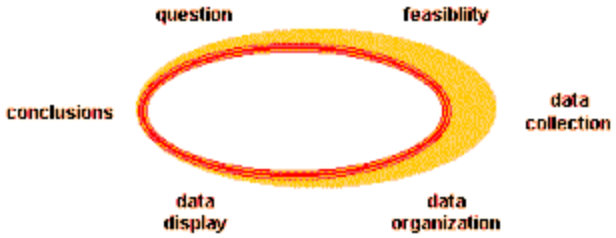
Lift on a Wing

LEARNING AREA: Inquiry & Research
EDUCATIONAL LEVEL: Middle School
CONTENT STANDARD: Inquiry

STANDARD: A student shall design and conduct a controlled experiment or investigation and interpret the results by:

1. Using relevant information to generate a hypothesis or frame a question in a given topic;
2. Defining the controls, variable, and sample size or number of repetitions;
3. Setting up a method to test the hypothesis;
4. Determining how to record and organize data;
5. Conducting experiment and record data;
6. Analyzing data and evaluating the hypothesis; and
7. Identifying areas for further investigation;

LARGE PROCESSES/CONCEPTS---



NEXT STEP: Assessment Task

Lift on a Wing continued---

Assessment Task---

Description:
After studying principles of flight, students will design, construct and test an airplane wing in order to determine its lift and stall characteristics. Students will follow set laboratory procedures and complete a report of their findings.

PRODUCTS/EVIDENCE OF LEARNING:

1. Design a wing
2. Construction of wing
3. Test of wing
4. Summary of test results

Overview: The overall objectives are to find the lift and stall characteristics on an airplane wing and describe results by applying Bernoulli's principle.

Problem:
A number of variables contribute to lift on an airplane wing. Since lift is critical to the safe operation of an airplane, the lift and stall characteristics of a particular wing design must be determined.

Solution:
Test wing position in a wind tunnel by incrementally increasing the angle of attack at various speeds to determine lift and stall characteristics.

Procedure:

1. Each student will design and construct an airplane wing out of balsa wood and plastic. Wings may have a maximum width of three inches and a maximum length of nine inches. Chamber and edge design determined by student.
2. Test wing in wind tunnel. The controls, variables, and number of repetitions are as follows: Wind direction will be "head on" and remains fixed. Each wing will be tested at three different air speeds. The angle of attack will start at zero degrees and increase one degree at a time. Repetitions will be determined by when stall begins. **TEACHER NOTE:** You can construct a wind tunnel by using two circular garbage cans connected by a clear Plexiglas tube. A leaf blower could be used as a source of wind.
3. The student will record data.
4. The student will summarize data and explain how Bernoulli's principle applies to their test results. Data summary to include; point at which optimal lift and stall occurred at each air speed as well as an explanation of the why each occurred.

Data Form Sheet on next page---

Minnesota Department of Transportation • Office of Aeronautics • Aviation Education Section
222 E. Plato Boulevard, St. Paul, MN 55107-1618 • www.mnaero.com/aved • 651-297-1600 | © 2000

Lift on a Wing continued---

Data Form Sheet---

AIR SPEED	#1	#2	#3	
				0 degree
				1 degree
				2 degree
				3 degree
				4 degree
				5 degree
				6 degree
				7 degree
				8 degree
				9 degree
				10 degree
				11 degree
				12 degree
				13 degree
				14 degree
				15 degree

Minnesota Department of Transportation • Office of Aeronautics • Aviation Education Section
222 E. Plato Boulevard, St. Paul, MN 55107-1618 • www.mnaero.com/aved • 651-297-1600 | © 2000

Lift on a Wing continued---

Check List:

STUDENT	TEACHER	
_____	_____	Shows a design that meets project specifications
_____	_____	Completed construction of a wing
_____	_____	Shows that observations were sufficiently made
_____	_____	Shows that data identifies angle of stall
_____	_____	Data used effectively to describe Bernoulli's principle
_____	_____	Provides a summary of the findings in written form

Minnesota Department of Transportation • Office of Aeronautics • Aviation Education Section
222 E. Plato Boulevard, St. Paul, MN 55107-1618 • www.mnaero.com/aved • 651-297-1600 | © 2000