

WILD BLUE WONDERS

OPERATIONS MANUAL



AVIATION FOUNDATION

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EAA Aviation Foundation

Science – Math – Technology Leadership Project

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Long hours of brainstorming, writing, testing, evaluating, programming, designing, and playing have gone into Wild Blue Wonders. The following people have made many significant contributions to the program.

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Introduction

If Charles Lindbergh were a middle school student today, his report card would read, "Does not work to potential". As a boy growing up in rural Minnesota, Lindbergh was withdrawn and unmotivated. In almost every photograph of him in his youth, Lindbergh is seen with a family pet instead of with other children. It wasn't until he discovered aviation in college that he blossomed into the confident and inspiring man history remembers.

After he made his famous flight in 1927, Lindbergh's love of flight grew to include a passion for public speaking, a fascination of biology, and a life-long yearning to explore other cultures. When he died in 1974, Lindbergh had explored the globe, patented an artificial heart, and penned several books on a variety of subjects.

Aviation has a way of exciting people. Charles Lindbergh wasn't the first or last person to find happiness and meaning in flight. For many people, aviation has been a magic carpet, capable of lifting them above their situation. If you combine that "magic" with the complex web of mathematics, science and technology at the core of aviation, a powerful teaching tool emerges.

The Experimental Aircraft Association is the leading recreational aviation organization in the United States. Along with fostering an appreciation of flight for its members, the EAA has committed to sharing the joy of aviation with the world. The EAA Science-Math-Technology Leadership Project has been formed within the EAA Aviation Foundation to bring the power of aviation into the classroom. With the young Charles Lindbergh and children like him in mind, the S-M-T Project has developed two programs that use aviation to teach math, science and technology. *Flight Site* is the elementary model for children in grades 3, 4 and 5. *wild Blue wonders* has been created for students in grades 6, 7 and 8.

wild Blue wonders uses a multi-disciplinary approach to activity-based learning. The five components of the program address a long list of state and national math, science, technology, history, geography, language, art, and life skill standards. *wild Blue wonders* is not pilot training, it is designed to be a co-curricular experience with aviation as the glue that holds a full spectrum of lessons together. Just as a teacher doesn't have to hold a Ph.D. in Biology to teach Life Science, teachers without a pilot's license can easily use *wild Blue wonders*. Within the *wild Blue wonders* program is a support network of aerospace museums, EAA Members, pilots, and aviation education experts.

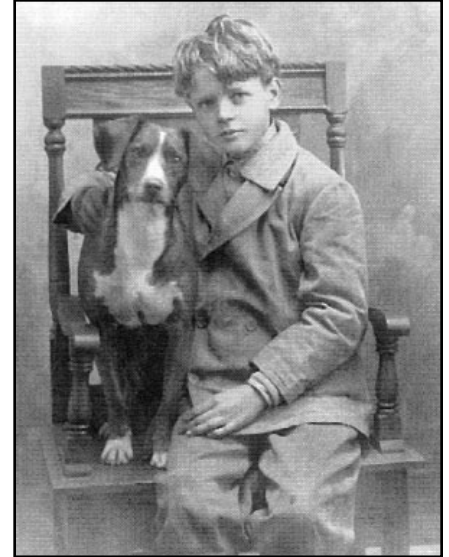
It's the network of aerospace museums that makes *wild Blue wonders* truly unique. Acting as regional centers, the museums serve as team support centers and host to *wild Blue wonders* competitions each Spring. Connecting schools with the extensive network of air and space museums will enhance the program and inspire the participants.

The *wild Blue wonders* program has been developed, tested and evaluated by education professionals under supervision of a distinguished National Advisory Panel and a Teacher Advisory Committee, (a full listing of contributors can be found on the previous page). The Experimental Aircraft Association Science-Math-Technology Leadership Project was formed by a grant from the Lilly Endowment and the EAA Aviation Foundation, (a private, not-for-profit organization).

wild Blue wonders is proud to have the support of the Ford Motor Company as the primary sponsor of the program. This partnership with Ford Motor Company is much more than a financial one, throughout the *wild Blue wonders* program, we have enhanced the aviation content with applications and examples from the automotive world. This partnership will lead to deeper understanding of both industries by the students involved in *wild Blue wonders*, and is intended to expose the students to career opportunities in both aviation and automotive.

On the pages that follow, the breadth and depth of *wild Blue wonders* will be explained.

welcome to the *wild Blue*!



Components

THE FLIGHT TEAM

Each wild Blue wonders(WBW) Flight Team is comprised of five students and one education professional. The students make up the Flight Crew and the educator is called the Flight Leader. The Flight Leader acts as the facilitator as the Flight Crew works to meet certain Mission Objectives. Any other people involved with the Flight Team are considered Ground Crew. Ground Crew members include parents, other students, or anyone who contributes to the success of the mission. EAA members and other aviation experts may serve on the Ground Crew, but as with all ground crews, they must stay on the “ground” as the Flight Team “flies” the mission.

The focus of the wild Blue wonders mission is on the Flight Crew, and they alone will square off against other Flight Crews during competition. To keep the Ground Crew from storming the cockpit, the Flight Leader must ensure that the mission be an educational experience for the crew, and not competition between ground crews.

FIVE COMPONENTS

The wild Blue wonders mission is broken into five components, each designed to stimulate, foster and engage different skills and talents. Each member of the Flight Crew should find a “specialty” in one or more of the components, and like any team everyone on the crew should take an active role in the completion of the mission.

The five components of the wild Blue wonders mission are:

LOGBOOK	Create crew identity, develop team focus, and track progress.
FLIGHT PLAN	Master navigation, absorb aeronautics, and achieve flight.
CHECKRIDE	Identify aircraft, explore history, and uncover meteorological mysteries.
RUNWAY	Demonstrate flight dynamics, perform for public, and recount aviation’s past.
FREE FLIGHT	Construct a model aircraft, engage in flight testing, and defy gravity.

Each component is introduced through a series of Mission Objectives that will guide the Flight Crew step-by-step toward success. Each objective builds on the lessons learned in the previous objectives, and each component reinforces skills and concepts developed by the other components. These components are enhanced and supported by an aerospace museum experience.

COMPETITION

wild Blue wonders is intended to culminate in a series of competitions. The program can be used without the intention of entering competition, but the inclusion of the social and mental pressure competition fosters can create a great deal of motivation in the Flight Team.

During the regional competition, WBW Flight Teams will participate in five distinct areas, with each area coinciding with each of the five WBW components.

Component Overview Matrix

COMPONENT	DESCRIPTION	GOALS	VALUE	TIME
FLIGHT PLAN	The core of WBW, Flight Plan employs cutting-edge flight simulation technology and traditional navigation techniques to teach basic aeronautics and pilotage skills.	Using teamwork, Flight Crews will master basic aviation concepts, understand fundamental scientific principles, and develop critical thinking ability.	1000 points maximum 33% of total score	20+ Hours Preparation 30 Minutes Competition
CHECK RIDE	Game show format challenges Flight Crews with questions on Aviation History, Meteorology, Forces of Flight, Aircraft Recognition, and Aircraft Parts.	Flight Crew members will gain a working knowledge of aviation history, physics, meteorology, and mechanics.	750 points maximum 25% of total score	10+ Hours Preparation 15 Minutes Competition
LOGBOOK	Reflecting aviation tradition, Logbook combines detailed time-tracking and creative effort to create a lasting record of Flight Crew activities.	By generating a team creed and logo, Flight Crew members will create a cohesive identity, build communication skills, and engage in self-assessment.	500 points maximum 17% of total score	10+ Hours Preparation 20-30 Minutes Competition
FREE FLIGHT	Through construction and flight testing of a simple self-powered model aircraft, Free Flight is an exciting and motivational way to learn and apply aerodynamic principles.	Hands-on creation of a flying model aircraft will enable Flight Crew members to develop teamwork, aerodynamic knowledge, critical thinking ability, and problem-solving skills.	500 points maximum 17% of total score	20+ Hours Preparation 15 Minutes Competition
RUNWAY	A theatrical presentation written and performed by the Flight Crew that relates the history and flight dynamics of a selected aircraft.	Through creative expression, Flight Crew members will develop confidence, public speaking skills, research ability and an awareness of aviation history.	250 points maximum 8% of total score	10+ Hours Preparation 5 Minutes Competition

Alternatives

wild Blue wonders was created with flexibility in mind. There are several ways the program can be used in and out of the classroom.

AFTER-SCHOOL

WBW was developed as an after-school club or as an activity period project. Similar to the Odyssey of the Mind and Science Olympiad programs, WBW is intended to be a long-term team project culminating in a competition in the Spring. To compete in WBW regional competitions, teams must have five student members and one Flight Leader (teacher). Competition teams will be judged on the entire WBW curriculum, so a long-term commitment is necessary for success.

IN-CLASS

Portions of the WBW curriculum can be used to augment an existing lesson, or the entire curriculum can serve as an intensive aviation unit. Each of the components of WBW can be used as full-class activities or in small groups.

wild Blue wonders can provide maximum benefit by using the curriculum in-class as a large-group program in the Fall, with interested students forming a flight team later to prepare for competition in the Spring. This option would deliver 20+ hours of classroom activities followed by an after-school opportunity for motivated students.

TIME COMMITMENT

COMPETITION PREPARATION *60 + Hours*

REGIONAL COMPETITION *Full-Day (Saturday) + Travel Time to Regional Museum*

NATIONAL CHAMPIONSHIPS *4 Days (Thursday - Sunday) Including Travel Time to AirVenture**

** AirVenture Oshkosh is the largest general aviation event in the world with over 750,000 EAA members and aviation enthusiasts attending annually.*

Requirements

To embark on the Wild Blue Wonders mission, you will need several things. Each Wild Blue Wonders Flight Team will need a Flight Kit, an empty 3-ring binder or scrapbook, and a windows-based personal computer with a joystick, a CD-ROM Drive, and a color monitor.

THE COMPUTER

A large part of the WBW program will utilize Microsoft Flight Simulator software. In order to use this excellent simulation program, you will need a Windows95 or 98-based PC with a minimum of 166 MHz microprocessor, 32 MB of RAM, 420 MB of hard disk space, and a CD-ROM drive. The incredible graphics of Flight Simulator require that your PC have a VGA monitor with at least 16-bit color.

Laptop PC's can run Flight Simulator if they meet the above criteria, but the small screen may prevent you from seeing some of the cockpit indicators. Unfortunately, Flight Simulator will not run on Macintosh computers. Microsoft would like to make a Mac version of Flight Simulator, but the years of reprogramming it would take to convert the software make it highly unlikely that a Mac version will be released. If you are in an all-Mac school, you will need to either acquire a windows-based PC or attempt to run Flight Simulator using an emulation program. These "PC in a box" programs set up your Mac to run Windows programs. While this sounds like a good solution, a very fast computer with a lot of RAM is necessary to get the emulator to run Flight Simulator with any performance. If you have a shiny new G4 with 500 MB of RAM in your room, you may have a chance with Flight Simulator 2000.

If you need to get a PC for Wild Blue Wonders, try to get a computer with at least a 500 MHz microprocessor and as much RAM as you can get. To enjoy good performance from Flight Simulator you should also have a graphics accelerator card and a large monitor. A joystick isn't required to use Flight Simulator, but without one the program is very discouraging to use. Microsoft makes several excellent joysticks that work flawlessly with Flight Simulator. During the Wild Blue Wonders competitions, the Flight Simulator computer will be outfitted with a Microsoft Force-Feedback Pro joystick.

THE FLIGHT KIT

Each Wild Blue Wonders Flight Kit will contain the following items:

- 1 - Operations Manual (Teacher's Guide)
- 1 - *Wild Blue Wonders* book (co-produced by NASA and EAA)
- 1 - Team Orientation Video
- 5 - Flight Crew Folios (for Flight Crew materials)
- 5 - Flight Crew Member Logbooks (to track time)
- 1 - Set of Objective Masters (ready-to-copy objective worksheets)
- 1 - Flight Planning Form Master (ready-to-copy flight planning form)
- 1 - Weather Worksheet Master (ready-to-copy blank weather information form)
- 1 - VFR San Francisco Terminal Area Chart (map)
- 1 - Navigational Plotter (special ruler/protractor for charting exercises)
- 1 - Microsoft Flight Simulator 2000 CD-ROM (Flight Simulator)
- 8 - EAA X-Flyer Balsa wood Rise-Off-Ground Airplane Kits (for Free Flight activity)
- 2 - Bottles of model glue (for X-Flyer construction)
- 1 - Box mounting pins (for X-Flyer construction)

Museum Support

There are over 100 exceptional aerospace museums in North America. This network of aviation artifacts and experts is an excellent educational resource.

The Experimental Aircraft Association has formed partnerships with many of the aerospace museums. Through these partnerships, WBW Flight Teams now have an enthusiastic professional support system in place. Each partnership museum will host a regional competition.

COMPETITIONS

Before the conclusion of the school year, a regional competition will be hosted by an aerospace museum. Registered WBW teams will be invited to attend the all-day event at the museum at no charge.

The regional championship team will then represent the museum at the National Championships during Airventure Oshkosh in July.

MUSEUM VISITS

The strength of any museum is in its collection. Aerospace museums house an amazing variety of historic and unique aircraft. Aviation museum personnel often prove to be as amazing as the aircraft. Museum visitors can often meet and learn from pilots, engineers, war heroes, and living legends. This synthesis of material history and personal testimony can lead to incredible education opportunities for middle school students.

Each flight team should visit the host museum at least once during the Wild Blue Wonders program. In the Runway portion of the program, each Flight Team must identify an aircraft in their regional museum and relate the history and flight dynamics of that aircraft in a short theatrical presentation. It is intended that each flight crew would have the opportunity to explore their aircraft of choice and become "experts" in that particular aircraft's history and performance.

In addition to the Runway objective, Flight Teams can utilize the museum staff as technical advisors throughout their competition preparation.

If it is not possible to visit the regional aerospace museum, the flight team may elect to use the internet or other museum resources to achieve their objectives.



LOGBOOK

LOGBOOK Introduction

They can be found in every pilot's flight bag. Veteran pilots open theirs with reverence, as if they were trying to keep the things inside from spilling out. Logbooks are far more than a record book for most flyers. Every flight taken is recorded on the lined pages.

Most logbooks have space for pilots to enter notes about their flights. Here pilots move from the analytical to the creative. Emotive passages are forever penned alongside sterile columns of hours flown, conditions endured, and aircraft commanded.

In the Logbook component of wild Blue Wonders, Flight Crews will keep detailed records of their efforts in the program, but they will also work together to forge a team identity, communicate their opinions and ideas, and set goals. Think of it as a pilot's logbook combined with a corporate marketing portfolio mixed with a family scrapbook.

MATERIALS

Included in the WBW Flight Kit are five Official Flight Crew Member Logbooks. These should be issued to each crew member for their personal record-keeping. Instructions on their use are included in the ALPHA OBJECTIVE on the next page.

The Flight Team will be judged on their team Logbook during the competition. This logbook can be as simple as a 3-ring binder or as elaborate as desired.

The following items must be completed in the team logbook for judging:

Official Flight Crew Log

(Detailed record of each Flight Crew member's time spent on WBW - see ALPHA OBJECTIVE)

Flight Crew Creed

(Statement of purpose composed by the Flight Crew - see BRAVO OBJECTIVE)

Flight Team Logo/Patch

(Graphic depiction of Flight Team concept and design - see CHARLIE OBJECTIVE)

The following items should be included in the team logbook for judging:

Flight Team Photograph

(Group photo of team, including Ground Crew if possible)

Sponsor Recognition

(Logos and/or names of any organizations or companies that supported the team)

Ground Crew Recognition

(Names and photos of Ground Crew members who supported the team)

School/Group Information

(Flight Crew-composed description and photos/logos of school/group the team represents)

Museum Information

(Materials, photos, descriptions of team museum visits)

The following items can be included in the team logbook for judging:

Anything that captures the "spirit" of the team and their efforts.

(This will assist the judges as they assess the efforts of the Flight Team)

PROCEED TO ALPHA OBJECTIVE

ALPHA OBJECTIVE - Time Log

MATERIALS NEEDED: 5 Official Flight Crew Member Logbooks
 Official Flight Crew Log
 Pencils

ESTIMATED TIME TO FINISH: 10 Minutes

GOAL: Establish time-tracking procedures.

INTRODUCTION

Pilots are required by the Federal Aviation Administration to keep track of their flight time. Most record their flights in a personal logbook. This logbook is the official record of their flight activity, so it can be used by the FAA to verify a host of things. Student pilots must have their Flight Instructor sign their logbook to have that time count toward their license. Needless to say, pilots don't like to lose their logbooks!

PROCEDURES

Each member of the Flight Crew should be issued an Official Flight Crew Member Logbook.

Fold the Logbook in half to form a booklet shape. The printed grid should be on the inside of the logbook.

Each Flight Crew member should write their name on their logbook.

Each time any of the Flight Crew members work on wild Blue Wonders, even if they are at home, they need to record their time in the logbook. Each Flight Crew member should carry their logbook with them as they work on WBW, but entries can be logged later if the logbook isn't available.

Have each Flight Crew member log any time that they have spent on WBW up to this point, including the time spent on this objective.

Logbook entries should look like this:

DATE	LOGBOOK	FLIGHT PLAN	CHECKRIDE	RUNWAY	FREEFLIGHT	OTHER
4/2/02	.5 hours					.5 hours

Before competition, the Flight Crew should transfer their total hours for each component to the Official Flight Crew Log. The Official Flight Crew Log will be judged, not the Flight Crew's individual logbooks.

MISSION ACCOMPLISHED! CONTINUE TO BRAVO OBJECTIVE

BRAVO OBJECTIVE - Team Creed

MATERIALS NEEDED: Blank Paper
Pens/pencils

ESTIMATED TIME TO FINISH: 10 Minutes

GOAL: Form Flight Crew mission statement while forging team identity and defining goals.

INTRODUCTION

Corporations and organizations work very hard to establish a clear identity. A major step in the process for many groups is the creation of a mission statement, or creed. A creed should reflect the personality of the group, while projecting a concise vision. As the Flight Crew discusses their creed, they will be examining their goals, expectations, talents, and purpose. This process should help the flight crew refine their team dynamic as they express their thoughts and emotions in a creative environment.

PROCEDURES

On blank paper (or blackboard/marker board) challenge the team to list their individual strengths in one column.

Have them list their team strengths in another column.

Alongside, have them list their goals for Wild Blue Wonders.

Finally, have them list words that describe flight, aviation, exploration, learning, and teamwork.

Engage the Flight Crew in a discussion about their creed. Facilitate the discussion to ensure that all crew members give input. Just as the discussion begins to take on a life of its own, quietly withdraw and allow the team to form their creed.

The creed should be presented in the Flight Crew Logbook for judging. Encourage the Flight Crew to design a page just for the creed.

Creativity is rewarded.

MISSION ACCOMPLISHED! CONTINUE TO CHARLIE OBJECTIVE

CHARLIE OBJECTIVE - Team Name and Logo

MATERIALS NEEDED: Blank Paper
Pens/pencils
(optional) Computer with graphics program and color printer

ESTIMATED TIME TO FINISH: 1 Hour

GOAL: Create Flight Crew name and insignia while refining team image.

INTRODUCTION

Apollo Astronaut Frank Borman was strapped into the rear seat of a jet trainer high above the Gulf of Mexico when he designed one of the most elegant logos ever. As his fellow astronaut Jim Lovell handled the quick flight from Cape Canaveral to Houston, Borman sketched the logo on his kneeboard. Borman, Lovell and Bill Anders were scheduled to make the first manned spaceflight around the Moon in a few months, and Borman wanted the mission patch to reflect the simple yet historic path of their spacecraft as it traced a figure-eight around the Earth and its lone satellite.



It has long been tradition among pilots to design their own mission patches. For decades, aviators and astronauts have put ideas to paper in an effort to capture the spirit of their endeavors. Military pilots are known by their worn leather jackets emblazoned with scores of unit and mission patches. The truly memorable patches are often the ones with the simplest design. The Army Air Corps of World War II chose the adjacent patch to decorate their uniforms.

Many aviators take great pride in their particular breed of aircraft. This pride is usually manifest in their patches. Some groups choose a name to set them apart from similar units in the military. The Lifesavers of the U.S. Coast Guard elected to include the likeness of their HH-60 Jayhawk helicopter along with a clever image of a life ring bearing their name on this patch.

**PROCEDURES**

Engage the Flight Crew in a brainstorming session on possible team names. Write down all ideas for review. Narrow the list to a few choices and then have the Flight Crew vote on a team name.

Begin discussion on possible design elements for the team logo. List all element ideas for review. Elements can include aircraft images, flags, objects, school logos, and mascots.

Allow Flight Crew members to sketch ideas and create several possible logos. Vote on the contenders to determine the final team logo.

Refine the logo and include it on the cover of the Official Team Logbook. If desired, have the logo placed on team shirts, hats or badges.

MISSION ACCOMPLISHED! CONTINUE TO FLIGHT PLAN COMPONENT



FLIGHT PLAN

FLIGHT PLAN Introduction

Navigation was once considered a form of black magic. 300 years ago, commoners considered the magnetic compass possessed with its mysteriously wobbly needle finding direction despite the movement of its housing. In those days, a precious few could look to the night sky and calculate their position on the face of the planet. Today a young child can slip a couple of batteries into a handheld computer and have position, direction, speed, altitude and precise time information at his or her fingertips. As satellites blanket the globe with data and people grow accustomed to instant digital guidance, pilots pour over paper charts and plot their course using traditional navigation techniques.

Why would someone intending to fly an expensive aircraft resort to such “outdated” practices? The answer is simple...computers fail, often without warning. The swarm of Global Positioning Satellites parked 250 miles up belong to the Federal Government. At any time they can flip a switch and render the flashy GPS units useless to protect National Security. Not a comforting thought for someone planning to take to the skies in an airplane with a finite amount of fuel and few places to land.

Many modern pilots do use GPS and other amazing technological wonders in their cockpits, but most carry charts and a wealth of navigation knowledge. By law, pilots are required to undergo training in aeronautical navigation to earn a Private Pilot Certificate, and they must bring current aeronautical charts along on every flight.

The practice of aeronautical navigation is one many pilots take very seriously. Before any lengthy flight, most pilots sit down to form a flight plan. Calculations are made to determine fuel consumption, the effect of wind on the course of the aircraft, and the safest altitude to fly.

Careful attention is paid to weather conditions and forecasts. All certified pilots hold a VFR rating, that means that they are only allowed to fly during periods when the weather allows for Visual Flight Rules. Simply stated, VFR pilots must be able to see the ground from a safe altitude before they are allowed to leave Terra Firma. Advanced pilots can hold IFR ratings, which means that they can fly in limited visibility conditions, or under Instrument Flight Rules. For Wild Blue Wonders, the conditions will always be VFR.

As VFR pilots plan their flights, they usually pay close attention to surface features (landmarks). The type of navigation that relies on moving from one place to another using visual references is called Pilotage. Walking around for most people is a form of pilotage. Turns are made at certain landmarks, direction decisions are made with consideration of the surrounding environment, and a simple set of guidelines govern the trip. For example, an employee at a grocery store could easily guide a customer to the Twinkies by telling them to turn a particular direction at a certain aisle and then walk a set distance to the objective. “Go down to Aisle 6, take a right and walk past the tortillas. The Twinkies are on the left.” Pilots can plan their flights the same way using a simple chart. “To fly to Watertown, I should follow the Red River until I see the bridge, then I can follow the highway to Sunfish Lake and over Bald Mountain to the airport at Watertown.”

Of course, the shortest distance between two points is a straight line, so pilots usually refrain from simple pilotage and use a more advanced type of navigation known as Deduced Reckoning. Normally called “Dead Reckoning”, this kind of navigation relies on the compass, clock and chart. Dead reckoning also happens to include plenty of applied mathematics.

FLIGHT PLAN Introduction (continued)

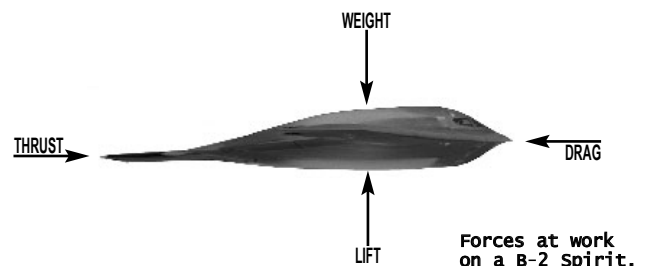
Calculating time, speed and distance has always been a large part of math education. Every student has worked through a few "Train 'A' left Boston at 10 o'clock and Train 'B' left Chicago at 11 o'clock" story problems. These challenges are at the core of Dead Reckoning.

A pilot using Dead Reckoning will measure the distance between the departure airport and the destination airport, determine the estimated flight time, and calculate how much fuel will be used during the flight. The process continues with the determination of a compass heading. The pilot simply measures the angle of the intended flight path in relation to True North, adjusts the angle to compensate for the difference between True North and Magnetic North, and then accounts for any known compass error caused by the aircraft itself. The resulting angle is the aircraft's course, or heading.

Once airborne, the pilot can use the flight plan to manage the flight. Combined with pilotage, the use of Dead Reckoning can ensure navigationally-accurate flight in VFR conditions. Obviously, the pilot needs to understand how to operate the aircraft in a safe manner. Excellent navigation skills alone will not keep a pilot from flying into trouble, that's where Aeronautics come in.

Aside from navigation, all pilots must demonstrate an understanding of Aeronautics to gain certification. Pilots must be able to fly a plane well enough to impress the FAA inspector along for the ride, no simple task considering the amazing array of physics at work.

The basic concept behind flight is best illustrated as a balance of four forces. These Forces of Flight are Lift, Thrust, Weight, and Drag. Lift is the ability of an aircraft (or creature) to deflect enough air to overcome gravity. Sir Issac Newton explained long ago that any force will have an equal and opposite force. As the wing of an aircraft interacts with the air around it, the resulting clash of forces creates lift. If the wing fails to interact properly with the air, gravity will overcome the wing's ability to lift the aircraft and weight will exceed lift. As weight battles lift, drag is contesting thrust. Any force that causes the wing of the aircraft to create lift is called thrust. On powered aircraft the engine or engines provide the thrust. As the aircraft is moving through the air and creating lift, the same air that causes that lift is also creating drag as it rubs against the aircraft. The thrust of any successful aircraft must exceed drag to generate enough force to provide lift. This ballet of forces is known as aeronautics.



Through the following objectives, the wild Blue Wonder Flight Team will learn to apply simple mathematic and scientific principles to navigate. The team should be able to exhibit an understanding of Pilotage, Deduced Reckoning, Wind Correction, Aeronautics, Aerodynamics, Geography, and Aviation Technology.

In lieu of the expense of operating an actual airplane to practice navigation and aeronautics, the Flight Crew will employ Microsoft Flight Simulator 2000 to achieve flight. MSFS2000 comes with a full tutorial package and excellent utilities. A complete description of MSFS2000 as a learning tool is provided on the next page.

Microsoft Flight Simulator 2000 as a Teaching Tool

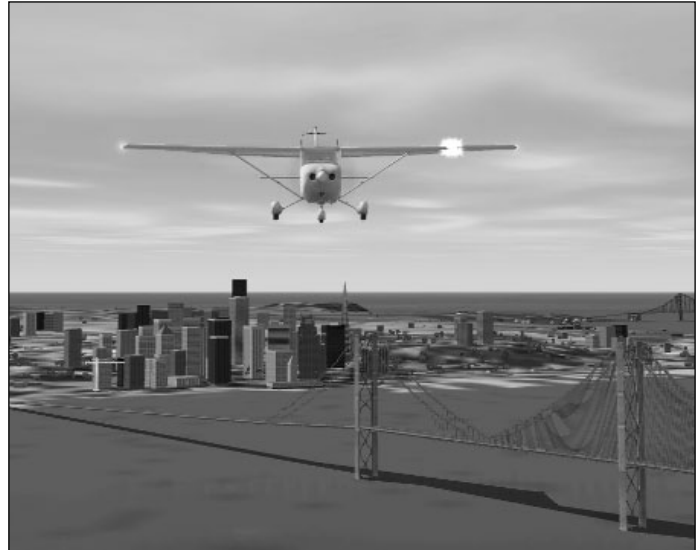
It's so accurate the U.S. Navy uses it to train their pilots. Microsoft Flight Simulator 2000 (MSFS2000) may look like a normal computer game at first glance, but it contains a full ground school, interactive flight lessons, and highly-accurate flight characteristics.

The cockpit of the virtual Cessna 182S Skylane is rendered in incredible detail, and all instruments function just as they do in the physical airplane. Pilots around the world have included MSFS2000 into their training and practice. The software allows a weather-grounded pilot in Virginia to soar through the Sierra Nevada Mountains on a clear day. It is truly an excellent teaching tool.

Don't worry! You won't have to learn or teach MSFS2000 on your own. Built into the program is an amazing interactive tutorial. Rod Machado, one of the most-respected flight instructors around, can guide you through each step as you explore the challenges, opportunities and excitement of flight simulation.

Before you can use MSFS2000 you must install it on your computer. The installation should only take a few minutes. Install the joystick at this time unless you have already done so.

Once the program is installed and running, you will see a window with a picture of the Concorde and several buttons. Click on "Getting Started" to view a quick movie about MSFS2000. The movie stars John and Martha King from King Schools, one of the largest flight schools in the world. After the movie, click on the LESSONS button to take your first flight with the guidance of Rod Machado. From that point, the software will guide you as you engage in the lessons included with MSFS2000. Flight Crews will fly the Cessna 182S during wild Blue Wonders competition. The Cessna is a stable, popular aircraft with flight schools around the world.



The MSFS Cessna 182S in flight over San Francisco.

You will find that Flight Simulator, like flying a real airplane, takes a lot of practice. For the purposes of wild Blue Wonders, the Flight Crew will be expected to demonstrate stable control of the aircraft and basic visual navigation. MSFS2000 comes equipped with GPS, radio navigation instruments, and a moving map display. While these tools are very helpful and exciting to learn, their use will not be allowed during the flight simulation portion of the wild Blue Wonders competition. MSFS2000 is a very intricate and complex program that offers far more features than you will have time to use during wild Blue Wonders, so do not be intimidated by the quantity of options, instruments and controls. wild Blue Wonders is about the science, math and technological applications of basic flight, and MSFS2000 serves as a useful tool in gaining an understanding of those concepts.

The wild Blue Wonders curriculum is designed to compliment the lessons included in the MSFS2000 software and Pilot's Handbook. Flight Crew members intending to fly in competition should complete the excellent MSFS2000 lessons before engaging in the wild Blue Wonders activities that utilize flight simulation.

PROCEED TO DELTA OBJECTIVE

DELTA Objective - Chartwork

MATERIALS NEEDED: San Francisco Terminal Area Chart (TAC)
DELTA Objective Checklist
Computer and MSFS2000

ESTIMATED TIME TO FINISH: 1+ Hours

GOAL: Build an understanding of aeronautical cartography, geography and pilotage while utilizing teamwork.

INTRODUCTION

At first glance, aeronautical charts seem a jumble of criss-crossing lines, circles and mysterious symbols. The key to understanding an aeronautical chart, (simply called a chart, or sectional by most pilots) is to remember that only information relevant to aircraft is included.

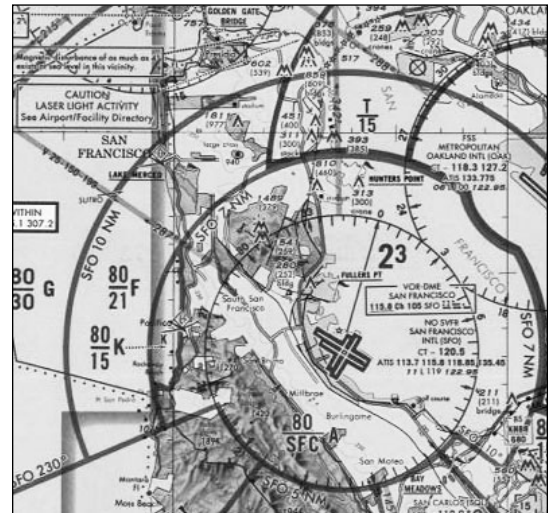
Cities are represented by yellow polygons, void of most roads. Major roadways are usually only included if they can serve as an aid to navigation. State and county borders are usually omitted as well. Things look quite different from the air, and aeronautical charts reflect that view. Radio towers, high-tension power lines, military airspace and other items normally left off typical maps find prominence on aeronautical charts.

What is most apparent on charts is the complex layer of circles, boxes and lines that signify controlled airspace boundaries. Each major airport in the United States has a system to control the air traffic approaching and departing the airport. Governed by the Federal Aviation Administration and its army of air traffic controllers, airspace is heavily monitored with RADAR and radio communications are used to direct the aircraft in the area. The controlled airspace can be thought of as highways in the sky. As aircraft use an

airport, the pilots are expected to fly in prescribed patterns and along set routes. These are indicated by the zones of blue and magenta lines on a chart. While it is a very interesting and vital subject to actual pilots, wild blue wonders flight teams will not be expected to learn and follow air traffic control procedures. The purpose of wild blue wonders is to apply aviation to the exploration of science, math and technology. The inclusion of complex and expansive air traffic control regulations to the program would detract from the lessons at hand. For the purposes of wild blue wonders, the teams own the sky. Consider the myriad of controlled airspace markings on the chart as aids to assist the teams in locating the airports, not guidelines for conduct while flying.

The legend found along the edges of the aeronautical chart should provide sufficient information as the Flight Crew identifies the symbols and features on the chart. Additional information about aeronautical cartography is available on the Internet.

CONTINUE ON NEXT PAGE



A portion of the San Francisco TAC

DELTA Objective - Chartwork (Continued)

PROCEDURE

Spread the chart out on a large table or floor. The Flight Crew will need to surround the chart as they work.

Identify one Flight Crew member to handle the DELTA Objective Checklist. This person should possess strong leadership skills.

Allow the team to work through the checklist, identifying each of the items and locating them on the chart. Guide them to the chart legend as they encounter symbols they are unfamiliar with.

As Flight Leader, you may use the DELTA Objective Visual Features Guide on the next page to assist the team as they search for landmarks and features on the chart.

After the Flight Crew has satisfactorily completed the checklist, identify a pilot for the flight simulation portion of the objective.

Activate MSFS2000, relocate the Flight Crew to the computer along with the checklist and chart.

In MSFS2000, click on FILE and select SELECT FLIGHT from the menu.

Select **Welcome to San Francisco!** from the list of flights.

The simulation will begin with the Flight Team Cessna 182 in flight at 6,000 feet MSL (Mean Sea Level) over the Pacific Ocean just west of the entrance to San Francisco Bay.

Using the chart as a guide, the Flight Crew should work together to identify items from the checklist on the chart and then fly to each target. The Flight Crew should attempt to fly directly from one target to the next using pilotage. Attention should also be paid to the safe operation of the aircraft.

Crashes will result in the restart of the MSFS2000 portion of the mission. If a crash occurs, the Flight Crew should select Welcome to San Francisco from the Flights menu and start over.

At certain targets, the Golden Gate Bridge for instance, the Flight Crew may attempt to fly under the target if it can be done without crashing. Several of the bridges on the checklist have clearance for an aircraft to pass beneath. This is a chance for the Flight Crew to try a maneuver that would land them in hot water with the FAA if they tried it in an actual airplane.

As each target is reached, it should be checked off on the checklist. Once all of the targets have been overflown, the pilot is welcome to land at any airfield or ditch the aircraft without penalty.

MISSION ACCOMPLISHED! CONTINUE TO ECHO OBJECTIVE

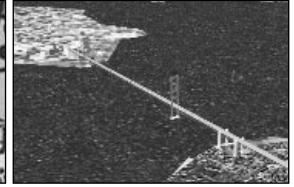
DELTA Objective - Visual Features Guide

OBJECT

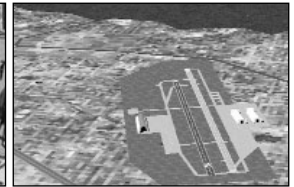
CHART

MSFS2000

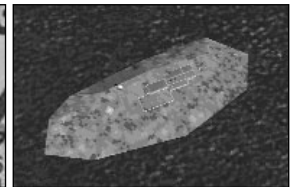
GOLDEN GATE BRIDGE (BRIDGES) Perhaps the most recognizable bridge in the world, The Golden Gate is easily identified by its bright red color. On charts, bridges will appear as solid lines. The locations of any anti-collision lights will be marked with stars. Due to its stature as a major landmark, a flag symbol is printed on the chart. The altitude of the top of the structure is also listed in blue.



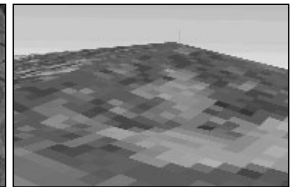
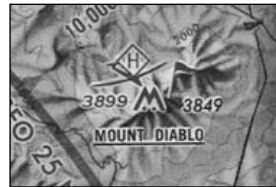
MOFFETT FIELD - NASA AMES RESEARCH CENTER (AIRPORTS) Home to one of NASA's research facilities, Moffett Field features two long parallel runways. Airports with runways longer than 8000 feet will be labeled with an exaggerated depiction of the field's layout. In this case, Moffett's two 9,200 foot-long runways are shown in blue. If an airport has a control tower, the symbols will be blue. Magenta-colored airports have no active air traffic control towers.



ALCATRAZ ISLAND (ISLANDS) "The Rock", as it was called by its imprisoned residents, is just that- a rock. Islands are colored on charts to represent the altitude of the terrain. In the case of Alcatraz, it barely sticks out of San Francisco Bay; therefore, it is colored blue to indicate an altitude below 500 feet MSL. Any navigation lights may be indicated by a small symbol and abbreviated name, like the flashing light (F1) on Alcatraz.



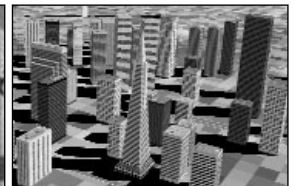
MOUNT DIABLO (MOUNTAINS) The view from Mt. Diablo is incredible, as is the hang gliding according to the glider symbol on the chart. Atop the 3,849 foot-high (MSL) peak, an array of broadcast towers are labeled with a symbol shaped like the letter "M". The altitude of the top of the highest tower is listed on the chart in blue (3,899 feet MSL). Due to its use as a major landmark, the mountain is labeled with a flag on the chart.



SAUSALITO VHF OMNI RANGE BEACON (VOR) Shaped like large Sombreros, VOR's are placed throughout the country to provide radio navigation signals to aviators. On charts, VOR's are labeled with a triangular blue symbol. Each VOR has a name and radio frequency information box printed on the chart near the VOR symbol. VOR's also have a large compass rose surrounding it on the chart. VOR's emit a radial signal that can be received by and instrument in an aircraft.



TRANSAMERICA TOWER (TALL STRUCTURES) Known by its pyramid shape, the Transamerica Tower in downtown San Francisco isn't the tallest building in the city, but it is by far the easiest one to identify. On charts, buildings and other tall structures are labeled by an "M"-shaped symbol. The altitude of the top of the structure is listed in blue next to the symbol. Occasionally, as is the case with the downtown area of San Francisco, the symbols are labeled with an abbreviated name (bldgs) to assist pilots in identifying them.



ECHO Objective - Time, Speed, and Distance

MATERIALS NEEDED: San Francisco Terminal Area Chart (TAC)
ECHO Objective Challenges sheet
2 ECHO Objective worksheets
3 Pencils (with erasers)
Plotter
Computer and MSFS2000

ESTIMATED TIME TO FINISH: 1 Hour

GOAL: Apply critical thinking skills to mathematic navigation challenges in a team setting.

INTRODUCTION

Story problems. A staple of math education, and the frequent inspiration for questions like, "When am I ever going to need this?". The answer: navigation. The question of relevance regarding mathematic problem-solving skills has never entered the mind of a pilot 10,000 feet up running on fumes. Pilots need to be able to use math to calculate fuel use, flight time, position and a myriad of other life-and-limb aviation subjects.

Despite the infusion of computers into the world of aviation, paper-and-pencil calculation is still taught with reverence in flight schools everywhere. Veteran pilots know that when everything else fails, the brain will have to fill in the gaps. Fundamental navigation skills should be in every pilot's arsenal of knowledge before the wheels ever leave the ground, and the most fundamental of skills relate to the big three of navigation- time, speed and distance. In the following activities, the Flight Crew will engage in basic and complex mathematic challenges involving time, speed and distance.

PROCEDURE

Supply each member of the Flight Crew with an ECHO Objective worksheet.

Identify one crew member to act as the Chart Reader, one as the Course Plotter, and one as the Instruction Reader. The remaining crew members will serve as human Calculators.

Begin with Challenge #1. The Instruction Reader should read the challenge aloud as the Chart Reader and plotter identify locations on the chart mentioned in the challenge. The Calculators should record all pertinent figures and instructions.

After the challenge has been read, the Instruction Reader should stand by in case there are any questions or needs for clarification.

The Chart Reader and Plotter should use the tools provided to draw a straight line between the locations identified in the challenge, in this case San Francisco International Airport and San Jose International Airport. Once the course line is drawn, the Chart Reader should measure it to obtain the number of Nautical miles between the two airports.

When the Calculators have the distance, they should quickly calculate the flight time based upon the cruising speed mentioned in the challenge. As the flight time is set, it should be recorded on the worksheets.

CONTINUE ON NEXT PAGE

ECHO Objective - Time, Speed, and Distance (Continued)**PROCEDURE (Continued)**

Quickly review the challenge. The Flight Crew used a ruler to measure the distance of the prescribed flight. The distance is usually measured in Nautical Miles for a reason. Aircraft instruments tend to display speed in Knots. Knots are nautical miles per hour. Nautical miles are slightly longer than the statute miles used on land. By using Nautical miles instead of Statute miles, pilots can make quick speed and distance calculations without having to convert anything. The Flight Crew should note that both the plotter and the chart have both Statute and Nautical mile scales. Great care should be taken to ensure the proper scale is used.

The calculators were able to establish a flight time by dividing the distance by the cruising speed of the aircraft. For Challenge #1, the Cessna 182S was used. The cruising speed of that aircraft is 120 knots (for this exercise only- the actual cruising speed is 140 knots). The distance between SFO and SJC is around 27 Nm. The resulting flight time should be .225 hours. Of course, few people think of time in decimal fractions of hours, so the conversion to minutes must be made. To convert .225 hours into minutes, simply multiply .225 by 60. The flight should take 13.5 minutes.

Here's another way to think of it. 120 knots is 120 Nautical miles per hour. There are 60 minutes in each hour, so the aircraft is flying at a rate of 2 Nm per minute. At 2 Nm per minute, 27 miles would take 13.5 minutes. This is math on the run!

Now for another challenge.

Have the Flight Crew members rotate positions, and proceed with Challenge #2.

This challenge has the team flying from San Francisco to Oakland to San Jose and back to San Francisco. The aircraft used is the Extra 300s. This nimble little aerobatic plane cruises at 178 knots. The total distance is about 62 Nm; therefore, the flight time should be just about 21 minutes. Not bad for a trip around the bay!

Continue rotating positions for the remaining 3 challenges. The repetition and simple nature of the math may seem redundant to the Flight Crew. Practice will allow them to do these types of calculations in their head while flying an aircraft.

After the Flight Crew has completed the challenges, they can activate MSFS2000 and fly the challenge routes to compare their calculations with the virtual flight times.

All of the challenge flights originate at San Francisco International Airport. To begin their MSFS2000 flights at SFO, the Flight Crew must click on the WORLD menu and select GO TO AIRPORT from the drop-down menu. Enter SFO in the airport ID window and stand by as the location is loaded into the simulator.

NOTE - Many calculators and manual flight computers are available for use in flight planning. During Wild Blue Wonders, Flight Crews are encouraged to practice pencil-and-paper calculations. Flight computers will not be allowed during the Flight Plan competition.

MISSION ACCOMPLISHED! CONTINUE TO FOXTROT OBJECTIVE

FOXTROT Objective - Coordinates

MATERIALS NEEDED: SAN FRANCISCO TERMINAL AREA CHART (TAC)
 5 FOXTROT Objective worksheets
 5 Pencils (with eraser)
 Plotter and 4 rulers
 Computer and MSFS2000
 Globe (optional)

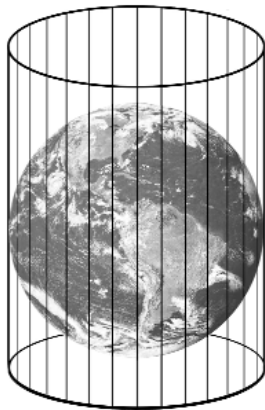
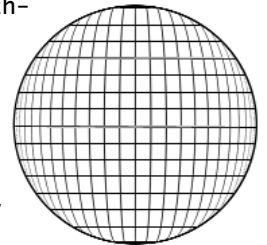
ESTIMATED TIME TO FINISH: 45 Minutes

GOAL: Gain an understanding of Latitude, Longitude and global positioning. Flight Crew members will be able to locate geographic features using coordinates and generate coordinates for geographic features.

OVERVIEW

Cartographers love straight lines. Circles present a very difficult set of mathematical challenges. For the human mind, thinking along orderly lines often works better than working in a spherical world.

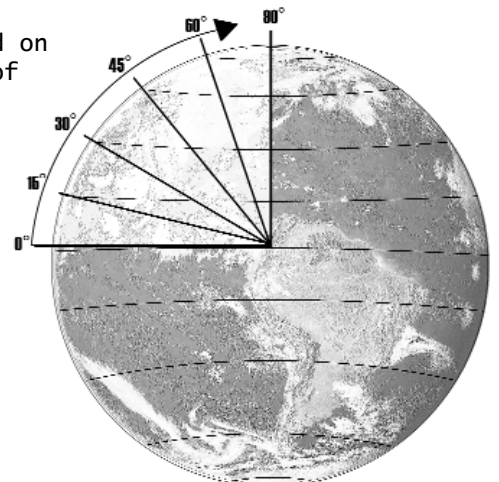
So how does one represent the surface of a 3-dimensional ball as neat, orderly straight lines? There is no single correct answer. The popular approach is to divide the surface of the planet into a grid of lines called a Projection. There are dozens of projections, each designed to most accurately present the 3-D surface on a 2-dimensional chart.



The most common projection is called the Mercator Projection, named for Flemish Cartographer Gerhard Kremer (His Latin name was Mercator). By wrapping a cylinder of uniform lines around the globe, vertical reference lines can be placed at equal distances around the circumference of the planet. This idea has its limitations, however. The cylinder only comes in contact with the surface at the Equator, so the vertical lines must follow the curvature of the Earth to the polar regions. These vertical lines are called Meridians, or Longitude lines. To provide the horizontal elements of the grid, Mercator placed bands around the globe at even intervals from the equator to the poles. These lines are known as parallels or Latitude lines. The parallels are just that, equidistant from each other regardless of placement on the globe. This allows for very accurate North-South measurement by using Latitude as a scale of distance.

The system of Latitude and Longitude lines is well established on modern charts. Global Positioning has become a simple matter of identifying the intersection of axis.

In the following objective, the Flight Crew will use the San Francisco TAC to explore Latitude and Longitude. By establishing the coordinates of a series of landmarks, the Flight Crew will learn to use global positioning as an accurate means of navigation.



FOXTROT Objective - Coordinates (Continued)

PROCEDURE

Imagine being forced to carry a globe with you whenever you went flying. A globe is the most accurate way to depict the geography of the planet, but it tends to take up a lot of space in the cockpit. Fortunately, cartographers have devised a way to illustrate the surface of the Earth on a 2-dimensional plane. The process of rendering the 3-D globe onto flat paper is called Projecting.

To create a decent map, cartographers need to identify direction and scale. The best way to do that is by generating a grid of lines. These lines run North, South, East, and West. If you were to draw a grid of lines on a piece of clear plastic and then hold the plastic against the globe, light shining through the grid would project the lines onto the curved surface. This method is exactly how cartographers have been able to create their projections. There seem to be as many projections as cartographers, but the one used most often is called the Mercator Projection. The lines of the Mercator Projection have two classifications, the North and South-running lines are called Longitude lines, or Meridians. The East and West-running lines are called Latitude lines, or parallels. Latitude lines circle the planet at equal distances from each other, and they are identified by their angle from the Equator. The Equator is the Latitude line running around the largest portion of the Earth. In each direction, Latitude increases in angle as it progresses from the Equator to the poles. In the Northern Hemisphere, Latitude is stated in North values, and in the Southern Hemisphere, South values. The border between the United States and Canada is formed by the 49 degree North Latitude line.

Longitude is a bit more difficult to describe. Because the Earth is a sphere, it is impossible to generate a parallel set of lines for both Latitude and Longitude. Longitude lines are formed by dividing the Equator into degrees. Longitude lines are perpendicular to Latitude lines at the Equator, but they converge as they approach the poles; therefore, the grid formed by the Mercator Projection is not a perfect grid. It is a series of quadrangles, or four-sided boxes with two obtuse angles and two acute angles forming the polygon. The distance between each degree of Longitude is essentially the same as the distance between each degree of Latitude at the Equator. Longitude is also marked just as Latitude, only each degree of Longitude decreases in size as the lines converge on the poles.

Latitude and Longitude lines are marked on Aeronautical charts. Along the edge of each chart, the angle of each line is listed. A method of dividing each degree has been developed. The fractions of degree are stated as Minutes and Seconds. Each degree of Latitude is comprised of 60 minutes each minute is divided into 60 seconds. Longitude lines are also marked by degrees, minutes and seconds. The simple method of recording a precise degree of Latitude and Longitude is in decimal form. For example, the Golden Gate Bridge is at 122 degrees, 29 minutes and 0 seconds west. This would be written as W 122.29.00. Remember, Latitude increases as it moves away from the Equator. Longitude increases as it moves away from the Prime Meridian, which runs through England. That means that the Golden Gate Bridge is almost 122.5 degrees west of the Prime Meridian.

Using the FOXTROT Objective worksheet and the San Francisco TAC, identify the coordinates of the landmarks from DELTA OBJECTIVE. The Flight Crew should work together on completing the worksheet.

Once the worksheet is completed, the Flight Crew should activate MSFS2000 and fly to the surprise target at the coordinates listed in the box at the bottom of the worksheet.

MISSION ACCOMPLISHED! CONTINUE TO GOLF OBJECTIVE

	LONGITUDE (WEST)	LATITUDE (NORTH)
GOLDEN GATE BRIDGE	W 122.28.45	N 37.49.31
BAY BRIDGE	W 122.22.06	N 37.48.83
SAN MATEO BRIDGE	W 122.13.25	N 37.35.86
ALCATRAZ ISLAND	W 122.25.80	N 37.49.77
MOFFETT FIELD	W 122.3.38	N 37.25.87
SAN FRANCISCO INTL.	W 122.22.45	N 37.37.15
METROPOLITAN OAKLAND INTL.	W 122.13.30	N 37.43.82
HAYWARD EXECUTIVE AIRPORT	W 122.7.61	N 37.39.73
MT. DIABLO	W 121.54.06	N 37.54.30
STANFORD UNIVERSITY	W 122.8.26	N 37.26.72
U.C. BERKELEY	W 122.17.65	N 37.53.05
CALAVERAS RESERVOIR	W 121.52.04	N 37.29.62
SAUSALITO VOR	W 122.31.38	N 37.51.21

GOOD WORK! TRY THIS BONUS CHALLENGE

Plot this location on the San Francisco TAC:
W 122.36.74 N 37.44.62
 Activate MSFS2000 and depart SFO for this target. Enjoy your flight!

GOLF Objective - Magnetism

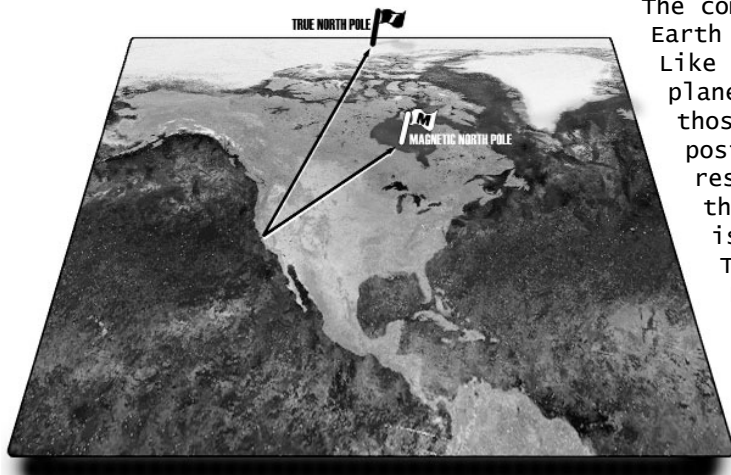
MATERIALS NEEDED: SAN FRANCISCO TERMINAL AREA CHART (TAC)
 1 GOLF Objective worksheet
 1 Pencil (with eraser)
 Plotter
 Magnetic Compass
 Computer and MSFS2000
 Globe (optional)

ESTIMATED TIME TO FINISH: 30 Minutes

GOAL: Gain a working knowledge of compass operations. Learn how to account for magnetic variation and deviation in a compass. Work as a team to determine compass headings.

INTRODUCTION

Over 1,000 years ago some enterprising navigator discovered that a magnetized shard of metal placed on a floating platform will turn to align with the Magnetic North Pole. It has undergone hundreds of years of refining, but the magnetic compass has remained simple, dependable and tireless. When all other instruments fail, the compass is usually still drifting in its liquid medium, seemingly unfazed.



The compass works under the principle that the Earth is surrounded by a dynamic magnetic field. Like a massive version of smaller magnets, the planet has a positive and negative polarity. For those living in the Northern Hemisphere, the positive end of the Earth's magnetic field resides North of Canada's Hudson Bay. Unlike the Geographic North Pole, the Magnetic pole is in constant motion, moving miles each year. The compass points to the Magnetic North Pole. A compass in San Francisco will vary from True North by an angle of 15 degrees. This is known as Magnetic Variation, and all navigators must compensate for it if they hope to achieve accurate headings.

Cartographers have included Magnetic Variation information on aeronautic charts. If you look at the San Francisco TAC, you will find a dashed magenta line running diagonally across the chart. Isogonic Lines represent the angle of variation for Magnetic North.

As if Magnetic Variation wasn't enough to worry about, compasses are also affected by magnetic disturbances. Inside an aircraft, wires, circuits and even the airframe itself are humming with electric energy. This energy disturbs the magnetic field around the aircraft, causing the compass to deviate from Magnetic North. This small disturbance is called Magnetic Deviation and can cause a compass to swing several degrees from Magnetic North. Pilots account for Deviation by "swinging" the compass. To swing a compass, a technician will align the aircraft with the proper Magnetic North heading and then measure the compass deviation for various equipment settings. Small placards are placed in most aircraft with Magnetic Deviation figures for different equipment settings.

CONTINUE ON NEXT PAGE

GOLF Objective - Magnetism (Continued)

PROCEDURE

Using the GOLF Objective worksheet, the Flight Crew should calculate the Magnetic Variation for each of the targets marked on the chart. Using the plotter, the crew should draw straight lines from each target to the Magnetic North marker. The chart has been created so the entire top edge represents True North. The Longitude lines on the chart run due North, so the angle of Magnetic Variation can be easily found by measuring the angle between the Meridians and the crews' target lines.

This activity does not represent a precise method of determining Magnetic Variation due to the 2-dimensional nature of paper charts. The intent is to introduce the concept of Magnetic Variation and how it varies depending on geographic position.

Once the Flight Crew has completed determining Magnetic Variation for each of the targets, open the San Francisco TAC and determine the variation for Alcatraz Island area using the Isogonic lines as a guide. The Magnetic Variation will be the angle listed along the Isogonic Line closest to Alcatraz. As you move North on the chart, the angle of variation increases.

Activate MSFS2000 and set up for a departure from San Francisco International Airport (SFO).

Before the Flight Crew begins the flight, select the compass view from the Views menu. The compass can be dragged to any place in the cockpit. From this point on, the Flight Crew should always have the compass displayed while flying.

As the virtual Cessna 182S is sitting at the end of the runway at SFO, make a note of the compass heading. Runways are named for their magnetic headings. At SFO, there are four runways, one pair of parallel runways is perpendicular to the other. The main pair of runways run at headings of 280 and 100 degrees. How can a runway have two headings? Most runways can be approached from either end to accommodate the prevailing winds, so the main runway at SFO has a heading of 280 if you are approaching from East and 100 if you are coming from the west. SFO has two runways with the same headings, so they are identified by their relation to each other as well. In the case of SFO, they have a runway 280 Right and a runway 280 Left. To simplify things, the names of runways are shortened versions of the runway's headings. The main set of runways at SFO are known as 28R and 28L or 10R and 10L depending on the approach, (a diagram of the SFO runways is on the next page, along with a screen shot from MSFS2000).

In MSFS2000, change the view to the spot plane view (hit the "s" key three times). Pan down until you can see the numbers on the runway. All major runways are labeled like this.

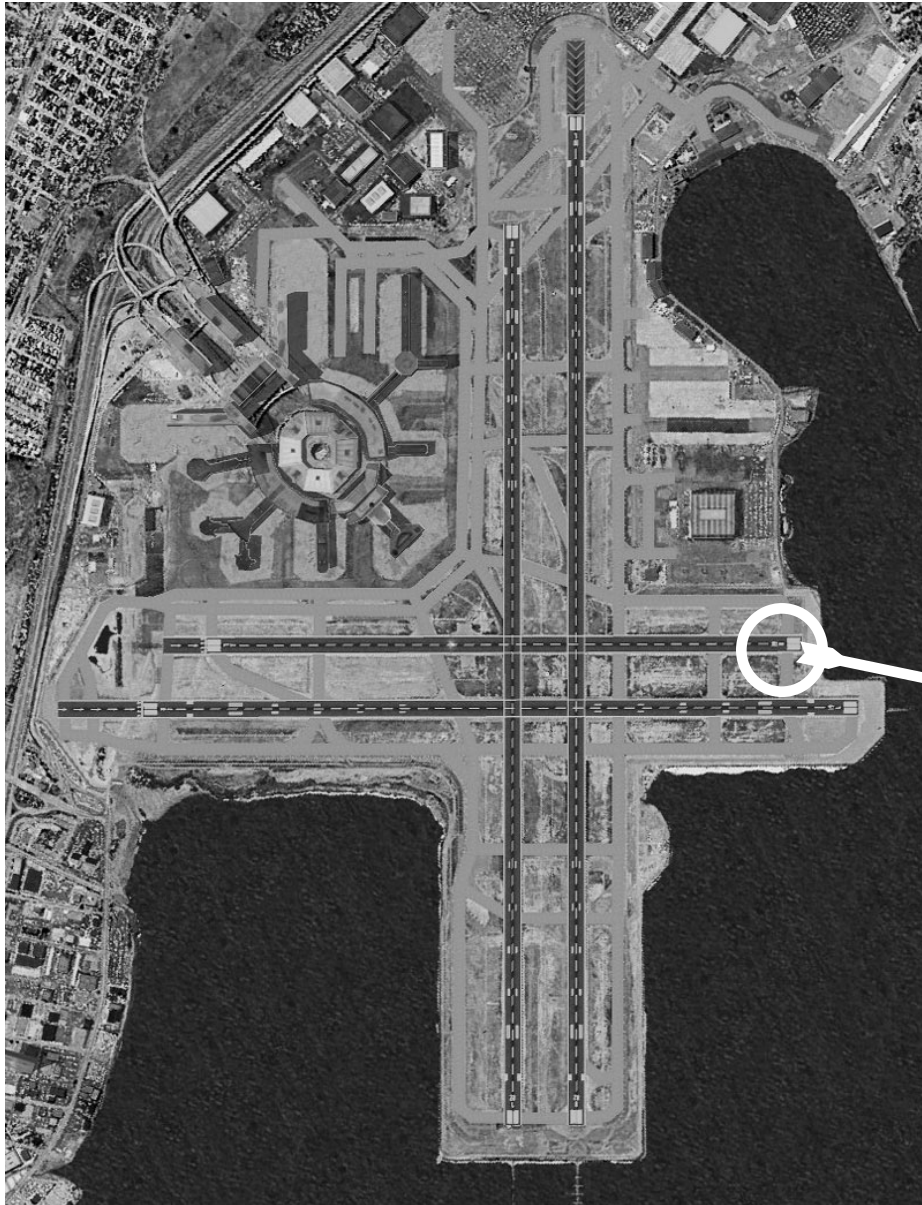
Return to cockpit view and locate the Heading Indicator. This gyroscopic instrument is not a compass, it serves as a companion to the compass. Flight Crews should check the heading shown on the Heading Indicator against the compass before every flight. Heading Indicators can "drift" in error during flight. It should be compared to the compass often.

Once the heading indicator is set, throttle up and go flying. While aloft, the Flight Crew should attempt to hold their course using the compass and Heading Indicator. During competition, the team will be expected to hold a course with little deviation.

MISSION ACCOMPLISHED! CONTINUE TO HOTEL OBJECTIVE

GOLF Objective - Runway Labeling Guide

Runways are named for their magnetic headings.
 Below is a photo of the runway system at San Francisco International Airport.



San Francisco International Airport is typical of many large metropolitan airports. Heavy airliner traffic can be managed by the use of parallel runways, thereby decreasing wait times and ground traffic.

As the winds in San Francisco change, the runways used can be changed as well. Typically, the winds blow up and down the bay, making runways 28/10 the main runways. During abnormal weather conditions, runways 35/1 can be activated instead.

Seldom are both sets of runways open at one time.



Images from Microsoft Flight Simulator

MAGNETIC REFERENCE

With the exception of GPS receivers, all aircraft heading instruments reflect the Magnetic Heading of the aircraft.

Airports and aids to navigation will always refer to heading as Magnetic heading.

During flight planning, great care should be taken to ensure proper compensation for magnetic variation.

HOTEL Objective - Deduced Reckoning

MATERIALS NEEDED: SAN FRANCISCO TERMINAL AREA CHART (TAC)
1 Pencil (with eraser)
Plotter
Computer and MSFS2000

ESTIMATED TIME TO FINISH: 1 Hour

GOAL: Apply teamwork skills and knowledge gained in previous objectives to navigate using Deduced Reckoning.

INTRODUCTION

It's time to apply some of the skills learned so far. Deduced Reckoning is a method of navigation that uses precise course measurements, time-speed-distance calculations, and instruments to navigate without visual reference points. You could say Deduced Reckoning is like flying without looking out the windows.

Dead Reckoning, (as Deduced Reckoning is usually called), isn't the same thing as flying by Instrument Flight Rules. IFR pilots use Dead Reckoning along with a host of other techniques to navigate without visual reference. For the purpose of Wild Blue Wonders, the focus will be on basic Dead Reckoning and not IFR navigation.

PROCEDURE

Open the San Francisco TAC on a large flat surface. Gather the Flight Crew around the chart. For this objective, allow the Flight Crew to brainstorm solutions to challenges that they face. They should have the skills and knowledge needed to Dead Reckon from their work on the previous objectives.

Tell the Flight Crew that they will be flying from San Francisco International Airport (SFO) to South County Airport (Q99). They will be flying the Cessna 182S. From South County they will fly to Byron Field (C83). From Byron they will fly back to SFO.

The Flight Crew must plot their courses on the chart and establish their true course heading. The True Course Heading is the angle of their flight path in relation to True North. Once they have established their True Course Heading for each leg of the trip, the team should apply the Magnetic Variation angle to the heading. In the West, the compass will have an error to the East due to Magnetic Variation, so the Flight Crew will have to either add or subtract the Magnetic Variation angle to their True Course Heading to generate the proper Magnetic Heading. The Magnetic Heading is the direction they should fly while in the aircraft.

The Flight Crew will need to establish a flight time for each leg based upon the distance and cruising speed of the Cessna 182S, (the cruising speed is listed in the MSFS2000 Pilot's Handbook, Page 170).

The crew should search the chart for the proper cruising altitude for each leg, and the approximate angle of each runway on the route.

CONTINUE ON NEXT PAGE

HOTEL Objective - Deduced Reckoning (Continued)**PROCEDURE (Continued)**

Once they are ready, the crew should activate MSFS2000 and begin their flight. To increase the reliance on careful Dead Reckoning, click on the main windshield view and slide it down behind the dashboard for the flight. If the Flight Crew has calculated and measured correctly, they should be able to fly "blind" with only a stopwatch, compass, altimeter, airspeed indicator and chart.

One member of the Flight Crew should act as the Pilot, one as the Co-pilot, one as the Timer, one as the Chart Reader, and one as the Calculator.

As the Pilot handles the joystick, the Co-pilot should handle any keyboard commands needed and watch the gauges with the Pilot.



Lowering the view window will increase concentration.

The Timer should work closely with the Chart Reader and Calculator to check the progress of the flight. Through constant monitoring, the three crew members should be able to pinpoint the position of the aircraft on the chart at all times.

As the aircraft approaches each checkpoint on the route, the windshield view can be slid back up to reveal the ground features ahead. At this point, there should be the proper airport directly ahead, if not - the Pilot and Co-pilot should attempt to find it by circling the area.

The positions of the Flight Crew can rotate at each stop along the trip.

Flying "blind" can be unnerving at first, but once the Flight Crew becomes more familiar with Dead Reckoning and accuracy improves, it will become a great source of pride for the crew.

MISSION ACCOMPLISHED! CONTINUE TO INDIA OBJECTIVE

INDIA Objective - Wind Correction

MATERIALS NEEDED: SAN FRANCISCO TERMINAL AREA CHART (TAC)
 5 INDIA Objective worksheets
 5 Pencils (with erasers)
 Plotter and 4 rulers
 Computer and MSFS2000

ESTIMATED TIME TO FINISH: 1+ Hour

GOAL: Gain an understanding of the effect of wind on an aircraft in flight and learn techniques to adapt Wind Correction to navigation planning.

INTRODUCTION

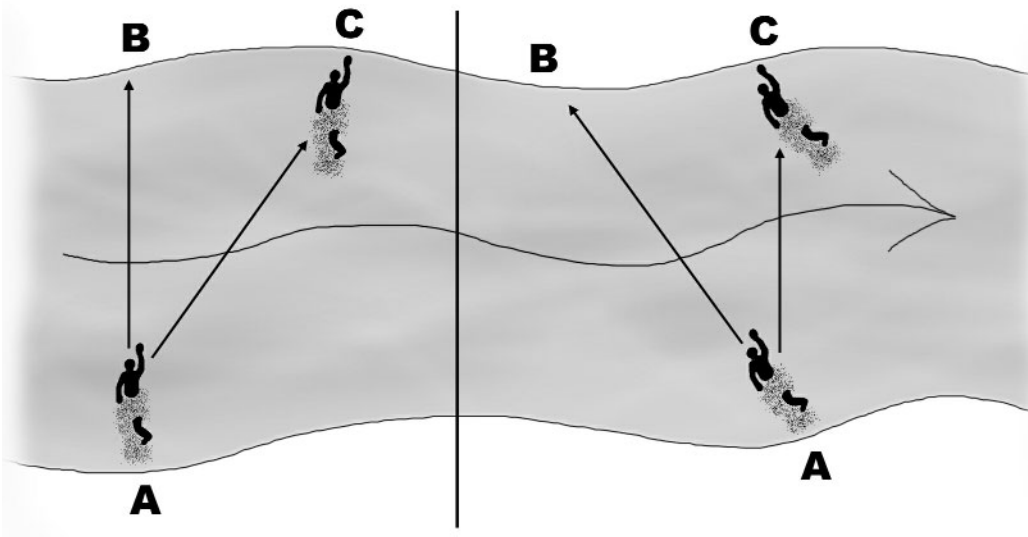
Deduced Reckoning works very well as long as the air the aircraft is flying through isn't moving. Once you introduce the dynamic of weather to flight, additional corrections need to be made to course headings to remain on course. This process is known as Wind Correction.

Similar in practice to Magnetic Variation, Wind Correction requires the application of corrective angles to the intended flight course to maintain the planned path of flight. Unlike Magnetic Variation, wind correction is not set for particular geographic areas.

The easiest way to think of wind correction is to think of the air around the aircraft as a liquid. For centuries, scientists have written volumes on the fluidity of air. If you consider that air flows and behaves like a liquid, the correlation isn't that hard to make.

Most people have had the opportunity to swim across a river during their lives. The flowing river is like the moving air mass (wind) around an aircraft. To swim to a point directly across the river, the swimmer must swim upstream to counteract the flow of the river. The same idea applies to Wind Correction.

Both swimmers are forced downstream by the river's current. The swimmer on the left did not compensate for the current, and was swept to point C instead of the intended destination of point B. The swimmer on the right compensated for the current by swimming toward point B, thus ending up at point C.



The angle of correction used by the swimmer on the right resulted in a correct course over the ground. In aviation, there are often differences in course and speed through the air and over the ground. Because navigation is concerned with reaching points on the ground, it is the over the ground information that is most important.

CONTINUE ON NEXT PAGE

INDIA Objective - Wind Correction (Continued)

INTRODUCTION (Continued)

The movement of air around an aircraft will do more than change its course, the ground speed of the aircraft will also change. Through the process of Wind Correction, you will learn how to compensate for course changes and compute ground speed.

The foundation of Wind Correction technique is the wind Triangle. This triangle can be drawn directly on a chart for quick and accurate wind correction computation.

The first leg of the triangle is the True Course of the aircraft. The True Course is the straight line between two points on a chart. No corrections have been made for Magnetic Variation or deviation. The True Course line (TC from now on) has two quantities: direction and distance. The direction is the course of the flight (85 degrees for instance). The distance is the number of Nautical miles between points on the chart.

The second leg of the triangle represents the wind. Wind also has direction and distance. The direction is the heading the wind is blowing, and the distance is the velocity of the wind as it relates to the estimated length of the flight.

The final leg of the triangle is the actual path of the aircraft over the ground, known as the Track. The track leg of the triangle will have both direction and distance. It is from the direction and distance quantity of the Track that the wind correction angle and speed is produced.

Wind Correction is best learned by doing, so prepare to master the weather!

PROCEDURE

Distribute the INDIA worksheets, pencils and rulers.

Lead a discussion about air as a fluid. Talk about Hot-Air Balloons and how they float through the air, riding in the invisible currents of wind. Lead the discussion to swimming, and ask if any of the team have ever tried to swim across a river. If a blackboard or whiteboard is available, draw the river and illustrate the two swimmers from the previous page.

Once the concept of correcting for current is understood, refer the Flight Crew members to the INDIA Objective worksheets.

At the top of the worksheet is a mock aeronautical chart. A compass rose has been placed over the airport at Gusty Gulch. That is the home airport for this activity. Have the team draw straight lines from Gusty Gulch to Breezy Bluffs airport. The scale for the chart is at the bottom. Instruct the Flight Crew to label their TC lines with the heading and distance.

The wind is blowing at 15 knots along the flight path and the wind is blowing from the west, so it has a heading of 90 degrees. Before you can draw the wind leg of the triangle, you must calculate the flight time for the TC. The distance is just less than 45 Nautical miles, and the Flight Crew will be flying the Cessna 182S, which cruises at 140 knots. The estimated flight time is 20 minutes. 20 minutes is 1/3 of an hour, which means the wind will move 5 Nautical miles during the flight, (15 knot wind speed / .333 hour = 5 Nautical miles).

CONTINUE ON NEXT PAGE

INDIA Objective - Wind Correction (Continued)**PROCEDURE (Continued)**

The wind leg of the triangle is drawn from the end of the TC leg. Instruct the Flight Crew to draw a straight line 5 Nautical miles long with a heading of 90 degrees from the airport at Breezy Bluffs.

To complete the wind triangle, the Flight Crew should connect the end of the wind leg to the beginning of the TC (at Gusty Gulch Airport). This final leg, the Track, is the path that the airplane will take over the ground as the wind causes it to drift off course.

Measure the length of the Track. That is the distance the aircraft will fly during the 20-minute flight. In this case, the track is about 46 Nautical miles long. The wind will push the aircraft one extra mile during the flight.

The Flight Crew should use the plotter (or a protractor) to measure the angle between the TC line and the Track line. That angle is the wind Correction Angle. In this case, the aircraft will be set off course by 6 degrees during the flight. Since the wind is coming from the west, the heading increased from 11 degrees to 17.

The team should subtract the wind Correction Angle from the TC to obtain a corrected heading.

REVIEW

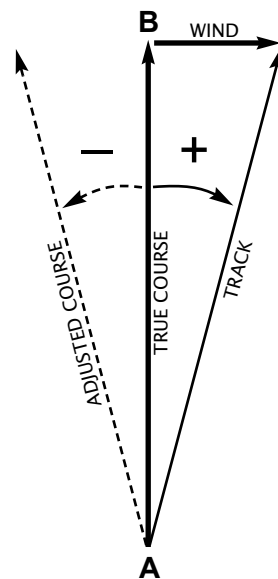
In the current wind conditions between Gusty Gulch and Breezy Bluffs, a Cessna 182S flying from Gusty Gulch to Breezy Bluffs will drift 6 degrees off course and 1 mile beyond the target during the 20 minute flight.

By subtracting the wind Correction Angle from the TC, the Flight Crew will now fly along the TC line. The crew will also expect to arrive at Breezy Bluffs slightly early.

Practice some wind triangles using the San Francisco TAC.

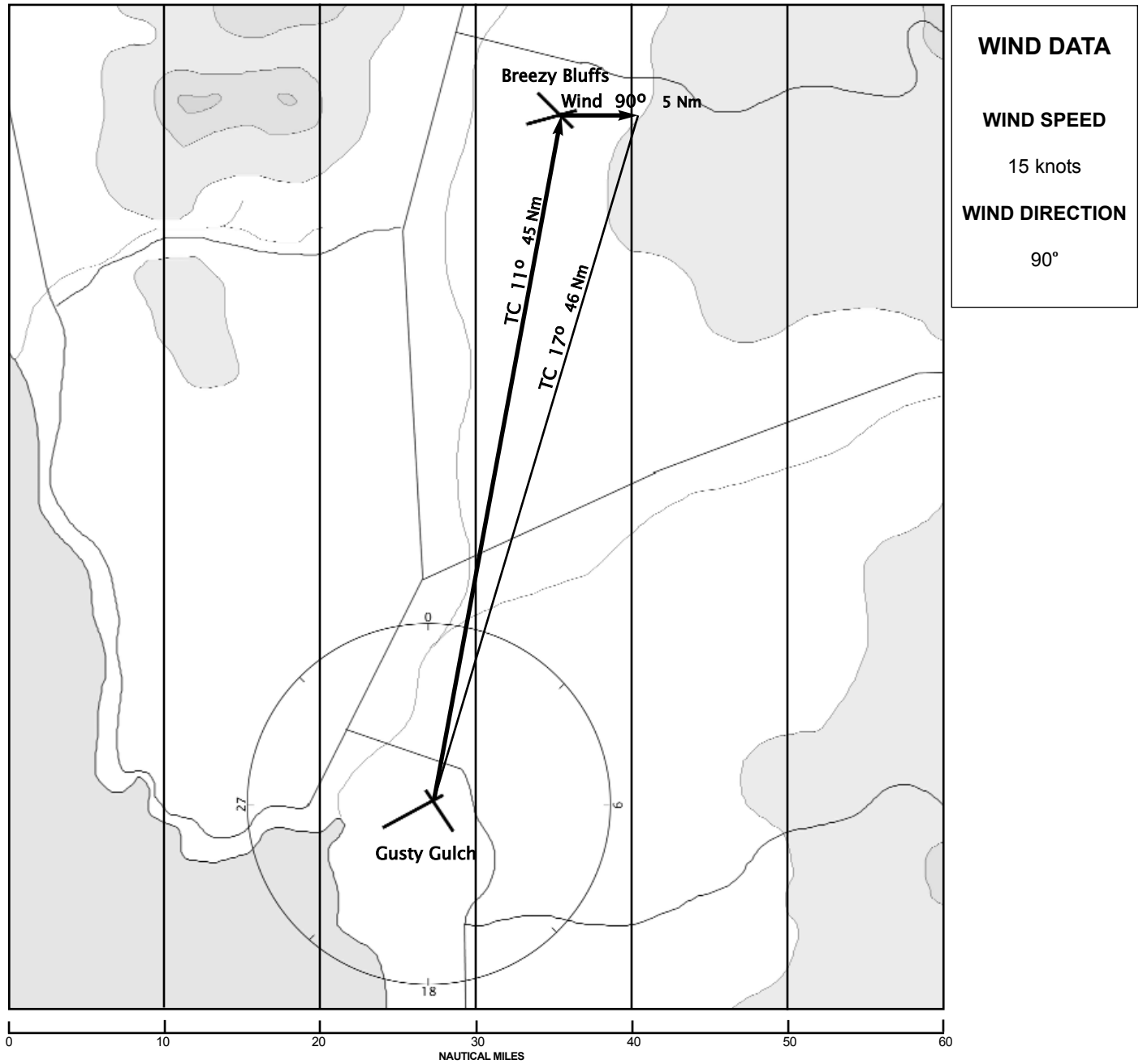
Once the team is ready to activate MSFS2000, they should click on the WORLD menu and select the weather menu. MSFS2000 can be configured to create specific wind conditions using the weather menu. Allow the team to set the wind velocity and direction then attempt to hold their intended course.

There will be wind during the Flight Plan portion of the Wild Blue Wonders competition.



MISSION ACCOMPLISHED! CONTINUE TO JULIET OBJECTIVE

WIND CORRECTION



JULIET Objective - Flight Planning

MATERIALS NEEDED: SAN FRANCISCO TERMINAL AREA CHART (TAC)
5 OFFICIAL WBW FLIGHT PLANNING FORMS
5 Pencils (with erasers)
Plotter
Computer and MSFS2000

ESTIMATED TIME TO FINISH: 30 Minutes

GOAL: Flight Crew members consolidate various navigation skills into a comprehensive flight plan while working as a team to evaluate large amounts of data.

INTRODUCTION

Piloting an aircraft is busy work. There are instruments to monitor, the sky above, below and around you to keep an eye on, and fast-moving radio communications to keep up with. Most pilots enjoy the challenge of juggling many responsibilities, but few would want to try it without preparation. That's where flight planning comes in.

Pilots like to think ahead, and there's no better way to prepare for a flight than sitting down with a chart and forming a plan. That plan should include the basics: heading, weather information, safe cruising altitude, destination airport information, and estimates for flight time and fuel use. Good flight planning will always result in a better flight, poor flight planning may lead to big trouble.

PROCEDURE

The key to a good flight plan is an orderly way to collect all of the information you will need. There seem to be as many flight planning forms as there are pilots. Some are packed with check boxes and lines of information, others are spartan, with only vital data included. The Official wild Blue wonders Flight Planning Form includes everything required during the wild Blue wonders competition.

Each member of the Flight Crew should be given a blank WBW Flight Planning Form, a pencil and an eraser.

Take a few minutes to walk through the parts of the form.

TEAM: The easy part. The Flight Team name goes here.

HOME AIRPORT: The airport where the flight will originate. The name, 3-character identification, and the field's altitude can all be found on the aeronautic chart next to the airport symbol.

DESTINATION AIRPORT: The airport the Flight Crew plans to fly to. For flights with multiple stops, multiple forms should be used.

WEATHER INFORMATION: Every pilot is required by law to receive a weather briefing before flying. The radio frequency for the Automated Terminal Information System is listed on the chart with the airport tower frequency (look for ATIS). There will be more information on aviation weather reporting in the Checkride Component objectives.

AIRCRAFT INFORMATION: Some pilots fly a variety of aircraft, all with different characteristics. The information for the MSFS2000 aircraft can be found in the Pilot's Handbook and in the program. The Flight Crew should compute the takeoff weight of the aircraft during the flight planning stage. Worrying about it as the aircraft strains to leave the runway is a little late.

CONTINUE ON NEXT PAGE

JULIET Objective - Flight Planning (Continued)

PROCEDURE (Continued)

ROUTE INFORMATION: Most of the critical information goes here. Heading, Magnetic Variation, wind Correction, flight time, and speed information should be consolidated in this section.

ALTITUDE INFORMATION: It is difficult (and unsafe) to scour a chart for altitude information as you fly. The area surrounding your flight path should be carefully examined on the chart prior to takeoff. Attention should be paid to ceiling measurements during the weather briefing as well (ceiling is the bottom of the clouds, if there are any). The aircraft cruising altitude should be sufficient to clear all terrain (the highest point) along the flight path by at least 1,200 feet. The cruise altitude also must be at least 500 feet from the ceiling, so a pilot must decide to fly below or above the clouds, depending on clearance.


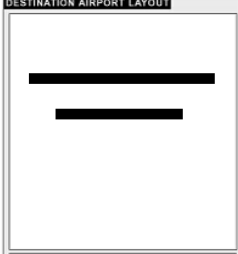
CHECKPOINT INFORMATION: It is always a good idea to identify at least two landmarks to serve as checkpoints along your flight path. Major roads, railroad tracks, rivers, lakes and population centers make great checkpoints. List the checkpoints and the estimated time your aircraft should be over them on the form. It also helps to mark which side of the aircraft the checkpoint should be on. This allows you to check for course deviation.

DESTINATION AIRPORT LAYOUT: An unfamiliar airport can be very confusing, so it is wise to sketch the layout of the runways and major taxiways on the flight plan form. Once you arrive at the airport, a quick glance at the sketch should allow you to identify the proper runway and confirm that you are at the right airport.

Open the San Francisco TAC and identify a home and destination airport. Choose one of the aircraft from MSFS2000 and plan the flight.

Once the flight plan is complete, the Flight Crew can check their work by flying the route in MSFS2000.

The wild Blue Wonders Flight Plan portion of the competition will mimic this scenario. The Flight Crew will be given a blank WBW Flight Planning Form, a weather briefing, aircraft specifications (the Cessna 182S will be the competition aircraft), and route information. The Flight Crew will have 30 minutes to plan their flight and then fly it on MSFS2000. Judges will look for accuracy, safety and team work throughout the competition.

OFFICIAL FLIGHT PLANNING FORM							
TEAM						WILD BLUE WONDERS	
NAME: Lancers							
HOME AIRPORT							
NAME: San Francisco Intl.		ID: SFO	ALTIMETER: 11				
DESTINATION AIRPORT							
NAME: Livermore		ID: LVK	ALTIMETER: 397				
WEATHER REPORT							
68° f	29.95	Unlim.	15 knots	90	Clear, calm		
TEMPERATURE	BAROMETRIC PRES.	VISIBILITY	WIND VELOCITY	WIND HEADING	OUTLOOK		
AIRCRAFT INFORMATION							
Cessna	182S	N4522T	88 Gal.	40 Gal.	400 Nm	2,400 Lbs.	
TYPE	MODEL	TAIL NUMBER	FUEL CAPACITY	FUEL LOAD	RANGE	TAKEOFF WEIGHT	
ROUTE INFORMATION				ALTITUDE INFORMATION			
080	002	015	063	1840	Unlim.	3700	
TC HEADING	WIND CORRECTION	MAGNETIC VARIATION	COMPASS HEADING	HIGHEST POINT	CEILING	CRUISE ALTITUDE	
27 Nm.	140 Knots	142 Knots	00:11+				
DISTANCE (NM)	INDICATED AIRSPEED	GROUND SPEED	FLIGHT TIME				
CHECKPOINT INFORMATION							
Hayward Field		Pleasanton Tower					
CHECKPOINT #1		CHECKPOINT #2					
00:05	Left	00:09	Right				
TIME TO	SIDE	TIME TO	SIDE				
CHECKPOINT #3		CHECKPOINT #4					
TIME TO	SIDE	TIME TO	SIDE				
DESTINATION AIRPORT LAYOUT							
							
7L - 5200' Paved RUNWAY HEADING							

MISSION ACCOMPLISHED! CONTINUE TO KILO OBJECTIVE

KILO Objective - Weight and Balance

MATERIALS NEEDED: Official wild Blue Wonders Flight Plan Form
Pencils/Pens

ESTIMATED TIME TO FINISH: 15 Minutes

GOAL: Calculate aircraft weight and determine balance.

INTRODUCTION

One of the four forces of flight is weight. An airplane must be able to lift its own weight to fly. An aircraft may be able to take off overloaded, but the stresses of turning and turbulence can tear the wings off an overweight airplane.

Each aircraft flown in the United States is required to have published documents specifying maximum takeoff weight. This information is usually found in the Aircraft Operations Manual.

As part of the flight planning process, pilots should calculate the weight of their aircraft, the fuel on board, the weight of the pilot, passengers and cargo. If the aircraft is overloaded, it is up to the pilot to rectify the situation by offloading cargo, fuel or passengers.

On the Official WBW Flight Planning Form, there is a section for calculating aircraft takeoff weight. During competition, the Flight Crew will be expected to complete the section and ensure their aircraft is below the weight limit.

PROCEDURE

Distribute a copy of the Official wild Blue Wonders Flight Planning Form to each of the Flight Crew members.

Ignore everything on the form except the AIRCRAFT INFORMATION section.

AIRCRAFT INFORMATION						
Cessna <small>TYPE</small>	182S <small>MODEL</small>	N0022T <small>TAIL NUMBER</small>	88 Gal. <small>FUEL CAPACITY</small>	 <small>FUEL LOAD</small>	 <small>RANGE</small>	 <small>TAKEOFF WEIGHT</small>

In wild Blue Wonders, the Flight Crew usually flies the Cessna 182S. In the TYPE box, the team members should write, "Cessna". In the MODEL box, "182S". Each Flight Crew member can invent a tail number for their imaginary Cessna. Aircraft in the U.S. must begin with a "N".

In the Operations Manual for the 182S (found in MSFS2000 Pilot's Handbook, Page 170), the Fuel Capacity is listed as 88 U.S. Gallons. This figure should be entered in the FUEL CAPACITY box.

CONTINUE ON NEXT PAGE

KILO Objective - Weight and Balance (Continued)

PROCEDURE (Continued)

The Cessna can carry a lot of fuel. Ask the Flight Crew members if they have noticed the Fuel Flow gauge in the cockpit of the MSFS2000 Cessna. It is located on the instrument panel just to the left of the Turn Coordinator. While in straight and level cruising flight, the gauge should indicate a fuel-use rate of approximately 13 gallons per hour.



How many hours could the Cessna fly with a full load of fuel? With both wing tanks filled to capacity, a Cessna 182S can fly for 6 hours and 45 minutes! That is an impressive range for a single-engine general aviation aircraft. It is also a lot more fuel than the Flight Crew will need.

Aviation fuel weighs 6 pounds per gallon. How much would the full load of fuel weigh? Add the 528 pounds of fuel to the empty aircraft weight of 1,882 pounds, and the Cessna weighs 2,410 pounds. Load a pilot, three passengers, and their luggage into the airplane and you could easily tip the scales at well over the 3,110 pound limit.

Suggest to the Flight Crew a fuel load of around half of the 88-gallon capacity. Based on their chosen fuel load, have the team calculate the range of their aircraft. The Fuel load and Range should be entered in the boxes on the form.

(The range of an aircraft can be represented in time or distance. For the purposes of wild Blue Wonders, the range will always be listed as time.)

Instruct each of the Flight Crew members to calculate the fuel weight for their airplane. They should then add the weight of the pilot, passengers and cargo. This is the Takeoff weight of the aircraft. It cannot exceed the maximum specified for the aircraft in the Operations Manual. In this case, the Maximum Gross Weight of the Cessna 182S is 3,110 pounds.

AIRCRAFT INFORMATION

Cessna	182S	N0022T	88 Gal.	45 Gal.	3:30:00	2,852 Lbs.
TYPE	MODEL	TAIL NUMBER	FUEL CAPACITY	FUEL LOAD	RANGE	TAKEOFF WEIGHT

The balance of the aircraft is also critical to safety. The weight load of an airplane should never be unbalanced. Too much weight in the back of the plane will cause it to climb, too much in the nose, the plane will dive. A balanced aircraft will fly straight and level.

Ask the flight crew to calculate their weights and balances. Have four of the five members sit in four chairs arranged to simulate the seats of the Cessna 182S. If the pilot is larger than the passenger in the right front seat, the passengers in the rear must be placed so the heavier of the two is on the right side. In the case of a unavoidable weight imbalance, fuel can be transferred to the wing tank on the "light" side of the plane to balance the load.

MISSION ACCOMPLISHED! CONTINUE TO LIMA OBJECTIVE

LIMA Objective - Flight Test

MATERIALS NEEDED: San Francisco Terminal Area Chart (TAC)
 Plotter
 Pencils
 Scratch Paper
 Official WBW Flight Planning Form
 Computer and MSFS2000

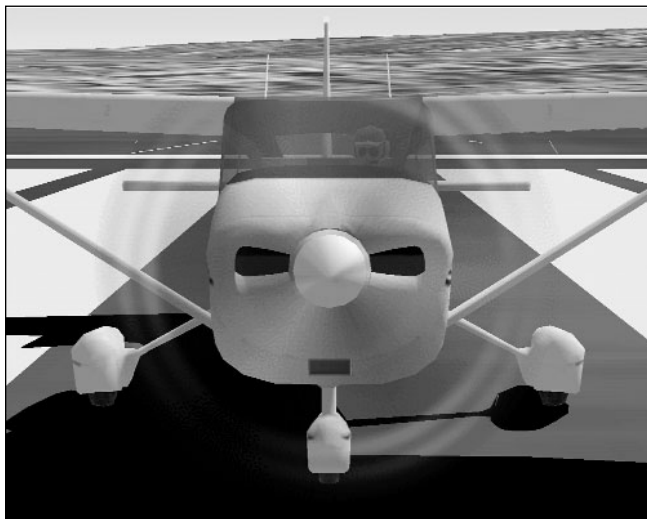
ESTIMATED TIME TO FINISH: 1 Hour

GOAL: Assess Navigation, Aeronautical and Teamwork skills through a comprehensive flight test.

INTRODUCTION

It's time. The Flight Crew has navigation down pat and they can fly MSFS2000 all day. Now it's time to see if they can put it all together.

PROCEDURE



Download the MSFS2000 flight "Flight Test" from the wild Blue Wonders web site. Place the file in the Pilots folder under FS2000 in the Program Files folder on the C drive.

Activate MSFS2000 and select the "Flight Test" flight in the "SELECT A FLIGHT" menu.

Spread the San Francisco TAC out on a large table or the floor so the Flight Crew can gather around it.

Select one member of the Flight Crew to act as the Pilot, one as the First Officer, one as the Navigator, one as the Flight Engineer, and one as the Ambassador.

Give the Ambassador the Official WBW Flight Planning Form and a pencil. The Plotter should

go to the Navigator.

The goal of this objective is to test the team's ability to follow directions, recall the information from the previous objectives, and work together to achieve success.

If the team is ready, read the following instructions and allow them to begin work.

"Welcome to your Flight Test. You have been given training in a variety of subjects relating to Navigation, Aeronautics, Physics, Mathematics and Technology. In this objective you will be expected to demonstrate your understanding of what you have learned.

"I am going to give you some information vital to the success of your objective. I expect you to work together as a team to accomplish the tasks required."

CONTINUE ON NEXT PAGE

LIMA Objective - Flight Test (Continued)

PROCEDURE (Continued)

"You should take careful notes of the information I am about to give you. I will not repeat any of it once I am finished. Here are some pencils and some scratch paper for notes. The Crew Ambassador will be in control of the Flight Planning Form.

"Are you ready?"

"If the crew is ready to go, begin with the instructions.

"You will be flying the Cessna 182S today from an airport located at 122 degrees, 28 minutes and 85 seconds West Longitude and 37 degrees, 36 minutes, 40 seconds North Latitude. Your destination airport is located at 121 degrees, 49 minutes, 73 seconds West Longitude and 37 degrees, 41 minutes, 64 seconds North Latitude.

"The weather conditions along the intended flight path are as follows:
The winds are from the North at 12 knots. Visibility is unlimited and the outlook is for clear skies all day. The barometric pressure is 29.92.

"Your aircraft is loaded with 44 gallons of fuel.

"Remember to complete your flight plan before departing. You must select at least two checkpoints along your route.

"When you reach your destination airport, you must fly at least one circuit of the traffic pattern before landing.

"This test is not timed. During the wild Blue Wonders competition you will have 30 minutes to perform a similar flight plan and flight.

"Good luck. Begin your work."

The Flight Crew should work together on the flight plan. They must plot their course, correct for magnetic variation and wind, select a cruising altitude, compute range and takeoff weight, and select checkpoints.

You may assist them if necessary, but during the competition, Flight Leader participation will be prohibited.

Once the team has flown the route and landed safely, spend a few minutes debriefing with them about the flight. Focus on teamwork and fundamentals.

The next objective will feature a similar challenge, only timed.

MISSION ACCOMPLISHED! CONTINUE TO MIKE OBJECTIVE

MIKE Objective - Race the Clock

MATERIALS NEEDED: San Francisco Terminal Area Chart (TAC)
Plotter
Pencils
Scratch Paper
Official WBW Flight Planning Form
PAPA Objective Data Sheet
Computer and MSFS2000

ESTIMATED TIME TO FINISH: 1 Hour

GOAL: Prepare for competition by completing a rigorous flight challenge as a team.

INTRODUCTION

In this final objective of the Flight Plan component, the Flight Crew will work as a team to complete a timed flight planning and flight simulation drill.

This objective can be used to assess the team's ability to communicate, problem-solve and transfer the knowledge gained in the previous objectives.

If you have assigned the Flight Crew roles prior to this point, enforce them in this objective. If you have not assigned roles, read the Teamwork section on Page 71 of this manual for role definitions and assign the roles at this time. The roles can be changed at any time, but they must be established during the competition.

As Flight Leader, your role during this objective is observation. The Flight Crew will have the information they need to complete the objective. Try to avoid helping the team unless they reach an impasse. The Flight Crew will not be able to interact with you during competition.

PROCEDURE

Download the MSFS2000 flight "Race the Clock" from the wild Blue wonders web site. Place the file in the Pilots folder under FS2000 in the Program Files folder on the C drive.

Activate MSFS2000 and select the "Race the Clock" flight in the "SELECT A FLIGHT" menu.

Spread the San Francisco TAC out on a large table or the floor so the Flight Crew can gather around it.

Issue the Official Flight Planning Form and the PAPA Objective Data Sheet. Once the crew is ready, inform them that they have 30 minutes to complete the flight plan form and fly the planned flight in MSFS2000. This is the same amount of time they will have during competition.

MISSION COMPLETED! CONTINUE TO CHECKRIDE COMPONENT



CHECKRIDE

CHECKRIDE Introduction

After dozens of hours of flight training and hundreds of hours of ground study, every student pilot must face the Checkride to receive the title of Private Pilot. The solo flight may be the most memorable experience for most fledgling pilots, but the Checkride is usually a close second for white-knuckle pressure.

In an official Checkride, an FAA inspector takes to the sky with the student pilot for a series of flight tests and demonstrations. It is the airborne version of the dreaded DMV Driver’s Test, only without the parallel parking.

In wild Blue wonders, the Checkride is a Jeopardy-style knowledge game. Challenging the Flight Crew with five categories, (Aviation History, Weather, Physics, Aircraft Parts, and Aircraft Recognition), Checkride is a race for points. In each category, five questions increase in difficulty and points.

Checkride is played on a computer. During competition, Flight Crews race to gather points in a limited amount of time. Each point earned in Checkride is equal to a point in the overall competition.



The graphic shows the word 'CHECKRIDE' in a large, stylized, 3D font at the top. Below it is a grid representing a Jeopardy-style game board. The grid has five columns and five rows. The columns are labeled: FLIGHT HISTORY, AVIATION WEATHER, FLIGHT FORCES, AIRCRAFT PARTS, and AIRCRAFT RECOGNITION. The rows represent point values: 20, 40, 60, 80, and 100. Each cell in the grid contains the point value for that category and difficulty level.

FLIGHT HISTORY	AVIATION WEATHER	FLIGHT FORCES	AIRCRAFT PARTS	AIRCRAFT RECOGNITION
20	20	20	20	20
40	40	40	40	40
60	60	60	60	60
80	80	80	80	80
100	100	100	100	100

Checkride isn’t easy. The wild Blue wonders staff has scoured the aviation world for the most challenging questions around.

Through the following objectives, the Flight Crew will be given the tools to practice for Checkride. To assist the team, practice games can be found on the wild Blue wonders web site.

MATERIALS

Each of the following objectives requires a computer with Internet access. If you do not have one available, the Flight Crew members can log onto the wild Blue wonders web site from home or the library to practice.

The Library is also a great place to find books about aviation history, meteorology, physics, and aircraft mechanics. In addition to the information found on the wild Blue wonders web site, there are many links to other informative web sites.

Much of what the Flight Crew will face in Checkride can be found throughout the wild Blue wonders curriculum.

Of course, one of the finest places to track down a wealth of aviation information is your host aerospace museum. The staff at the museum is an excellent source of information on all of the subject matter in Checkride.

NOVEMBER OBJECTIVE - Aircraft Recognition

MATERIALS NEEDED: Library and/or Computer with Internet Access

ESTIMATED TIME TO FINISH: 30+ Minutes

GOAL: By studying aircraft designs, the Flight Crew will be able to recognize specific aircraft by their shape.

INTRODUCTION

During World War II, anti-aircraft gunners were issued booklets filled with depictions of Allied and Axis aircraft. Designed as quick-reference guides, the Aircraft Recognition books were meant to keep the gunners from shooting down friendly aircraft.

As the war raged on, trainers sought easier ways to educate the troops on aircraft recognition. Someone had the idea of printing silhouettes of aircraft on decks of playing cards. While the soldiers and sailors enjoyed a relaxing game of poker with their buddies, they could be studying. The idea caught on, and the cards were a big hit with the troops.

The need for military aircraft recognition cards has diminished in the age of standoff weapons. Ground troops on the modern battlefield don't see enemy aircraft until it's too late. Aircraft spotters have been replaced by airborne RADAR systems and ground-based air defense assets.

During the wild Blue Wonders competition, Flight Crews will be playing a computer game called Checkride. In the game, the team will have the opportunity to win points by identifying aircraft by their silhouettes. Included in the game will be military fighters, helicopters, airliners, general aviation aircraft, transport planes, and experimental aircraft. The aircraft found in Checkride are not from any one era. World War II bombers, advanced tactical fighters and pioneering aircraft will all be featured.

Crew members can find excellent aircraft information on the Internet and in the Library. A list of useful web sites and books can be found on the wild Blue Wonders web site.

PROCEDURE

There seem to be as many different kinds of aircraft as there are people. Using the library and the internet, locate photos and drawings of as many kinds of aircraft as possible.

You'll notice that certain types of airplanes tend to look similar. Aircraft design is a form-follows-function craft. Airplanes have to look the way they do to do the jobs they do. Obviously, a 747 is made to carry people and cargo. It can haul huge loads, and it looks like it! An F-16, on the other hand, carries one person and a cargo of weapons. It looks fast and mean.

If you can, find an aircraft recognition book. As a team, study the different shapes of airplanes. In the Checkride competition, you will be shown the outline of an airplane and be asked to identify it. Can you tell the difference between a Boeing 737 and an Airbus 300? How about a P-51 Mustang and a P-40 Tomahawk?

Good Luck!

MISSION ACCOMPLISHED! CONTINUE TO OSCAR OBJECTIVE

OSCAR OBJECTIVE - Meteorology

MATERIALS NEEDED: 5 - Wild Blue Wonders Weather Worksheets
Telephone
Computer with Internet Access (optional)

ESTIMATED TIME TO FINISH: 30 Minutes

GOAL: The Flight Crew will gain an understanding of basic aviation weather.

INTRODUCTION

Weather still mystifies scientists. Many advances have been made in the science of meteorology, and weather forecasting has become increasingly accurate. Yet, a slight shift in the Jetstream can send meteorologists scrambling to keep up. It isn't that meteorologists aren't good at what they do; it's just that weather is a very dynamic subject.

Aviators are especially interested in the weather. For obvious reasons, pilots keep a watchful eye on the sky and a bent ear on the radio. The importance of understanding weather is so great for pilots that they are required to receive a weather briefing before they taxi to the runway for takeoff.

There are numerous sources of weather information for pilots. The FAA maintains a network of Flight Service Stations across the country to keep pilots up-to-date. Internet web sites feature immediate weather observations, satellite images, and complex RADAR data for nearly the entire planet. Cable television networks devote full-time coverage to weather, and most of the remaining media outlets feature regular updates. Each airport with an active control tower also broadcasts a continuous stream of localized weather data. There is no shortage of information about the weather.

Pilots look for several key items in whatever weather information they gather. Foremost is visibility. For VFR pilots, if the weather isn't producing enough visibility, they can't fly. The minimum visibility for VFR flight is 3 miles. In addition to the lateral visibility minimum, the cloud deck must be at least 1,000 feet above the surface. Again, these are the MINIMUMS for VFR flight. Many pilots won't fly unless conditions are well above minimums.

Another key element of aviation weather is the movement of the airmass. If it is windy, a pilot must know about the direction and magnitude of wind. As you know from the wind correction objective in the Flight Plan component, pilots can compensate for wind, but they must be able to plan for it. Moderate to severe winds can render an aircraft uncontrollable, so pilots will rarely fly in high winds.

The Barometric Pressure is also very important to pilots. Not only does the Barometric Pressure indicate stable or changing weather, it is what the aircraft's altimeter indicates. Once a pilot knows the Barometric Pressure, the altimeter can be adjusted to indicate the proper altitude.

In Wild Blue Wonders competition, the Flight Crew will be expected to interpret standard aviation weather reports as they plan their simulator flight. During Checkride, the team will also face questions about meteorology. Much of what they will need to know has been covered in school science classes, but this objective is designed to enhance that experience.

CONTINUED ON NEXT PAGE

ROMEO OBJECTIVE - Meteorology (Continued)

PROCEDURE

In this objective, the Flight Crew will be exploring the world of Aviation weather.

Pilots have special weather reports and forecasts provided by the FAA and many private companies. This weather information seems to be in a strange language of abbreviations and acronyms. It will be up to the Flight Crew to learn this language and interpret the weather data.

On the Wild Blue Wonders weather worksheet, the Flight Crew will find a key for deciphering the language of aviation meteorology.

Begin with the required weather information supplied by your local FAA Flight Service Station. These automated weather recordings play on a loop, so stay on the line for a few trips through the report to ensure that you caught the important information. Call (800)WXBRIEF (WX is short for weather in the pilot's lexicon).

What you will hear when you call is a recorded summary of weather conditions in your area, a synopsis of the past several hours, a brief outlook for the next several hours, and any special notices or warnings. The recording will also give advice for pilots to watch out for special conditions or developing weather.

In most of the AFSS (Automated Flight Service Station) recordings, the meteorologist will seem almost conversational. This is intentional. Before the advent of computers, pilots would call the FAA FSS (Flight Service Station) in their area and talk with a meteorologist, who would ask questions about the pilot's route and schedule. The FSS briefer could then give the pilot a personal forecast and discuss any concerns the pilot may have about the conditions.

Pilots can still talk with a real person at the FSS, but the automated recording has become the standard route for most pilots.

After each member of the Flight Crew has had a chance to listen to the recording, hang up and discuss the information in the briefing. Would the team fly in the conditions as they are? Would they wait a few hours? Did the weather seem to be improving? Getting worse? These are all things pilots can be found debating at just about any airport.

Direct the Flight Crew to the Wild Blue Wonders weather worksheet. During the Flight Plan competition, the team will be given a blank weather worksheet and a simulated AFSS weather briefing. The Flight Crew should fill in the blanks on the worksheet with the data from the briefing. That data can then be analyzed by the team and entered on the Flight Plan.

Over the weeks before the competition, encourage the Flight Crew to call the AFSS and listen to the weather briefing. Also ask them to check some of the Internet weather sites for aviation information that they can share with the rest of the team.

It will take a while before the Flight Crew is used to aviation weather talk. Don't allow them to become discouraged by the rapid-fire speech in some of the briefings. They will learn to understand the fastest talkers in the FAA.

MISSION ACCOMPLISHED! CONTINUE TO PAPA OBJECTIVE

PAPA OBJECTIVE - Aircraft Inspection

MATERIALS NEEDED: Computer with MSFS2000

ESTIMATED TIME TO FINISH: 30 Minutes

GOAL: The Flight Crew will be able to identify the basic parts of aircraft and understand their function.

INTRODUCTION

Any aircraft is a symphony of moving parts, all working in unison to maintain flight. While aircraft can vary greatly in appearance, many share common components and parts. The names of some of those parts haven't changed since the birth of human flight. A wing is still a wing whether it is made of muslin and spruce or Titanium and Carbon fiber.

Modern aircraft like the Boeing 747 Jumbo Jet contain literally millions of parts. During the Wild Blue Wonders Checkride competition, the Flight Crew will not be expected to identify the locknut from an Airbus A320 cargo door, but they should be able to name the main structural parts of most aircraft.

This objective will give the Flight Crew an opportunity to learn some of the basic parts of several aircraft featured in MSFS2000. If time permits, the team should explore the vast resources of the Internet and the library for additional information. A list of helpful links and books can be found on the Wild Blue Wonders web site.

PROCEDURE

Activate MSFS2000 and go to the SELECT AN AIRCRAFT MENU.

Select the Boeing 777 from the list.

Once the simulator has drawn in the scenery, switch to the Spot Plane view (hit "s" twice), and zoom out until the team can see the entire aircraft. Pan and roll around the aircraft until you see the underside.

Notice the wing shape of the 777. Early airliners had almost straight wings. The 777 can cruise at .85 Mach, or almost the speed of sound, so its wings must be swept back to keep the wingtips from cutting into the airplane's shockwave. It is a general rule in aircraft design that the faster the plane, the shorter the wings. To intrude upon the aircraft's turbulent shockwave is to invite structural damage!

Pan around to the tail of the plane and observe the elevator and rudder in action. Move the controls around to see the control surfaces respond. Can you identify the control surfaces on the 777? For an amazing display of engineering, deploy the flaps fully. Notice how the wing area has increased? Pan around the wingtip and take a look at the huge airfoil created by the flaps. The 777 can generate enormous amounts of lift with the flaps and slats deployed (the slats are flaps that extend from the leading edge of the wing).



CONTINUE ON NEXT PAGE

SIERRA OBJECTIVE - Aircraft Inspection (Continued)**PROCEDURE (Continued)**

Pause MSFS2000 and select the Concorde from the aircraft menu.



Pan around so the Flight Crew can see the long, slender fuselage of the fastest passenger jet ever. The Concorde is a huge jet, yet it can only carry a fraction of the passengers capable of filling a 777. The cramped cabin of the Concorde is a result of the sleek, efficient shape of the jet. The secret to Concorde's

Mach 2 cruising speed is its sharp fuselage and delta wing (of course the 4 massive Rolls-Royce afterburning engines don't hurt). Remember the swept wings of the 777? Compare them to the knife-thin delta wings of the Concorde. Find the button to lower the nose/visor of the Concorde. Notice how the nose tilts down to allow for the pilots to see the runway. The landing gear of the Concorde are shorter in back than in front. The nose-up attitude of the aircraft allows it to generate more lift as it accelerates down the runway for takeoff. The delta wing of the Concorde has very little airfoil shape, so the aircraft must depend on an increased Angle of Attack for lift.

Pause MSFS2000 and select the Sopwith Camel from the aircraft menu.

The Camel is about as far from the Concorde as you can get! The legendary biplane was an engineering wonder in its day. Pan around to view the wing structure. Most of the early airplanes relied on a complex structure of wires and struts to strengthen the wings. A biplane like the Camel could produce more lift than a monoplane, but as engines became more powerful, airplane designers began to drop the extra wing to cut drag.



What else would cause drag on a biplane like the Camel?

Pause MSFS2000 and select the Learjet 45 from the aircraft menu.

The Learjet is the epitome of executive style.



Capable of swift cruising speeds and altitudes well above the weather, the Learjet is a great way to travel. Pan around to the nose of the aircraft and note the high T-tail of the plane. Look at the placement of the engines. Do you think the location of the tail has anything to do with the engines?

Aeronautical engineers must design airplanes with careful attention to the location of the engines. The turbulence caused by the turbines can disrupt the airflow over the wings and cause control problems.

CONTINUE ON NEXT PAGE

SIERRA OBJECTIVE - Aircraft Inspection (Continued)**PROCEDURE (Continued)**

Pause MSFS2000 and select the Bell 206 Jet Ranger from the aircraft menu.

Very few flying machines feature the complexity of helicopters. Known as Rotor-wing aircraft by some, helicopters fly by generating lift with two sets of spinning wings called rotors. The Main Rotor projects above the fuselage of the helicopter and generates lift to control pitch and roll. Yaw is controlled by the Tail Rotor at the end of the Tail Boom.



Attempt to hold the 206 in a hover by coordinating the tail rotor and main rotor. Helicopter pilots must use both hands and both feet to fly. The feet control the pitch of the Tail Rotor blades, thereby controlling yaw (much like in an airplane). One of the pilot's hands controls the Cyclic, which is the stick that adjusts the angle of the Main Rotor plane (the spinning rotor). The Cyclic allows the pilot to pitch and roll the aircraft. In the pilot's other hand is the Collective, and it controls the pitch of the Main Rotor blades and the RPM of the engine. As you can see by flying the Jet Ranger, helicopter pilots are a coordinated bunch!

Pause MSFS2000 and select the sailplane from the aircraft menu.



Flying without the help of an engine requires an especially efficient aircraft.

Sailplanes (or gliders) have the same control surfaces as most airplanes (ailerons, rudder and elevator).

Fly the sailplane in a circle and take note of the shape of the wings.

Slow-moving aircraft tend to have long, slender wings.

These type of wings provide good lift without creating much drag. Obviously, glider pilots don't have to worry about transonic shockwaves, so the wings can be quite long. Some hyper-efficient aircraft like the Voyager and Gossamer Albatross have wings so long and thin that they droop to the ground when the aircraft is parked, but curve up in flight. The U-2 Spyplane and B-52 bomber both have wings much longer than the fuselage, and both aircraft come with special wingtip landing gear to keep the wings from dragging on the ground.

Encourage the Flight Crew to seek out unusual and amazing aircraft in the Library and on the Internet. During the Checkride competition, the Flight Crew will face questions about a variety of aircraft and aircraft parts.

MISSION ACCOMPLISHED! CONTINUE TO QUEBEC OBJECTIVE

TANGO OBJECTIVE - Faces and Places

MATERIALS NEEDED: Computer with Internet Access
Library Access

ESTIMATED TIME TO FINISH: 1+ Hour

GOAL: The Flight Crew will work together to understand the history of aviation.

INTRODUCTION

The history of human flight didn't begin with the Wright Brothers' famous flight at Kitty Hawk in 1903. Centuries before, humans were taking to the sky in lighter-than-air craft, gliders and even kites.

To fully appreciate modern aviation, you must understand the long history behind flight. You must see the sketches of Leonardo da Vinci, read the account of Charles Lindbergh's trans-Atlantic flight, hear the story of Otto Lilienthal's amazing gliders, and touch the skin of a warbird. The story of human flight is a chain of events, people and places that stretches way back to the dawn of human history.

In this objective, the Flight Crew will work together to explore aviation history. This challenge is designed to prepare the team for the Checkride competition, and instill an appreciation of aviation's rich heritage.

PROCEDURE

Use the Internet or the books in a library, to search for aviation history. Attempt to form a timeline of events over the centuries that people have been flying. Spend time exploring the record-setters and innovators in the exciting world of aviation.

Record your findings in your logbook or on a home page.

MISSION ACCOMPLISHED! CONTINUE TO ROMEO OBJECTIVE

ROMEO OBJECTIVE - Flight Forces

MATERIALS NEEDED: Computer with Internet Access
Library Access

ESTIMATED TIME TO FINISH: 1+ Hour

GOAL: Through continued study of flight physics, the Flight Crew will gain further understanding of the Forces of Flight, Aerodynamics, and aircraft design.

INTRODUCTION

There are many ways to experience the forces of flight without actually flying. One way is to think of air as a liquid and compare aircraft to boats. Leonardo da Vinci envisioned a flying machine with a fuselage shaped like a boat hull. He theorized that since air is like a thin fluid, a "buoyant" hull would allow the craft to "float" in the air. A modern variant of his idea can be found in blimps and other dirigibles.

If you have ever thrust your hand out of a car window to play in the stream of moving air, you've experienced the inspiration of several aircraft designers. One early aviation pioneer would take small models of wings he had designed onto the train for testing. During the trip, he would stick the wings out of the window to see how they would perform in fast-moving air. This engaging method of testing is similar to wind tunnel testing.

Most aircraft designers have experimented with lightweight wooden models of their designs. Even modern aeronautical engineers form models of their creations for wind tunnel tests. In the Free Flight component of Wild Blue Wonders, the Flight Crew will build a balsa airplane. During the testing and adjustment of the aircraft, the team will mimic the process used by aircraft designers for centuries.

This objective will depend heavily on the inventiveness and initiative of the Flight Crew. To prepare for the Flight Forces portion of the Checkride competition, the Flight Crew should work together to explore the physics of flight. The Flight Crew should experiment with MSFS2000, paper airplanes, the local swimming pool, or whatever helps them understand the nature of flight science.

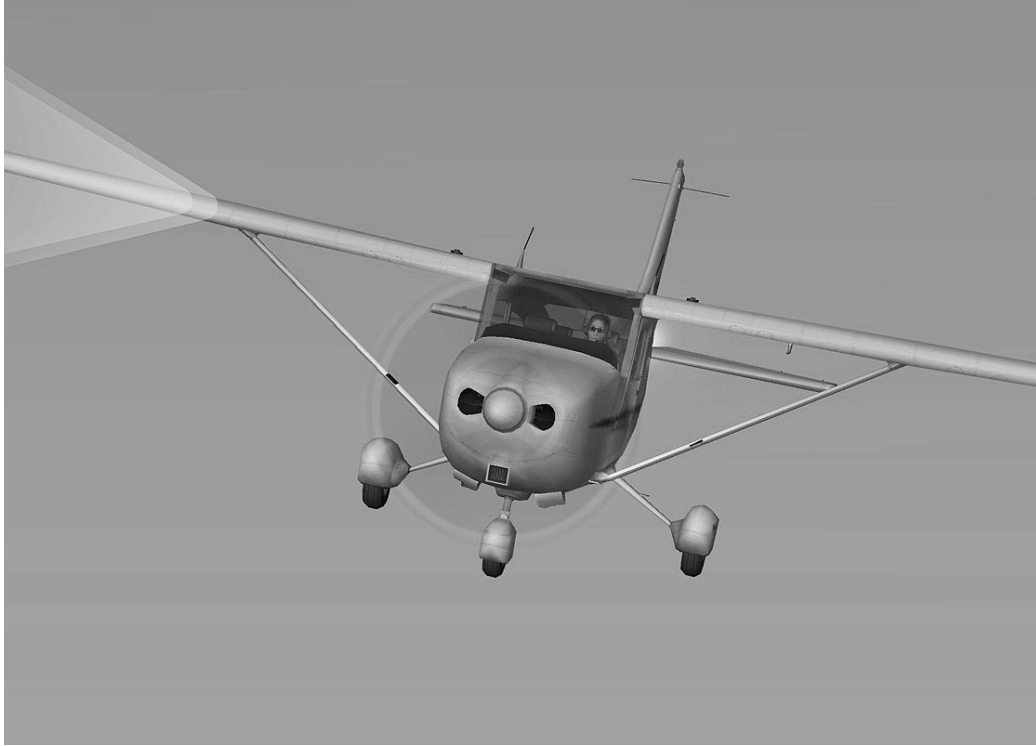
PROCEDURE

Instruct the Flight Crew to brainstorm ideas about flight physics experiments and research they can perform without flying in an aircraft. Encourage them to think "outside the box" about modern airplane design. If necessary, review the Four Forces of Flight with the team.

Ask the Flight Crew to document their work in the Flight Team Logbook.

The Flight Forces portion of Checkride will contain questions about all aspects of flight physics. Tell the team to be prepared by working on the practice Checkride games found on the Wild Blue Wonders web site.

MISSION ACCOMPLISHED! CONTINUE TO RUNWAY COMPONENT



RUNWAY

RUNWAY Introduction

If you ask most aerospace museum workers, they will tell you that people have strong bonds with certain aircraft. War veterans will often visit air museums to visit aircraft as if they were old friends. For many people, an airplane is more than metal, wood and glass. It symbolizes adventure, escape, excitement, and fear. Strong emotions are assigned to aircraft, and each airplane that leaves the ground has a pilot or passenger somewhere who will always remember it.

In your host aerospace museum, there are aircraft that carry history in their empty cabins and cockpits. The purpose of the Runway component is to introduce the Flight Crew to an aircraft and allow them to explore the stories and characteristics that make each aircraft special.

Aircraft are about more than their history, though. The Flight Crew must also get to know the dynamics of the aircraft. How does it fly? Why was it built the way it was? Did it perform as expected?

By building a relationship with a special aircraft of their choosing, the Flight Crew will, in fact, become experts on that particular piece of aviation history. As experts, they will be expected to convey their knowledge of the aircraft through a short theatrical presentation.

Through the creative process of research, writing, rehearsing and performing a play about the aircraft, the Flight Crew will have the opportunity to share their relationship with "their" aircraft.

In the following objectives, the Flight Crew will choose an aircraft, explore its "personality" and develop the play. During the Wild Blue Wonders competition, the Flight Crew will perform the play for the other teams and a panel of judges.

Think of it as the Theater of the Air!

MATERIALS

As the flight crew develops their play, they will need to create some costumes and props. In an effort to keep costs down for the Flight Team, the Runway competition will require that all of the props, costumes and backdrops for the Flight Crew's play must be kept in a carry-on size package. Along with restricting cost, this requirement inspires creativity and efficiency. The package can be an actual carry-on bag or any form of durable container. As long as it meets the size restrictions found in UNIFORM Objective, the Flight Crew can pack whatever they wish inside. Additional guidelines for costumes and props can be found in the UNIFORM Objective.

A trip to your host aerospace museum is suggested to complete the objectives in the Runway Component. As your schedule permits, you can choose to interrupt the order of the Wild Blue Wonders objectives to accommodate the field trip and Runway work. If the museum is nearby, arrange for frequent visits by the Flight Crew for research on the entire Wild Blue Wonders program, not just the Runway portion. The museum is one of your best resources.

PROCEED TO SIERRA OBJECTIVE

SIERRA OBJECTIVE - If This Plane Could Talk

MATERIALS NEEDED: Flight Crew Folios
Note Paper
Pens/Pencils
Transportation to Host Aerospace Museum
Camera (optional)

ESTIMATED TIME TO FINISH: 2+ Hours

GOAL: The Flight Crew will choose an aircraft from the collection at their host museum. Through teamwork and research, the team will learn the history of the aircraft and gain an understanding of its flight characteristics.

INTRODUCTION

The difficult part of this objective for the Flight Crew will be narrowing their choice to just one aircraft. Once they set foot inside their host museum, each member of the team will be drawn to a particular aircraft. The allure of aircraft is hard to explain for many people.

Most aerospace museums are staffed by a dedicated docent corps. These volunteer guides are often personally involved in the renovation, acquisition and exhibitry of the aircraft. They can be the most enthusiastic people around. If you choose to involve the docents in your search for an aircraft, you will undoubtedly be drawn into a world of opinion, anecdotes, and emotion. It may be difficult for some docents to single out a favorite aircraft, but they will be filled with information that may make the choice easier for the Flight Crew.

The docents, along with the museum's curator, will be able to assist the team in gathering information about the aircraft's history and characteristics.

PROCEDURE

Encourage the Flight Crew to explore the entire museum before choosing an aircraft. Sometimes, the "star" aircraft in a museum are not the ones with the best stories behind them.

Have the Flight Crew narrow their list of choices to a handful. The choice may be easy, but if it isn't, instruct the Flight Crew to vote.

Once the aircraft has been chosen, the Flight Crew should research the history of the aircraft and its pilots. The team will have only a few minutes to perform their play, so the story they choose to tell must be easy to convey in a limited amount of time.

Encourage the Flight Crew members to take careful notes as they talk with docents, museum staff and any other sources.

In the next objective, the Flight Crew will write the script for their play. If they have a wealth of information, it will make it easier to create a compelling and fact-filled presentation later.

If a camera is available, encourage the Flight Crew to record the visit to the museum for the Flight Crew Logbook.

MISSION ACCOMPLISHED! CONTINUE TO TANGO OBJECTIVE

TANGO OBJECTIVE - Dynamic Scripting

MATERIALS NEEDED: Note Paper or Computer with Word Processing Software
Notes from Museum Visit
Any Additional Aircraft Information

ESTIMATED TIME TO FINISH: 1 Hour

GOAL: Working as a creative team, the Flight Crew will write a script for a 3 to 5-minute play about the aircraft they have chosen. The script will feature historical information and a description of the flight dynamics of that aircraft.

INTRODUCTION

Most Middle School students can tell a story. Some can even make up some pretty amazing tales! The secret to memorable storytelling is entertainment.

In this objective, the Flight Crew will create a script for a short play. In this script, they will tell the story of their chosen aircraft. Intertwined with the history of the aircraft should be a thread of science.

The outcome of this process should be an entertaining, concise, factual, and educational theatrical presentation about a very special aircraft.

PROCEDURE

The Flight Crew should begin by forming an outline of their play. They should decide which parts of the aircraft's history to include in the skit, and how to include the description of the aircraft's flight dynamics.

Once an outline is formed, the team should decide who will play the characters in the story. Each member of the Flight Crew must perform in the skit. That does not mean that each person must have spoken parts. Use of a narrator is acceptable.

Instruct the Flight Crew to build their play on the outline that they have created. Encourage the team to include each member on the discussion.

Once the script is on paper (or computer) have the Flight Crew read through the script aloud and in character. Time the run-through and instruct the Flight Crew to add or remove lines as necessary to meet the time restrictions.

Encourage the team to practice their skit often. Creativity in presentation is welcome, as long as the play remains factual and scientifically accurate.

If a video camera is available, tape a rehearsal and have the Flight Crew critique their performances.

During competition, the play will be judged for historic accuracy, timing, scientific explanation, presentation quality, and creativity.

In the next objective, the Flight Crew will create the props and costumes for their play.

MISSION ACCOMPLISHED! CONTINUE TO UNIFORM OBJECTIVE

X-RAY OBJECTIVE - Carry-On Baggage

MATERIALS NEEDED: Carry-on Size Container
Costumes
Props

ESTIMATED TIME TO FINISH: 30 Minutes

GOAL: The Flight Crew will overcome the challenge of creating props and costumes for their play that can be contained in a restricted-size package.

INTRODUCTION

Airline passengers are faced with the choice of entrusting their belongings to strangers or packing them into containers that must fit in a finite space. Most frequent travelers have devised ways of packing everything they need for their trip into two "carry-on" size bags.

Travelling light has its advantages. Carry-on passengers enjoy shorter check-in lines, no waiting at Baggage Claim, no wayward luggage, and the pleasure of knowing that their bags aren't being knocked around in the cargo hold.

In this objective, the Flight Crew will choose what costumes and props they wish to use for their play. During the Runway competition, the team will be supplied with chairs, a table, a wall to hang a backdrop, and a 12-foot by 12-foot area. Any props or costumes, beyond the clothing the Flight Crew will be wearing for the rest of the competition, must be contained in a carry-on size bag or similar package.

PROCEDURE

Instruct the Flight Crew to arrange their costumes and props on the floor or a large table.

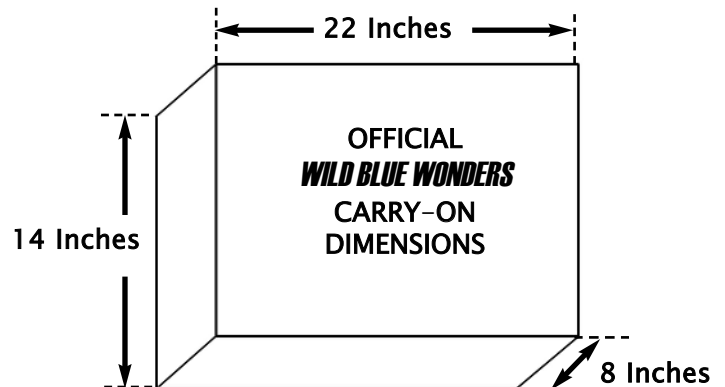
Have each member of the team fold their costume into a small bundle.

Bundle any props or backdrops as well.

Place the bundles in the carry-on bag.

(Each airline varies on what is acceptable size for a carry-on, but an average is 22" x 14" x 8". Those are the dimensions that will be enforced in the competition.)

If the costumes and props fit, great job!
If not, the Flight Crew will have to revise their plans.



MISSION ACCOMPLISHED! CONTINUE TO FREE FLIGHT COMPONENT



FREE FLIGHT

FREE FLIGHT Introduction

Orville and Wilbur Wright built them. So have Burt and Dick Rutan. It seems every aviation enthusiast's first solo flight was a balsa wood airplane.

There's no better way to safely test the laws of flight physics, aeronautical engineering, and the ingenuity of young flyers.

In Wild Blue Wonders, each Flight Team will construct, test and fly a rubber band-powered model airplane in competition. The Free Flight portion of the Wild Blue Wonders program has proven to be very popular with teams, spectators and judges.

The opportunities for teamwork, creativity, and confidence-building are abundant as the Flight Crew members apply their knowledge of aviation to a hands-on project.

MATERIALS

The Flight Crew will build several airplanes before they have a competition-ready craft. Included in the Wild Blue Wonders Flight Kit are the parts for 8 EAA X-Flyers, detailed instructions, glue, and mounting pins.

The Flight Crew will also need X-Acto blades (or sharp blades of some sort), wax paper, and a placemat-sized piece of styrofoam or ceiling tile.

The glue supplied with the X-Flyers is non-toxic and can be used with bare hands. Care must be taken with the blades and pins, however.

COMPETITION RULES

During the Free Flight Competition, each Flight Team will have three flights in a large hangar or gymnasium. The objective of each flight will be long-duration flight. Each of the Flight Crew's three flights will be timed, and the longest time of the three will be used.

Free Flight aircraft must be X-Flyers. Only materials provided in the Wild Blue Wonders Flight Kit will be allowed in the competition. Great care has been taken to ensure that the very best Rise-Off-Ground (ROG) airplane design was chosen to be the X-Flyer model. It is intended that teams would compete with "stock" aircraft to level the playing field.

Each team will have the opportunity to take one test flight prior to the competition. Teams may also make repairs to their aircraft between flights.

Points will be awarded based on a percentage of the longest flight time. The First Place team will be awarded 500 points, with all remaining teams receiving a percentage of the 500 points based on their flight times. (For instance, if the winning flight is 100 seconds, that team would receive 500 points. If the runner-up had a time of 90 seconds, they would receive 90 percent of 500, or 450 points.)

The times for each flight will be based on the moment the wheels of the aircraft leave the ground until the moment the aircraft makes contact with the ground.

PROCEED TO VICTOR OBJECTIVE

VICTOR OBJECTIVE - X-Flyer

MATERIALS NEEDED: 1- X-Flyer Kit
1- Bottle Glue
1- Box Mounting Pins
Wax Paper
X-Acto Knife/Razor Blade
Mounting Board (1" thick foam board, ceiling tile, etc.)

ESTIMATED TIME TO FINISH: 2 Hours

GOAL: The Flight Crew will work together to construct an X-Flyer ROG model plane.

INTRODUCTION

The first time the Flight Crew constructs an EAA X-Flyer airplane, they will make mistakes. It is expected and anticipated. There are sufficient supplies in your Wild Blue Wonders Flight Kit to construct 8 X-Flyers. Only one will fly in competition, so it goes without saying that the other 7 will serve as test models.

The instruction book that comes with the X-Flyers is excellent. The EAA X-Flyer is the Wild Blue Wonders version of the popular Right Flyer from Midwest Products Co., Inc. The EAA S-M-T staff have worked closely with various modeling experts and suppliers to find the best model for the Wild Blue Wonders Free Flight competition. The X-Flyer is a tried-and-true Rise Off Ground rubber powered airplane. It has been used in classrooms for years and in such competitions as Science Olympiad and Odyssey of the Mind. The instructions are easy to follow and well-illustrated.

Since the X-Flyer will be built by a team, the stages of construction can be divided amongst the Flight Crew to expedite construction. Again, the first try will go fast and shortcuts may be taken. It is normal for a group to want to rush the process. Through trial and error, the team will learn that careful, deliberate construction methods result in the best airplanes.

PROCEDURE

Instruct the Flight Crew to select only the parts they will need for one X-Flyer from the box of supplies. There are enough parts to make 8 airplanes, but only if they are not scavenged for other planes.

Place the Mounting Board on a large table or desk. The plans should be taped to this board during construction. A separate piece of wood or heavy cardboard may be used for cutting purposes. Obviously, the Flight Crew should exercise great care when using the X-Acto blade to avoid cutting people, desktops, clothing, etc.

As the aircraft is constructed, encourage the Flight Crew to take their time and be sure the glue is dry on each piece before handling. Despite its simple design, the X-Flyer is a precise aircraft and will not fly properly if bent or crooked.

Once the aircraft is completed, find a safe place to store it. A heavy box or plastic tote works well. In the Next objective the Flight Crew will test fly their aircraft to evaluate its performance.

MISSION ACCOMPLISHED! CONTINUE TO WHISKEY OBJECTIVE

WHISKEY OBJECTIVE - Flight Testing

MATERIALS NEEDED: X-Flyer
Stopwatch
ZULU Objective worksheet
Large Open Room/Gymnasium

ESTIMATED TIME TO FINISH: 30 Minutes

GOAL: The Flight Crew will use critical thinking skills and teamwork to evaluate the performance of their X-Flyer aircraft.

INTRODUCTION

The moment of truth! Will it fly?

The urge will be to run out and launch the X-Flyer as soon as possible, but to evaluate the aircraft, certain steps must be taken to ensure that it will survive the test flight, yield valuable information, and perform as expected.

To properly test the X-Flyer the Flight Crew will need a large indoor area like a gymnasium. The ceiling should be at least 30 feet high. The X-Flyer is a rugged aircraft, but it is not designed to withstand repeated collisions with walls, light fixtures, or people. The Flight Crew should use great care in carrying the plane and retrieving it.

Before winding the rubber band, it should be coated with a vinyl protectant like Armour-All. This will soften the rubber and lubricate it so it provides better performance. The rubber band can take several hundred winds before breaking when properly treated.

PROCEDURE

Prior to winding the propeller, a timer and recorder should be chosen from the Flight Crew. The timer will run the stopwatch during the test flights and the recorder will log the results of each flight on the ZULU Objective worksheet.

As two crew members hold the aircraft steady, one crew member should wind the propeller. The winder should be sure to wind the prop. clockwise. For the first test flight, the winder should put 50 winds on the band.

One person should hold the aircraft fuselage with one hand and the wound propeller with the other. Standing in the center of the room, the launcher should gently release the plane at shoulder level. For the first few test flights, the aircraft should be hand-launched due to the low number of winds on the band.

As the timer clocks the flight, the rest of the team should observe the flight path of the X-Flyer.

By design, the plane is supposed to circle and gently climb. If the plane climbs sharply and then stalls, the wing is too far forward on the fuselage. If it dives, the wing is too far back.

Adjust the wing as needed and rewind the propeller.

CONTINUE ON NEXT PAGE

WHISKEY OBJECTIVE - Flight Testing (Continued)**PROCEDURE**

As the Flight Crew tunes the X-Flyer, they should attempt to trim the aircraft so it circles gently to an altitude of over 10 feet.

If the aircraft flies in a straight line instead of a circle, the Flight Crew can add a simple rudder to the model by attaching a tab of paper or tape to the vertical stabilizer. By bending the rudder to one side the team should be able to make the airplane fly in a circle.

The Flight Crew should not worry if the aircraft climbs quickly. As long as it doesn't stall or hit the ceiling, the aircraft should level off eventually. Once the power begins to decrease, the aircraft should level off and circle for many revolutions.

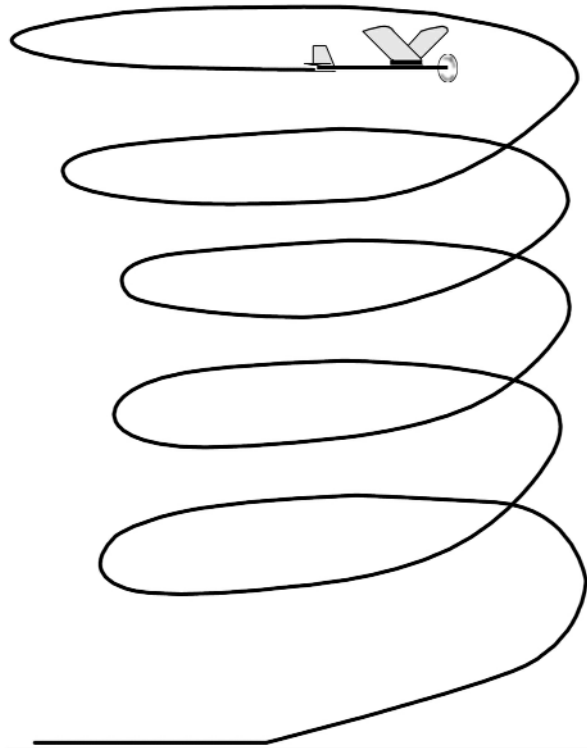
It may take a few tries before the team has a plane capable of climbing and circling. Encourage the team to keep trying. Even engineers with decades of experience must return to the shop a few times before they have an aircraft that flies right.

When the Flight Crew has an aircraft they consider competition ready, they will need to determine the optimum number of turns to put on the rubber band for maximum performance.

Using the ZULU Objective worksheet, the team should test fly a number of different "power settings" with the X-Flyer. It is important that no adjustments be made to the model between test flights. To receive pure data from their test flights, the team will need to fly the plane unchanged except for the number of turns on the rubber band.

Once the optimum number of turns has been determined, the Flight Crew should record that number and use it during competition.

The competition X-Flyer should be kept in a crush-proof container while not being test flown. This will protect it from damage during storage and while transporting the plane to competition.



MISSION ACCOMPLISHED!

ALL OBJECTIVES HAVE BEEN ACHIEVED! CONGRATULATIONS!!

(Continue competition preparations by reviewing the objectives)

The wild Blue wonders Competition

OVERVIEW

Great care has been taken to ensure that the experience of a wild Blue wonders competition is positive, encouraging and respectful. The five component-based portions of the competition have been designed to challenge the skills of the Flight Team without risking their self-esteem.

Each regional competition will be held at an aerospace museum. It is expected that the location of the competition will serve to inspire and stimulate the Flight Crews to higher levels of performance.

The International Championships will be held at the end of each July during EAA's International Convention, AirVenture. Held at the EAA Headquarters in Oshkosh, Wisconsin, AirVenture is the world's largest gathering of recreational aviation enthusiasts. Approximately 800,000 EAA members, aviators and aviation enthusiasts attend the event each year. The wild Blue wonders International Championships are held in the EAA Aviation Foundation Leadership Center on the EAA grounds.

RULES

The wild Blue wonders competition is broken into five parts, each part corresponding to one of the program's components. All participant teams must consist of five 6, 7 or 8th grade students.

LOGBOOK

In the Logbook judging, the Flight Crew will be interviewed by a panel of aviation and education professionals. The team will have the opportunity to explain their team logo, creed, and name. The team may be asked to express their feelings about the program, their experience and the impact it has made in their lives. The judges will rate the Flight Crew's Logbook based upon their observation of the required materials and the comments of the team.

The Logbook portion of the competition is worth a maximum of 500 points, or 17 % of the total points.

The Logbook judging and interview will last approximately 20-30 minutes.

FLIGHT PLAN

In the Flight Plan competition, the Flight Crew will have 30 minutes to plan and fly a 30 Nm cross-country flight in MSFS2000. The team will be provided with the following items:

- Aeronautical Chart
- Coordinates of departure airport and destination airport
- WBW Flight Planning Form
- Weather briefing
- Plotter
- Pencils
- Calculator
- Scratch Paper
- Cessna 182S Specification Sheet
- Stopwatch

A panel of judges will monitor the team as they complete the Flight Planning Form and fly the route in MSFS2000.

CONTINUED ON NEXT PAGE

The Wild Blue Wonders Competition (Continued)

RULES (Continued)

FLIGHT PLAN (Continued)

The judges will score the competition based on a variety of criteria including:

- Teamwork
- Safety
- Accuracy
- Completion of flight in time provided
- Proper aircraft-handling skills

The Flight Plan portion of the competition is worth 1,000 points, or one-third of the total points.

CHECKRIDE

In the Checkride portion of the competition, the Flight Crew will have 12 minutes to amass as many points as possible by providing questions to the answers in a Jeopardy-style computer game. The Flight Crew must respond in the form of a question to each chosen answer. Judges will award points for each correct response based upon the point value of the answer.

Incorrect questions will not be counted against the team's score.

The Captain must provide the response to each answer after consulting with the entire team. Points will not be awarded for responses made by other Flight Crew members.

The Checkride portion of the competition is worth a maximum of 750 points, or 25% of the total points.

RUNWAY

The Flight Crew will have 3 minutes to set up for their Runway presentation and 3 to 5 minutes to perform the play. Each member of the team must participate in the presentation. The costumes and props used by the Flight Crew must fit inside a carry-on size container, (22" x 14" x 8"). The team will be provided with a table, two chairs, one wall, and a 12' x 12' area. Use of the items is optional.

A panel of judges will rate the performance on historic accuracy, scientific explanation, creativity, costumes, props and timing.

The Runway portion of the competition is worth a maximum of 250 points, or 8% of the total points.

FREE FLIGHT

During the Free Flight portion of the competition, each Flight Team will be given three opportunities to fly their X-Flyer models. The teams will have to use rubber bands provided at the time of the competition, but the bands will be identical to the stock rubber in the X-Flyer kits. Each flight will be timed by judges from the moment the wheels of the aircraft leave the ground until the moment the aircraft touches the ground. The longest flight time of the three attempts will be judged against the longest flight time from each team. The Flight Team with the longest flight will be awarded 500 points. Each of the remaining teams will receive points based on their flight times. To convert the times into point values, the judges will compare the flights to the winning time. The times will be converted into a percentage of the winning flight, and a corresponding percentage of the maximum points will be awarded. (For instance, a team with a maximum flight that is 90% of the winning flight's time will be awarded 450 points, or 90% of the 500 point maximum.)

At the conclusion of the competition, the judges will submit their score sheets for each team to the Competition Leader, who will total the points for each team and rank the teams.

The overall winner of each regional competition will be invited to compete in the National Championships at AirVenture in July. If the winning team is unable to represent the region at nationals, the runner up will be invited to compete.

The wild Blue wonders Flight Team

To participate in the wild Blue wonders competition, a Flight Team must be formed. The Flight Team must consist of five middle school students or home school equivalents, (6, 7 and 8th grade). Each team must have a Flight Leader. The Flight Leader should be an education professional. In addition to the core team, Flight Advisors and other supporters are welcome to assist the team in preparation for the competition. All supporters outside of the core six members of the Flight Team are known as Ground Crew.

The Flight Crew members do not need to have assigned roles until the competition. It is suggested that the Flight Leader rotate the members through the various roles to evaluate the individual crew members in each position.

The roles of the Flight Crew are:

CAPTAIN	<i>Serves as crew leader. Flies the aircraft in MSFS2000. Answers for the team in Checkride.</i>
1st OFFICER	<i>Assists Captain with MSFS2000 aircraft controls. Leads Runway presentation.</i>
NAVIGATOR	<i>Leads Flight Planning. Monitors chart during MSFS2000 flight.</i>
ENGINEER	<i>Handles and launches Free Flight X-Flyer model. Monitors instruments in MSFS2000 flight.</i>
AMBASSADOR	<i>Maintains Team Logbook. Serves as team spokesperson during Logbook presentation.</i>

The Flight Crew roles are designed to promote teamwork and allow for individual specialization. The roles have been modeled after traditional flight crew roles and reflect the variety of skills necessary to achieve success.

Over the weeks of preparation for competition, the Flight Crew members will naturally gravitate to the roles in which they excel. By allowing each member of the team to serve in each of the roles, you will provide the individuals in the team the opportunity to work outside of their comfort level. This challenging of the natural roles inherent in any small group will cause the entire team to evaluate their contributions to the project.

Given the opportunity, typically shy students have taken successful leadership roles on Flight Teams. Flight Leaders have commented on the "blossoming" of previously-unseen talents and ambitions.

To assist you in developing a strong interpersonal dynamic in your Flight Crew, links to several team-building web sites have been included on the wild Blue wonders web site. The addresses for the teambuilding sites are also included in the resource section of this manual.

Support

You are not alone in this!

The EAA S-M-T Leadership Project staff have gone to great lengths to ensure that you have a strong network of aviation and education professionals close by as you undertake this project.

It is a goal of the wild Blue wonders program that teachers and students not familiar with aviation can prosper. It cannot be emphasized enough that wild Blue wonders is NOT pilot training. The purpose of the program is the use of aviation as a tool for the instruction of science, math, technology, and a host of life skills. Many teachers and students have successfully participated in wild Blue wonders.

Your first source of support is the Experimental Aircraft Association. The EAA has hundreds of thousands of members around the world. EAA members are known for their enthusiasm for aviation, many participate in the EAA's popular Young Eagles Program. As Young Eagles pilots, the members volunteer to provide introductory flights to children. It is strongly suggested that you contact the Young Eagles office at (877)806-8902 or www.young eagles.org to arrange for flights for your team. If the EAA member who takes your team flying is interested, they can serve as a team advisor. Many EAA members are aware of the wild Blue Wonders program, and they are eager to share their knowledge and passion for aviation.

In addition to the dedicated volunteers and members of EAA, the staff of the Science-Math-Technology Leadership Project is available to support you. The SMT Leadership Project is responsible for wild Blue wonders, and leads teacher training and all wild Blue wonders competitions. The wild Blue wonders Project Manager can be reached at (920)426-6846.

Another source of support is found at your local aerospace museum. The museums that have agreed to assist with wild Blue wonders are an excellent source of technical knowledge. Many aerospace museums also house excellent aviation libraries and bookstores.

The Internet is a vast and eclectic source of aviation information. An extensive list of links can be found on the wild Blue wonders home page. (www.wildbluewonders.org)

The wild Blue wonders web site will be a valuable tool as you progress through wild Blue wonders. The site will feature subject-specific support, online forums for flight leaders and teams, and news updates from the Program Director.

NATIONAL EDUCATION STANDARDS		WILD BLUE WONDERS PROGRAM COMPONENTS				
		LOGBOOK	FLIGHT PLAN	CHECKRIDE	RUNWAY	FREE FLIGHT
MATHEMATICS						
1	Uses a variety of strategies in the problem-solving process		✕	✕		
2	Understands and applies basic and advanced properties of the concepts of numbers		✕	✕		
3	Uses basic and advanced procedures while performing the processes of computation	✕	✕			✕
4	Understands and applies basic and advanced properties of the concepts of measurement		✕	✕		✕
5	Understands and applies basic and advanced properties of the concepts of geometry		✕	✕		
6	Understands and applies basic and advanced concepts of statistics and data analysis		✕	✕		✕
7	Understands and applies basic and advanced concepts of probability		✕			✕
8	Understands and applies basic and advanced properties of functions and algebra		✕			
9	Understands the general nature and uses of mathematics	✕	✕	✕		✕
SCIENCE						
1	Understands the features of the Earth		✕			
2	Understands basic Earth processes		✕			
3	Understands essential ideas about the composition and structure of the universe and the Earth's place in it		✕			
8	Understands the cycling of matter and flow of energy through the living environment		✕	✕		
10	Understands basic concepts about the structure and properties of matter		✕	✕		✕
11	Understands energy types, sources, and conversions, and their relationship to heat and temperature		✕	✕		
12	Understands motion and the principles that explain it		✕	✕	✕	✕
13	Knows the kinds of forces that exist between objects and within atoms		✕	✕		✕
14	Understands the nature of scientific knowledge		✕	✕		
15	Understands the nature of scientific inquiry		✕	✕		✕
16	Understands the scientific enterprise		✕	✕		✕
HISTORICAL UNDERSTANDING						
1	Understands and knows how to analyze chronological relationships and patterns	✕		✕	✕	
2	Understands the historical perspective			✕	✕	
LANGUAGE ARTS STANDARDS						
1	Demonstrates competence in the general skills and strategies of the writing process	✕			✕	
2	Demonstrates competence in the stylistic and rhetorical aspects of writing	✕			✕	
3	Uses grammatical and mechanical conventions in written compositions	✕			✕	
4	Gathers and uses information for research purposes	✕	✕	✕	✕	
5	Demonstrates competence in the general skills and strategies of the reading process		✕	✕		
6	Demonstrates competence in the general skills and strategies for reading a variety of literary texts			✕		
7	Demonstrates competence in the general skills and strategies for reading a variety of informational texts		✕	✕	✕	
<i>CONTINUED ON NEXT PAGE</i>						

NATIONAL EDUCATION STANDARDS		WILD BLUE WONDERS PROGRAM COMPONENTS				
		LOGBOOK	FLIGHT PLAN	CHECKRIDE	RUNWAY	FREE FLIGHT
8	LANGUAGE ARTS STANDARDS (CONTINUED) Demonstrates competence in speaking and listening as tools for learning	✕	✕	✕	✕	✕
GEOGRAPHY STANDARDS						
1	Understands the characteristics and uses of maps, globes, and other geographic tools and technologies		✕			
2	Knows the location of places, geographic features, and patterns of the environment		✕			
3	Understands the characteristics and uses of spatial organization of Earth's surface		✕			
5	Understands the concept of regions		✕			
7	Knows the physical processes that shape patterns on Earth's surface		✕			
12	Understands the patterns of human settlement and their causes		✕			
13	Understands the forces of cooperation and conflict that shape the divisions of Earth's surface		✕	✕		
14	Understands how human actions modify the physical environment		✕	✕		
15	Understands how physical systems affect human systems		✕	✕		
16	Understands the changes that occur in the meaning, use, distribution and importance of resources		✕	✕		
ART CONNECTIONS						
1	Understands connections among the various art forms and other disciplines	✕			✕	
THEATER						
1	Demonstrates competence in writing scripts				✕	
2	Uses acting skills				✕	
3	Designs and produces informal and formal productions				✕	
4	Directs scenes and productions				✕	
VISUAL ARTS						
1	Understands and applies media, techniques, and processes related to the visual arts	✕			✕	
2	Knows how to use structures (e.g., sensory qualities, organizational principles, expressive features) and functions of art	✕			✕	
3	Knows a range of subject matter, symbols, and potential ideas in the visual arts	✕			✕	
4	Understands the visual arts in relation to history and cultures	✕				
5	Understands the characteristics and merits of one's own artwork and the artwork of others	✕				
TECHNOLOGY						
1	Knows the characteristics and uses of computer hardware and operating systems		✕	✕		
2	Knows the characteristics and uses of computer software programs		✕	✕		
3	Understands the relationships among science, technology, society, and the individual		✕	✕	✕	
4	Understands the nature of technological design		✕	✕	✕	✕
5	Understands the nature and operation of systems		✕	✕		✕
<i>CONTINUED ON NEXT PAGE</i>						

NATIONAL EDUCATION STANDARDS		WILD BLUE WONDERS PROGRAM COMPONENTS				
		LOGBOOK	FLIGHT PLAN	CHECKRIDE	RUNWAY	FREE FLIGHT
BEHAVIORAL STUDIES						
1	Understands that group and cultural influences contribute to human development, identity, and behavior	✕	✕	✕	✕	✕
2	Understands various meanings of social group, general implications of group membership, and different ways that groups function	✕	✕	✕	✕	✕
3	Understands that interactions among learning, inheritance, and physical development affect human behavior	✕	✕	✕	✕	✕
4	Understands conflict, cooperation, and interdependence among individuals, groups, and institutions	✕	✕	✕	✕	✕
LIFE WORK						
1	Makes effective use of basic tools					✕
2	Uses various information sources, including those of a technical nature, to accomplish specific tasks	✕	✕	✕	✕	✕
4	Pursues specific jobs	✕	✕	✕	✕	✕
5	Makes general preparation for entering the work force	✕	✕	✕	✕	✕
6	Makes effective use of basic life skills	✕	✕	✕	✕	✕
7	Displays reliability and a basic work ethic	✕	✕	✕	✕	✕
8	Operates effectively within organizations	✕	✕	✕	✕	✕
SELF REGULATION						
1	Sets and manages goals	✕	✕	✕	✕	✕
2	Performs self-appraisal	✕	✕	✕	✕	✕
3	Considers risks	✕	✕	✕	✕	✕
4	Demonstrates perseverance	✕	✕	✕	✕	✕
5	Maintains a healthy self-concept	✕	✕	✕	✕	✕
6	Restraints impulsivity	✕	✕	✕	✕	✕
THINKING AND REASONING						
1	Understands and applies the basic principles of presenting an argument	✕	✕	✕	✕	
2	Understands and applies basic principles of logic and reasoning	✕	✕	✕	✕	✕
3	Effectively uses mental processes that are based on identifying similarities and differences (compares, contrasts, classifies)	✕	✕	✕	✕	✕
4	Understands and applies basic principles of hypothesis testing and scientific inquiry		✕	✕		✕
5	Applies basic trouble-shooting and problem-solving techniques	✕	✕	✕	✕	✕
6	Applies decision-making techniques	✕	✕	✕	✕	✕
WORKING WITH OTHERS						
1	Contributes to the overall effort of a group	✕	✕	✕	✕	✕
2	Uses conflict-resolution techniques	✕	✕	✕	✕	✕
3	works well with diverse individuals and in diverse situations	✕	✕	✕	✕	✕
4	Displays effective interpersonal communication skills	✕	✕	✕	✕	✕
5	Demonstrates leadership skills	✕	✕	✕	✕	✕

DEBRIEFING

Throughout the testing and development of the wild Blue Wonders program, one thing has become evident: middle school students are attracted to the topic of aviation. The excitement of human flight seldom fails to captivate even the most cynical students. With an understanding of the power of aviation to captivate and motivate people, the EAA has endeavored to share the joy of flight with the world.

The purpose of the program is not to recruit members to the EAA, or to train young pilots. The goal is simple...to instill an appreciation of exploration. Whether it be in an aircraft, a submarine, an electron microscope, or a computer, the search for knowledge, self-discovery and a deeper understanding of the unknown are at the core of humanity. It is the hope of EAA that through wild Blue Wonders, students will be encouraged to seek knowledge and adventure wherever they find it. Aircraft are just tools in that search.

Like with the young Charles Lindbergh, it is hoped that aviation can act as a catalyst to a life filled with wonder and growth.

Thank you for leading the effort to improve the lives of children.