model rockets will never carry live animals or payloads that are intended to be flammable or explosive.

7. LAUNCH SITE - I will launch my model rockets outdoors in a cleared area, free of tall trees, power lines, buildings and dry bush and grass.

8. LAUNCHER - I will launch my model rockets from a rod or other device which provides rigid guidance until the rocket has reached a speed adequate to ensure a safe flight path. To prevent accidental eye injury, I will always place the launcher so that the end of the rod is above eye level or will cap the end of the launch rod when approaching it. I will cap or disassemble my launch rod when not in use and will never store it in an upright position. The launch device will have a jet deflector to prevent the engine exhaust from hitting the ground directly. I will always clear the area around my launch device of brown grass, dry weeds, and other easy to burn materials.

9. IGNITION SYSTEM - The system I use to launch my model rockets will be remotely controlled and electrically operated and will contain a launching switch that will return to “off” when released. The system will contain a removable safety interlock in series with this firing switch. When launching, all persons will remain at least 15 feet away from any model rocket when igniting engines totaling 30 n-sec of total impulse or less and at least 30 feet when igniting engines totaling more than 30 n-sec total impulse. I will use only electrical igniters which will ignite my rocket engine within one second of actuation of the launching switch.

10. LAUNCH SAFETY - I will ensure that people in the vicinity are aware of the pending rocket launch and are in a position to see the rocket’s lift-off before I begin my audible 5-second countdown. I will not let anyone approach a model rocket on a launcher until I have made sure that the safety interlock has been removed or the battery has been disconnected from the launcher. In the event of a misfire, I will wait one minute before allowing anyone to approach the launcher.

11. FLYING CONDITIONS - I will launch my model rocket only when the wind is less than 20 miles (30 kilometers) per hour, and under conditions where the model will not fly into clouds, fly near aircraft in flight, or be hazardous to people or property.

12. PRE-LAUNCH TEST - When conducting research activities with unproven designs or methods I will, when possible, determine their reliability through pre-launch tests. I will conduct launchings of unproven designs in complete isolation from persons not participating in the actual launching.

13. LAUNCH ANGLE - My launch device will be pointed within 30 degrees of vertical. I will never use model rocket engines to propel any device horizontally.

14. RECOVERY HAZARDS - If a model rocket becomes entangled in a power line or other dangerous place, I will not attempt to retrieve it.

INTRODUCTION

IN SEARCH OF SPACE: INTRODUCTION TO MODEL ROCKETRY is an interactive software tutorial which helps you learn the basics of model rocketry. The programs on this disk utilize detailed graphics and user response to present the information and to monitor and reinforce the user's learning.

SOFTWARE CONTENTS

Introduction	Model Rocket Engines Classification
Model Rocket Flight Profile	Model Rocketry Safety Code
Parts of a Model Rocket	Safety Code Review
Model Rocket Engines	Tech Tip™ - Multi-Staging

Each program contains important and useful information about model rocketry. Graphics help you to visualize and understand what is being said. The computer will ask you questions periodically to make certain that you understand some key points.

SUMMARY OF THE PROGRAMS

The programs are interactive. Periodically the user is asked questions about what has just been learned. The computer responds to each answer appropriately. The computer may congratulate the user for correct responses, suggest other possible answers, chide the user for the wrong answer or review the information for the user.

Introduction

This program introduces model rocketry, provides credits to the individuals who developed this software and the products used in the disk, provides special instructions on the use of the disk and contains the Main Menu.

Model Rocket Flight Profile

This program illustrates the steps in a typical flight sequence for a single stage model rocket. It includes selection of the model rocket engine, insertion of the electrical igniter, recovery wadding insertion and parachute packing. The rocket is placed on the launch pad and micro-clips are attached to the igniter. The rocket is launched, accelerates to maximum velocity, coasts to apogee while emitting smoke to aid in tracking the flight, ejects the parachute and is recovered safely.

Parts of a Model Rocket

The parts of a model rocket are illustrated and their functions explained in this program. The body tube, nose cone, fins, launch lug, engine, engine hook, shock cord, parachute and shroud lines are shown and discussed.

Model Rocket Engines

The three basic sizes of model rocket engines are illustrated and described. The parts of a model rocket engine (casing, nozzle, propellant, delay element, ejection charge and clap cap) are shown and their functions explained.

Model Rocket Engine Classification

The coding system used to classify model rocket engines is explained. The learner discovers how to determine the total impulse of the engine in newton-seconds, how to find the average thrust of the engine in newtons and how to tell the engine's delay time in seconds.

Safety Code

The National Association of Rocketry, Hobby Industry of America Model Rocketry Safety Code.

Safety Code Review

The user of this software should study the Model Rocketry Safety Code before using this program. The safety code is printed on page 4 of the Owner's Manual and on pages 6 and 7 of this Teacher's Guide. This safety code should be reproduced and given to each student to study and to follow. After each individual has learned the rules, he or she may use the Safety Code Review program.

For this program, the correct responses are not given after each question, but a total score is given at the end. As a bonus for doing well on this review, those who answer correctly 20 or more of the 25 questions will have the opportunity of seeing a special message from Tech Tip™ about multi-staging.

Tech Tip™ -- Multi-Staging.

SAFETY CODE REVIEW

This is the review on the disk. You can easily write your own review. Be sure to adjust the wording of the questions used to the reading level of your students.

1. My model rocket will weight no more than _____ ounces with the engine in place.
   A. 16
   B. 30
   C. 40
   D. 53
   E. 1500
2. I must always test each new model rocket I design and build before I launch it.
   A. True
   B. False
3. Before anyone approaches the launch pad after the launch, always remove the _____ from the launch controller
   A. Rocket
   B. Safety key
   C. Launch pad
4. I will use only pre-loaded, factory-made _____ safety certified model rocket engines in the manner recommended by the manufacturer.
   A. NAR
   B. HIA
   C. NASA
   D. USDA
5. NAR stand for
   A. Nation Assembly of Regents
   B. National Association of Rocketry
   C. Nashville and Rio Grande
   D. North American Rocketeers
6. Select the characteristics of a good launch site:
   A. Free of any easy to burn materials
   B. Not more than one tall tree within 15 feet of launch pad
   C. Close to an active airport
   D. Away from power lines
   E. None of the above
   F. A,B,D
7. What is the maximum height of telephone pole or power line pole which I should climb to recover my rocket should it become caught in the wires?
   A. 0 feet
   B. 15 feet
   C. 30 feet
   D. 45 feet

8. Select the permitted construction materials for building model rockets from this list.
   A. Paper and metal
   B. Plastic and metal
   C. Rubber and flubber
   D. Paper, plastic and balsa wood
   E. Any of the above
9. How many times may a model rocket engine be safely reloaded to use again?
   A. None
   B. Three
   C. Fifteen
   D. Until it starts to show signs of wear
10. I will always us a _____ in my rockets that will return them safely to the ground so that they may be flown again.
   A. Nose Cone
   B. Fins
   C. Recovery system
   D. Model rocket engine
11. When conducting research activities with unproven designs or methods, I will, when possible, determine their _____ through prelaunch tests.
   A. Stability
   B. Weight
   C. Size of parachute
   D. Number of fins
12. I will use only _____ recovery wadding in my rockets.
   A. Colored
   B. Flame-resistant
   C. Cotton
13. The launch control system I use to launch my model rocket must be _____.
   A. Remotely controlled
   B. Electrically operated
   C. Commercially manufactured
   D. A and B
   E. B and C
   F. A and C
14. My launch pad will have a jet deflector device to make the rocket's exhaust move back into the air parallel to the rocket's axis.
   A. True
   B. False
15. To prevent accidental eye injury I will always place the launcher so the end of the _____ is above eye level or cap its end with my hand when approaching the launcher.
   A. Blast deflector plate
   B. Launch pad leg
   C. Launch rod

16. I will conduct launchings of unproven designs in complete isolation from _____.
    A. Persons not participating in the actual launch
    B. Grass
    C. The Range Safety Officer
    D. Visible trees
17. When my launcher is not in use I will always store it so that the launch rod _____ in an upright position.
    A. Is
    B. Is not
18. I will not launch rockets so that their flight path will carry them against targets on the ground.
    A. True
    B. False
19. My model rockets can carry which types of payloads?
    A. Aerial cameras
    B. Grasshoppers
    C. Radio transmitters
    D. Explosive warheads
    E. None of the above
    F. A and C
20. I will always launch with my launch rod pointed within _____ degrees of vertical.
    A. 0
    B. 15
    C. 30
    D. 45
21. When I release the launch button on my launch controller, the switch must return to _____.
    A. On
    B. Off
22. A friend built a cluster-powered rocket using 6 D engines. Unlikely as it seems, he managed to build it so that it passed the string test for stability. Its total weight is just under one pound when it is fully prepared for launch. The total weight of propellant is just over 5.4 ounces. Why may this rocket not be launched?
    A. Total weight is over eight ounces
    B. Propellant weight is over one ounce
    C. Cluster-powered rockets are illegal
    D. Propellant weight exceeds permitted propellant weight
23. I must always remain at least _____ feet away from the launch pad when launching my model rocket powered by one D engine.
    A. 5
    B. 15
    C. 30
    D. 45

24. Select the condition which will prevent me from launching model rockets.
    A. High winds
    B. Tall trees nearby
    C. Low flying aircraft nearby
    D. Power lines nearby
    E. All of the above
    F. None of the above
25. Which is a better launch site, if other conditions are equal
    A. A field covered with ankle high green grass
    B. A freshly mowed field of brown grass and weeds

Answers to "Test on Safety Code"

1. D
2. A
3. B
4. A
5. B
6. F
7. A
8. D
9. A
10. C
11. A
12. B
13. D
14. B
15. C
16. A
17. B
18. A
19. F
20. C
21. B
22. D
23. B
24. E
25. A

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