TEACHER'S GUIDE FOR

FLIGHT:

AERODYNAMICS OF MODEL ROCKETS

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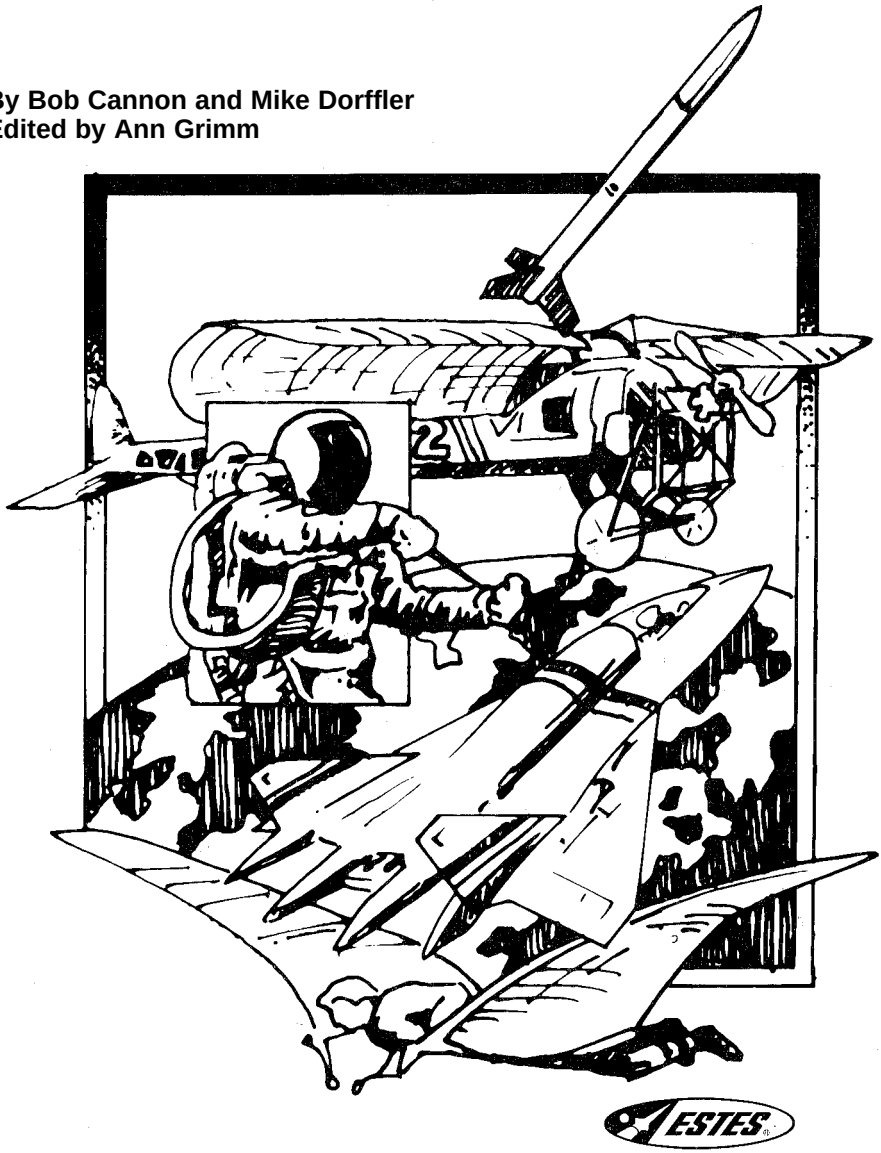

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LESSON PLAN

GENERAL CONSIDERATION

This software product may be used for independent study. It was designed to be an excellent tutorial for an individual to learn about the forces which effect flying objects in flight, especially with respect to model rocketry. The coverage is broad enough to include all flying objects. The programs are very suitable for review for those who were absent when the material was originally presented or for those who need reenforcement of the information. 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 learn? You may not wish to study all the programs even though they were designed to be used in sequence. You may wish to have the students learn part of the material from each program. Determine in advance exactly what learning goals you hope to achieve. 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 disk per student or team of not more than three students.

SUGGESTED DAILY SCHEDULE

Monday

A. Introduce the topic.
B. Review how to use the computer and disks, if necessary.
C. Give specific instructions on what to do today. Use of the Introduction program is suggested.
D. Use the Forces on Flying Objects poster. Students learn using the software.

Tuesday

A. Review what was learned yesterday
B. Give specific instructions for today. Use of Aerodynamics program is suggested. Instruct students how to go to this program. Use the Stall, Glide and Dive poster.
C. Students learn using the software.

Wednesday

A. Review what has been learned so far.
B. Give specific instructions about what is to be done today. Use of Drag program is suggested.
C. If your class is going to build and fly model rockets, and hopefully gliders launched on model rockets, teacher or class members start selecting the kits and engines they will use.
D. Students learn using software.

Thursday

A. Review what has been learned so far.
B. Give specific instructions for today's work. Use of Center of Gravity / Center of Pressure program is suggested.

Friday

A. Review what has been learned
B. Give specific assignments for today's work. Use of the Stability program is suggested. Use the Center of Gravity/Center of Pressure poster.
C. Let each student have a chance to see the Tech Tip™ program. Take the students' orders or fill out your class order for model rocket kits and engines and mail it today or Saturday or take it to the store. Plan on building and launching the model rockets and/or model rocket launched gliders on specific days in the future. Announce these days now and include these activities in your lesson plans for those days.

OBJECTIVES

Select from this list the objectives you want your class to meet.
Add other objectives as applicable.

1. Learn the four forces affecting the flight of all flying objects.
2. Understand the effects of each of these four forces.
3. Understand the concept of relative wind.
4. Learn how to spell "aerodynamics" and what the word means.
5. Understand how the fins apply a corrective force to keep the rocket flying straight.
6. Learn how a side wind affects the direction of flight of a model rocket.
7. Understand how air flows over the surfaces of objects moving through the air.
8. Learn the effect of angle of attack on the amount of lift generated.
9. Understand what causes a stall and how it can be avoided.
10. Understand what causes a dive and how it can be avoided.
11. Learn why a good glider will not climb.
12. Discover the factors which affect drag and the relative importance of each in determining the total drag experienced by a flying object.
13. Find out the different problems which may arise in construction which may increase the drag on a model rocket and how to minimize each.
14. Discover the effects of changes in the density of air on the flight performance of a model rocket.
15. Learn what is meant by the center of gravity and center of pressure and the relationship which they must have if a model rocket is to be stable in flight.
16. Learn how to move the center of gravity and the center of pressure to improve the flight performance of a model rocket.
17. Experience the joy of learning new concepts.
18. Experience the thrill of applying new concepts.

SUGGESTIONS

Model rockets are exciting learning aids. Many different concepts can be learned while your students are excited by the model rockets. Understanding the principles of flight is much more fun when concepts are applied, as they are in the flight of model rockets and model rocket launched gliders. Let your students experience the unforgettable fun of building and launching their own model rockets. Emphasize that the rocket is his or hers and that its performance is totally under the control of the student. "You build it right, it flies right! You make mistakes in its construction, these mistakes will affect its flight, and you can see the changes in its flight path."

The Drag Formula is a real formula. It produces useful results. You might let your students actually solve some problems involving variations in one factor at a time. Perhaps they can devise some simple experiments which can be performed when they launch model rockets to test the theoretical results achieved when the formula is solved for each change in a variable. Solve the formula when you change different variables. Validate your results through experimentation. Emphasize that the formula is simply a way of looking at a series of separate items.

INTRODUCTION

FLIGHT: AERODYNAMICS OF MODEL ROCKETS is an interactive software tutorial which helps you understand why objects are able to fly. Emphasis is placed on the flight of a model rocket, but flight in general and the factors which influence the performance of all flying objects are discussed.

The software consists of a series of programs designed to be used in sequence. Each program builds on what was learned in the previous program. Detailed graphics and periodic user responses are utilized in the presentation of the information to monitor and reinforce the user's learning.

SOFTWARE CONTENTS

SUMMARY OF THE PROGRAMS

The programs are interactive. Periodically the user is asked questions about what has just been learned. The computer responds based on the answer provided by the user.

Introduction

This program provides information on how to use the disk. It also includes the Main Menu. The concept of relative wind is introduced.

Forces on Flying Objects

The concepts of lift, drag, gravity and thrust are explained and illustrated as they relate to flying objects.

Aerodynamics

Aerodynamics is defined. The effects produced by relative wind are examined. Fins and wings are compared. Flat and curved surfaces and the importance of the angle of attack are examined. The correlation between the angle of attack and the amount of lift produced and stalls is examined. The cause of a dive is examined. Stalls, glides and dives are compared. The correlation between amount of thrust and speed of the aircraft is examined.

Drag

The causes of drag are examined. Good finishes are compared to poor finishes. The effect of speed on drag is explained. The connection between the size of the object and the amount of drag it produces is examined. The Drag Formula is presented. The various factors in the formula are explained and their importance in determining the total drag are evaluated. Examples of construction features which produce high drag are explained so that you can minimize them in the design and construction of your own model rockets. Factors which affect the density of air are examined. The importance of speed in producing drag is explained. Rockets are compared for features which affect their performances.

Center of Gravity/Center of Pressure

The concepts of center of gravity and center of pressure are explained. How each is determined is examined. The importance of the relative positions of these two points is discussed. How to move each is explained. The importance of this relationship to the stability of the model rocket is explained.

Stability

The importance of the correct relationship between the center of pressure and the center of gravity to stability is reviewed. Different rockets are analyzed for factors which affect their stability. A technique for testing the stability of a model rocket in flight without using a mathematical analysis or using a wind tunnel is presented.

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