The Evergreen Aviation Museum, co-founded by Delford M. Smith, Chairman and CEO of Evergreen International Aviation, Inc., and his son, Captain Michael King Smith, opened to the public on June 6, 2001, showcasing the famed Howard Hughes’ *Flying Boat*, the “Spruce Goose”.

Our threefold Mission is:

- **To Inspire and Educate,**
- **To Promote and Preserve Aviation and Space History,**
- **And to Honor the Patriotic Service of Our Veterans.**

The Museum accomplishes this mission through:

- Programs at the Educational Institute for youth, ages K–12
- The collection, preservation and display of historical aircraft and aerospace artifacts
- Special events and recognition ceremonies to honor the patriotic service of veterans, as well as the support of their families

The Evergreen Aviation & Space Museum includes a 121,000 square foot Aviation Museum specifically dedicated to aviation history, and a 55,000 square foot IMAX® 3D Theater that showcases static displays and the Oregon Aviation Hall of Honor. The Museum currently has more than 80 vintage and historic aircraft on display. The Museum is located in the heart of Oregon’s wine country, 45 minutes south of Portland (the largest urban metropolitan city in Oregon) and an hour from the Central Oregon Coast.

In June of 2008, an additional 121,000 square foot Space Museum facility will open to the public. This facility is located directly next to the Aviation Museum and will showcase twelve comprehensive galleries dedicated to the history of space exploration and related technologies, which will include Titan II and Titan IV interactive missile exhibits like no other in the world.
Table of Contents

Lesson 1

People in the Airport .................................................. 3-4
Transparency: AIRPORT PICTURES .............................. 5
Student Handouts: MY AIRPORT JOB ......................... 6-7
Student Handout: AIRPORT PEOPLE ......................... 8

Lesson 2

What Flies? ................................................................. 9

Lesson 3

What Forces Makes Airplanes Fly? .............................. 10-11
Transparency: WINGS .................................................. 12

Lesson 4

What Forces do Airplanes Need to Overcome? .......... 13-14
Student Handout: FORCES OF FLIGHT .................... 15
Student Handout: AVIATION WORD SEARCH ............... 16

Resources

Fun Aviation Facts ...................................................... 17
Oregon Standards ...................................................... 18-20
Resources .............................................................. 21
Lesson 1: People in the Airport

Materials
- Pictures of airport people *(pilot/co-pilot, flight attendant, air traffic controller, ticket/baggage collector, security operator)
- Instructor Transparency: AIRPORT PICTURES
- Student Handouts: MY AIRPORT JOB
- Student Handout: AIRPORT PEOPLE

Objective
In this activity, students learn about the different people from their community that they might see at an airport and how those people play a part in keeping that airport running.

Activity
1. Airports are exciting places and it is full of dedicated members of society who work together to make sure things run smoothly. Tell your class that you will be talking about the airport and ask if anyone has ever been to one. Who did they see?

2. Give your students an idea of who they might see at the airport by showing them the transparency AIRPORT PICTURES of airport personnel and talking about their jobs at the airport. You can use additional pictures to show what equipment they use or where they might be seen at the airport. Be sure to point out their clothing which is essential to their identity.

3. After the discussion, give each student a copy of student handout MY AIRPORT JOB and invite your students to choose the title of their airport person and have them write a few words or sentences describing what their person does. Collect the students’ finished projects and string them onto a piece of yarn for display. The students can look back at the artwork to review the various roles that people play at the airport and admire their accomplishments.

4. To further assess your students’ understanding, have them complete student handout AIRPORT PEOPLE.

*See next page for additional information
Lesson 1

Instructional Information

* **Pilot/Co-pilot** fly people and cargo. They are responsible for the aircraft, crew and passengers. The pilot sits to the left in the cockpit and the co-pilot sits to the right.

**Flight Attendants** are men and women on the airplane who ensure the safety of the passengers. They are also responsible for the comfort and care of these passengers. Other duties include managing entertainment, distributing food and completing sales transactions. Flight attendants are well trained individuals.

**Air Traffic Controllers** watch over planes in the air from a tower at the airport. They direct take-offs, landings and watch radar to track the plane’s route. Making sure planes don’t collide is another part of their job.

**Ticket/Baggage Collectors** check your tickets and weigh your baggage before you get onto the plane. They help to track how many seats on the plane are filled and how much weight the plane can carry.

**Security Operator** make sure the airport is safe. They check your bags and clothing to make sure you don’t bring anything on the plane that is not allowed.
AIRPORT PICTURES

Pilot/Co-pilot

Ticket/Baggage Collector

Air Traffic Controller

Flight Attendant

Security Operator
MY AIRPORT JOB

Name: ______________________

Airport Job Title

This is what I do: ______________________

______________________________

______________________________

______________________________

______________________________

______________________________
MY AIRPORT JOB

Name: __________________________

Airport Job Title

This is what I do: ____________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________
AIRPORT PEOPLE

Match the airport person with their correct picture and description below by drawing a line:

**Pilot/Co-pilot**
I check your bags and clothes to keep you safe.

**Flight Attendant**
I watch over the planes in the sky.

**Air Traffic Controller**
I fly the plane and sit in the cockpit.

**Security Operator**
I take your bags and give you your tickets.

**Ticket/Baggage Collector**
I watch over your safety on the plane and bring you food and drinks.
Lesson 2: What Flies?

Materials

- Several pieces of large butcher paper
- Crayons
- Magazines

Objective

In this activity, students will explore and categorize things that fly.

Activity

1. Begin this lesson by brainstorming with your students’ suggestions of objects or animals that fly (e.g., bubbles, bats, planes, birds, kites, balloons). Write their ideas on a large sheet of butcher paper.

2. Talk about the different qualities of flying. What does it look like to zoom or float? To flutter or soar? Have your students act out zooming, floating, fluttering and soaring.

3. As a whole group, sort the things on your brainstorm list in those categories.

4. Have your students cut out pictures from magazines of objects or animals that fly. Invite them to sort their items into categories of their own and have them explain their reasoning for the groupings. Suggest some categories to get them started (e.g., objects and animals, fast and slow, big and small). How many different ways are there to group the items?

5. Have your students make a mural of the things that fly on a piece of butcher paper. Sketch or cut and paste from magazines, a few mountain peaks or building tops along the very bottom of the paper, leaving most of it blank. Let the children make a mural by filling the blank paper (the sky) with drawings and cutouts of all the flying objects or animals they can think of.
Lesson 3: What Forces Make Airplanes Fly?

**Materials**

- Thin strip of paper: 2” x 6”
- Large butcher paper
- Instructor Transparency: **WINGS**

**Objective**

In this activity, students will perform experiments to learn about the forces of lift and thrust, which help planes fly.

**Activity**

1. To begin this activity, ask your students how airplane wings are similar to animals wings. How are they different? Why might scientists study the wings of animals? Tell them about the *Wright Brothers and how they studied birds to figure out how to achieve lift off.

2. Show the transparency **WINGS** and discuss the similarities and differences between the wings of planes and birds. Share that both react in similar ways to air to make them fly. As the aircraft moves forward into a stream of air, the wing deflects the air. Some of the air flows above the wing, while some of the air flows below the wing. The upper surface of the wing is curved to make the air flowing above the wing move more quickly than the air that was able to flow below the non-curved bottom of the wing. Since the air on top of the wing is moving more quickly it reduces the pressure put on the wing. Meanwhile, the air that is moving at a consistent speed underneath maintains its rate of pressure. This quick pressure differential produces “lift”, the first force responsible for making planes fly.

3. Have your students demonstrate lift with a 2” x 6” strip of paper. Invite them to hold the strip of paper in place just under their lower lips, touching their chins and blow over the top of it. The paper will go upwards because the quick air moving on top reduces the air pressure pushing down on it so that the constant air pressure underneath pushes it up. Blowing underneath the strip will have little effect. Have your students experiment with the idea of lift. Give them time to change the dimensions of the paper, the type of paper, and/or add paper clips to the end of the strip.

*See next page for additional information*
4. Describe to your students how air is not empty space but acts more like water. Air is filled with molecules and can apply pressure and occupy space. The Wright Brothers used wind tunnels to test wing shapes, which led to the discovery of this principle. If there is a sink available, you can also show your students how air moves over a wing by placing a spoon in a stream of water. Students will think that the water will be displaced away from the spoon, but it actually curves along the spoon instead. Air molecules do the same thing on a curved wing.

5. Another force that assists in airplane flight is called thrust. Humans and animals create thrust everyday. Birds use their wings and humans use their legs to move forward. Have your students stand up and jump up and down. How were they able to jump into the air? Their muscles were responsible for providing the needed thrust. How can we jump higher in the air? Trampolines, catapults, springy shoes, pole vaults, and of course, stronger muscles can give us greater thrust. Airplanes gain thrust from their engines, either propeller or jet. As the engine turns the propeller, air is pushed backwards, causing the plane to go forward. Swimmers move forward in water in a comparable fashion. By pushing water backwards, they move forward.

**Instructional Information**

*The Wright Brothers:* Orville and Wilbur Wright were from Dayton, Ohio, born to a minister and his wife. After receiving a helicopter-like toy from their father as children, flying fascinated them. In their twenties they opened a bicycle repair shop and used bicycle parts in many of their inventions. In 1896, Wilbur read of a famous German glider pilot and was inspired to pursue his interest in aviation. A few years later he wrote to the Smithsonian Institute for additional information on aeronautical research. He had soon read all that was written about flying. Through the Wright Brothers inventions of kites and gliders, they discovered key elements to a controlled flight. They used wind tunnels to develop wing shape, made an engine to provide the necessary thrust and developed the three axes of flight. In 1903, the brothers moved to Kitty Hawk, North Carolina to test their latest invention: The Wright *Flyer*. It was made of wood and fabric and had a simple, 4-cylinder engine. On December 14, 1903, Wilbur won a coin toss and was the first to attempt to fly the machine. Being overly excited, he pushed too far on the elevators and stalled the *flyer*. He also crashed it, causing them to spend two days repairing the elevator. On December 17, 1903, it was Orville’s turn and he flew 120 feet in 12 seconds. They took four more flights that day, the longest being 852 feet in 59 seconds. The original *flyer* can still be seen at the Smithsonian Institute and a replica of the original is on display at the Evergreen Aviation & Space Museum.
WINGS

AIRPLANE WING (AIRFOIL)

BIRD WING (AIRFOIL)
Lesson 4: What Forces do Airplanes Need to Overcome?

Materials
- Two sheets of paper
- Balls of various sizes and weight
- Large beach towel
- Student Handout: FORCES OF FLIGHT
- Extended Activity: Student Handout: AVIATION WORD SEARCH

Objective
In this activity, students will learn how airplanes have to overpower the forces of drag and weight by using simple experiments and fun discussions.

Activity
1. Review the forces that were discussed in the previous activity with your class. Have your students tell you what lift and thrust do to make a plane fly. Explain to them that they are going to learn about two forces working against both lift and thrust, called drag and weight.

2. Select volunteers to come up and give them various balls. Assign them the task of trying to make the ball stay suspended in the air. After many tries, they will not be able to do it. Why can’t the balls float?

3. Gravity is the reason for this. Ask your students if they have heard of gravity and have someone tell the class what it is. Expand on the explanation given to inform the whole class about this force. State the balls were not able to stay in the air because gravity was pulling them back to Earth. Discuss how gravity pulls all kinds of materials: weight, water, people and animals toward Earth. Everything! It even pulls the Moon. Even though airplanes are in the sky, they are still pulled by gravity. This force is always at work, pulling everything downward. Gravity is one force that works against lift and thrust.
4. Drag is the second force working against lift and thrust. Drag works to slow the motion of an object, due to air resistance. Have your students recall the discussion from the previous lesson about how air is not empty. Air resistance pushes against the plane and slows it down. As air flows over an aircraft, there is an internal friction that makes it resistant to flow and it wants to stick to a plane. Objects with big areas, like parachutes, have more air resistance. The shape of an airplane determines how much drag there is. The more space there is for air to move over, the more drag there will be. To demonstrate this, each student will need two pieces of paper. Have them crumple one and leave the other one flat. The students will then hold the papers at an equal height and drop them at the same time. Which one fell faster? Why? The students will determine that since the flat paper is bigger, more air can hit it to slow it down.

5. To further illustrate drag, get a large beach towel and/or sheet and a location where you have space to run. Then inform your students that you are going to experiment with air resistance known as drag. Have them think about whether you are going to be able to run faster with the towel bunched up behind you or open. Do the experiment and discuss the results. If appropriate, allow your students to try this out for themselves so they can feel the force slowing them down. Next, you might want to have them compare the amount of drag between different sized towels.

To check their understanding, have the students return to their seats and complete the student handout **FORCES OF FLIGHT**.

**Extended Activity:** Have students complete the **AVIATION WORD SEARCH** to become more familiar with aviation terms.
FORCES OF FLIGHT

1. **Circle** the plane that has more DRAG:

![Plane Images]

Fill in the blank:

2. _______________ is invisible, but helps planes fly.

3. **Label** the forces of flight (lift, thrust, drag, gravity (weight)) on the plane below.
AVIATION WORD SEARCH

| P | G | I | L | F | F | L | E | T | X | T | Y | I | A |
| M | C | F | H | L | C | M | N | I | B | H | Y | L | T |
| N | O | B | T | I | D | B | N | O | Y | N | C | R | R |
| T | C | A | A | G | V | R | B | A | N | M | O | Q | S |
| X | F | L | R | H | E | S | A | R | L | P | I | T | A |
| P | I | L | O | T | H | G | W | G | R | L | K | D | C |
| D | C | O | M | A | G | J | U | I | J | E | T | Q | L |
| N | O | O | E | T | B | N | A | S | A | F | D | H | J |
| O | P | N | K | T | D | J | H | A | W | E | S | S | K |
| F | W | E | D | E | W | Q | H | X | Z | F | G | R | R |
| V | B | N | J | N | W | E | L | G | R | E | S | D | R |
| F | J | E | L | D | L | U | I | M | G | J | L | E | D |
| S | D | V | B | A | F | V | F | G | Q | M | T | D | N |
| P | U | J | E | N | Y | J | T | S | H | P | E | T | F |
| O | N | A | L | T | I | U | F | Q | O | T | W | H | D |
| C | O | C | K | P | I | T | O | C | K | A | I | R | C |
| X | L | M | D | D | G | V | I | T | G | P | J | U | B |
| K | N | M | H | J | C | L | C | W | G | L | I | S | M |
| V | O | C | I | Q | E | U | B | A | U | E | U | T | L |
| C | B | X | L | H | Z | O | Q | W | I | N | G | H | A |

Drag       Lift       Wing       Airport
Weight     Pilot      Cockpit    Thrust
Balloon    Jet        Helicopter Flight Attendant
Fun Aviation Facts

- Hot air balloons were used during the Civil War by both the Union and the Confederate armies for spying.
- The Wright Brothers only had a fifth grade education.
- Prior to 1926, a person could fly passengers or goods without obtaining a pilot’s license.
- The first animal aviators were a sheep, a duck and a cockerel that were sent aloft in a hot air balloon in 1783.
- Before air traffic control towers were developed, pilots avoided other aircraft by a method called “see and be seen”.
- “Air Stewardess” was the official title given to the position that we now refer to as “Flight Attendant”. The first Air Stewardess was Ellen Church and she began work with United Airlines in May 1930. She was paid $125 a month.
- Amelia Earhart was the first woman to fly the Atlantic solo in 1932. She was also the first woman to fly from Hawaii to the mainland and from Mexico to New York City.
- The SR-71 Blackbird can fly at 85,000 feet. That’s about 16 miles high. Most commercial airplanes fly about 6 miles above Earth.
- In 1911, Harriett Quimby was the first woman to earn a pilot’s license.
- The Boeing-737 uses 5 gallons of fuel per mile. The average car gets 25 miles to the gallon.
- Bessie Coleman was the first black woman to fly. She was also the first black woman stunt and exhibition pilot.
- One wing of a Boeing-747 is big enough to fit 40 middle sized cars on it.
- Charles Lindberg flew nonstop from New York to Paris. The flight was 1,000 miles long and took 33 hours and one half hour to complete. If you were to travel today the flight would take a little over 3 hours.
Oregon State Standards

Lesson 1: People in the Airport

Arts, Create, Present, and Perform: Create, present and perform works of art.

**AR.03.CP.01** Use experiences, imagination, essential elements and organizational principles to achieve a desired effect when creating, presenting and/or performing works of art.

*Validation:* Students will be coloring a person involved in aviation of their choice by using discussions from class, previous experiences, and their imaginations.

Language Arts, Writing, Communicate supported ideas across the subject areas, including relevant examples, facts, anecdotes, and details appropriate to audience and purpose that engage reader interest; organize information in clear sequence, making connections and transitions among ideas, sentences, and paragraphs; and use precise words and fluent sentence structures that support meaning.

**EL.02.WR.11** Use correct word order in written sentences.

*Validation:* Students will be writing a few sentences about their coloring to show their understanding of that person's role in aviation.

Language Arts, Conventions: Spelling: Demonstrate knowledge of spelling, grammar, punctuation, capitalization, and penmanship across the subject areas.

**EL.02.WR.14** Spell correctly previously studied words and spelling patterns in own writing.

*Validation:* Students will be writing a few sentences about the person they chose, allowing them to demonstrate their spelling capabilities.

Language Arts, Conventions: Handwriting: Demonstrate knowledge of spelling, grammar, punctuation, capitalization, and penmanship across the subject areas.

**EL.02.WR.20** Form letters correctly and space words and sentences properly so that printing can be read easily by another person.

*Validation:* Students will be writing sentences where it will be necessary to write legibly so that others can understand.

Social Sciences, Civics and Government: Understand participatory responsibilities of citizens in the community (voluntarism) and in the political process (becoming informed about public issues and candidates, joining political parties/interest groups/associations, communicating with public officials, voting, influencing lawmaking through such processes as petitions/initiatives).

**SS.03.CG.03** Identify ways that people can participate in their communities and the responsibilities of participation.

*Validation:* Students will describe a person in aviation and how they help their community.

Lesson 2: What Flies?

Science, Life Science: Organisms: Understand the characteristics, structure, and functions of organisms.

**SC.03.LS.01** Recognize characteristics that are similar and different between organisms.

*Validation:* Students will be categorizing things that fly, including animals and other organisms.

Science, Life Science: Heredity: Understand the transmission of traits in living things.

**SC.03.LS.03** Describe how related plants and animals have similar characteristics.

*Validation:* Students will be putting related flying animals into categories on a class chart.
Oregon State Standards

Arts: Create, Present, and Perform: Express ideas, moods and feelings through the arts and evaluate how well a work of art expresses one’s intent.

AR.03.CP.03 Create, present and/or perform a work of art that demonstrates an idea, mood or feeling.
Validation: Students will be creating a mural of things that fly and will be asked to supply one of their own ideas to the mural.

Language Arts: Speaking and Listening, Speaking: Communicate supported ideas across the subject areas using oral, visual, and multi-media forms in ways appropriate to topic, context, audience, and purpose; organize oral, visual, and multi-media presentations in clear sequence, making connections and transitions among ideas and elements; use language appropriate to topic, context, audience, and purpose; and demonstrate control of eye contact, speaking rate, volume, enunciation, inflection, gestures, and other non-verbal techniques.

EL.02.SL.05 Speak clearly and at an appropriate pace for the type of communication (e.g., informal discussion, report to class).
Validation: Students will be asked to contribute in a brainstorming activity to come up with things that fly and add their ideas to a class list.

Lesson 3: What Forces Make Airplanes Fly?

Science, Physical Science, Matter: Understand structure and properties of matter.

SC.03.PS.01 Describe objects according to their physical properties.
Validation: Students will begin to understand the properties of an airplane by learning about how the wings are involved in lift off.

Science, Physical Science, Force: Understand fundamental forces, their forms, and their effects on motion.

SC.03.PS.03 Describe an object’s position and how to affect its movement.
Validation: Students will do experiments to discover lift and thrust and how they affect an airplane’s movement in the air.

Science, Scientific Inquiry, Forming the Question/Hypothesis: Formulate and express scientific questions or hypotheses to be investigated.

SC.03.SI.01 Make observations. Based on these observations, ask questions or form hypotheses, which can be explored through simple investigations.
Validation: Students will participate in experiments that will foster curiosity and questions.

Science, Scientific Inquiry, Analyzing Data and Interpreting Results: Analyze scientific information to develop and present conclusions.

SC.03.SI.04 Use the data collected from an investigation to explain the results.
Validation: Students will use the results from the experiments to form an understanding of how an airplane flies.

Language Arts, Speaking and Listening, Listening: Listen critically and respond appropriately across the subject areas.

EL.02.SL.09 Give and follow three- and four-step oral directions.
Validation: Students will be given directions for the experiments that they will need to follow.
Oregon State Standards

Lesson 4: What Forces do Airplanes Need to Overcome?

Science, Physical Science, Matter: Understand structure and properties of matter.

SC.03.PS.01 Describe objects according to their physical properties.

Validation: Students will begin to understand the properties of an airplane by learning about how gravity and drag affect it during flight.

Science, Physical Science, Force: Understand fundamental forces, their forms, and their effects on motion.

SC.03.PS.03 Describe an object's position and how to affect its movement.

Validation: Students will do experiments to discover how drag and gravity affect an airplane's ability to fly.

Science, Scientific Inquiry, Forming the Question/Hypothesis: Formulate and express scientific questions or hypotheses to be investigated.

SC.03.SI.01 Make observations. Based on these observations, ask questions or form hypotheses, which can be explored through simple investigations.

Validation: Students will ask questions fostered by curiosity and engagement in the experiments.

Science, Scientific Inquiry, Analyzing Data and Interpreting Results: Analyze scientific information to develop and present conclusions.

SC.03.SI.04 Use the data collected from an investigation to explain the results.

Validation: Students will understand what works against an airplane during flight using the results from the experiment.

Language Arts, Speaking and Listening, Listening: Listen critically and respond appropriately across the subject areas.

EL.02.SL.09 Give and follow three- and four-step oral directions

Validation: Students will follow directions for perform the experiments.
Resources

Internet Resources

FAA Education Program
http://www.faa.gov/education_research/education/
Contains aviation information and resources for teachers and students

National Air and Space Museum
http://www.nasm.si.edu/
This site has teaching resources, online activities and aviation information for exploring the science of flight

National Coalition for Aviation Education
www.aviationeducation.org
Provides access to teacher resources

NASA Education Program
http://education.nasa.gov/home/index.html
Offers classroom activities and educational learning programs

Principles of Aviation
http://wings.avkids.com/
Contains lessons, student activities, principles, curriculum bridges and other resources for planning your unit on aeronautics

Helpful Links

HowStuffWorks
http://www.howstuffworks.com/
This site offers simple explanations for how things work, including airplanes

InfoUse, in cooperation with NASA
http://www.planemath.com/
Contains activities that relate math concepts with aviation

PBS
Offers a lesson on the types of things that fly and other various resources

ProTeacher
http://www.proteacher.com/110069.shtml
Provides student activities, experiments and information for aviation studies