Powered Flight

Description of Unit of Study

Overview

This unit of study titled "Powered Flight" was presented in a high school level Technology Education course called "Innovation and Invention." Through study of this unit, students not only learn how aircraft fly, they also learn how to apply knowledge gained in other areas of the school curriculum through a design project. Each student is challenged to research, design, construct, and put on display an actual flying aircraft.

Description

The teacher begins the unit of study by leading the class through a discussion that begins with the question "How exactly do airplanes fly?" This discussion leads into a presentation about key people and events in the history of aviation.

The teacher then asks the students to participate in a computer flight simulation activity. Over the next few days the teacher challenges the students to not only take off and land the simulator safely, but also to navigate the their way from airport to airport. During the simulation activity, topics in math and science are discussed when appropriate including topics such as directional angle measurement and simple geography.

After a few days at the simulator, the students may still be wondering how airplanes actually fly. The students know from the simulator controls that it must have something to do with airspeed and the angle and shape of the wings, but most are still not sure. The teacher then gives the class a short lesson about how airplanes fly. The teacher explains that there are four forces that act on an aircraft while in flight. There is a forward force called thrust, an upward force called lift, a backward force called drag, and the downward force of the weight of the plane that is caused by gravity. The teacher explains that aerospace engineers are challenged everyday to maximize the thrust and lift forces while keeping the drag and weight of the airplane to a minimum.

Next, the teacher delivers a brief lesson on the concept of ratios. It is explained that ratios are an important thing for aircraft designers to understand because a balancing act needs to be played with the four forces acting on an aircraft. If the thrust and lift forces are greater than the drag and weight forces, the airplane will fly. The students come to understand how ratios are applied in a real life context rather than pondering over numbers on a piece of paper. The following day, the teacher presents a short series of demonstrations that introduce the science concepts of Bernoulli's principle and center of gravity, as these are also important in powered flight.

The teacher then announces that over the next few weeks the students will actually have the chance to design and build a powered aircraft using some materials that will be provided in class. The students will receive a small electric motor, a plastic propeller, some foam material, balsa wood, and electrical wire.

After the students are clear about the criteria for the project set by the teacher, they are challenged to do some research about how airplanes are designed and constructed. The students form design teams and venture to the school library to try to find some resource materials. In the library the students may find a few books, some magazine articles, and a few good sources from the Internet, all of which contain some bits of information about how airplanes are designed and how they fly.

After finding some good information, each team is ready to brainstorm alternate ideas for the aircraft design. After the teams have developed a few alternate solutions, the students must decide which design they will develop further. Not only will the students have to make a decision, but they also know that the teacher will ask them to justify their decision based on the project criteria. The students finally decide which solution they will try to build and begin to plan for construction.

After checking their completed plans the teacher gives the students the materials they will need to build their airplane. Over the next few days the students put their plans into action as they meticulously construct a body, wings and other parts of the their airplane. Each one of the teammates has the responsibility to produce one component of the aircraft and the students work hard because they know their work is being counted on by others.

The students have now spent a few hours worth of class time working on their prototype aircraft and all the pieces seem to be together. The teacher has set up an apparatus in an open area of the room for the students to tether their prototype for a flight test. The students are very anxious to see what will happen during the first test. The teacher warns that success on the first attempt is rare. Now the real problem solving begins, as the students will need to make a series of tests, observations, and adjustments that will hopefully lead to successful, sustained flight.

During each test, the students analyze the flight of their aircraft. If it is not successful they must redesign and readjust the aircraft in an attempt to gain a successful flight. After a successful flight, the students must finish their aircraft by painting it.

Upon completion of the designing, building, testing and redesigning phases of the activity, the students then are required to create a one page technical document about the aircraft that they have produced. The document must report information including designer's names, at least one photograph of the actual constructed aircraft, at least two paragraphs describing the aircraft and any special features, maximum speed in feet per second, dimensions for wing span and length, weight, and minimum power (watts) required for sustained flight.

In a culminating activity, the students prepare for and display their work during an school event called "Flight Day." Flight day takes place on December 17th of each year to celebrate the anniversary of the Wright Brother's original powered flight. The students from the Technology and Design class fly their aircraft in the student commons area of the school during the school lunch periods. Flight simulators, educational videos, and other displays are also included in the activities which are open to all students and faculty for their active participation. In addition, several other teachers from the school deliver

lessons related to powered flight. As examples, students in select Spanish classes learn about airplane vocabulary, students in some mathematics classes learn how to calculate the surface area of an airplane's wing, and students in history classes view a presentation about the history of flight.