SOARING OKLAHOMA: AEROSPACE & DEFENSE

You Have Friends in High Places

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Oklahoma's future begins in the classroom.

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- Sentry One, LLC

You Have Friends in High Places

Brig Gen. Ben Robinson USAF (R) is the Owner/Operator of Sentry One, LLC and is the (STEM) liaison with the Oklahoma Career Technology Education Center

My name is Ben Robinson and I am the owner and operator of an aerospace consulting company headquartered in Oklahoma City, Sentry One LLC. Sentry One LLC has worked with aerospace companies in Kansas, Oklahoma, Texas and New Mexico. We work mostly with aerospace engineering and manufacturing companies. In Oklahoma, I am the aerospace and Science, Technology, Engineering and Math (STEM) liaison with the Oklahoma Career Technology Education Center, our Career Tech Centers. Prior to my current business, I was the executive director of Boeing Aerospace Operations, headquartered in Oklahoma City. I spent 34 years in the military, both in the Army and Air Force, as a pilot. I was able to fly all kinds of helicopters and fixed wing aircraft during that time.

My younger brother and I were always interested in airplanes of all kinds as we grew up in Texas and New Mexico. We built airplanes that we intended to actually fly. We even used our mother's dryer as a Mercury capsule when we were growing up. We both ended up living out our passion for airplanes. He was a Navy pilot and is now a captain on the Boeing 737 for United Airlines.

Oklahoma is a great place to find a future career if you love airplanes. Our aerospace industry is one of the top 5 industries in the state with over 143,000 employees doing some kind of aerospace work. We are very fortunate to have opportunities for technical specialists, information and business specialists, engineers and innovators. The overwhelming number of careers in aerospace all require some level of technical and academic education and training. Study STEM subjects and join the great aerospace industry right here in Oklahoma.

LET'S TALK S.T.E.M.

What do science, technology, engineering and math (S.T.E.M.) have to do with Aerospace & Defense?

S.T.E.M. subjects have played, and continue to play, an instrumental role in the Aerospace & Defense industry. We use math to explain science. Engineers use science to create the technology that allows the industry to defy the laws of physics. That technology utilizes precise mathematical equations. Without science, technology, engineering and math – the Aerospace & Defense industry would not exist.

When you really think about what it takes to keep an aircraft, made of heavy and cumbersome parts, carrying large amounts of fuel and transporting a variety of passengers and cargo, in the air- you really begin to understand how amazing it is to successfully take off and land an airplane. Now take things a step farther and think about how vast the open sky is; it just goes on and on. When you think about the enormity of the area being navigated you can also begin to appreciate how fantastic it is that an aircraft can make it from its point of origin to its destination without getting lost.

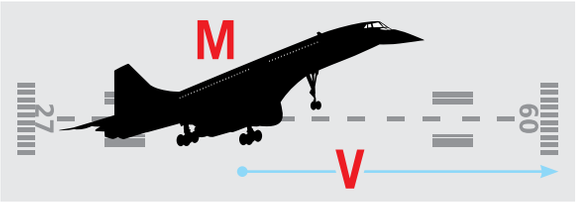
Let's take a look at some of the concepts that play a role in the Aerospace & Defense industry. Kinetic Energy, Newton's Laws of Motion and Object Momentum are just a few scientific concepts that play a role in the success of every flight.

KINETIC ENERGY: the energy of motion

Kinetic Energy, also known as the energy of motion, is dependent upon both the Mass (the quantity of matter) of an object and the Velocity (speed) at which that object is moving. This type of energy is calculated to express the impact that one object can have on another object based on its motion. Kinetic Energy is extremely important when calculating take offs and landings. If Kinetic Energy is calculated incorrectly, the plane may find itself taking off or landing on too short of a run way – and both scenarios can be catastrophic to the pilot(s) and any passengers.

The following formula is used to describe Translational Kinetic Energy:

Kinetic Energy (KE) = 0.5 x Mass x Velocity^2



NOTE: When calculating Kinetic Energy, answers are expressed in Joules and in powers of ten.

Let's do the math!

If an object has a mass of 3 kg and is traveling at a Velocity of 12.5 meters per second (m/s) what would the Kinetic Energy be?

$$KE = 0.5 \times 3kg \times (12.5\ m/s)^2$$

$$KE = 0.5 \times 3kg \times 156.25$$

$$KE = 234.378$$

$$KE = 2.34 \times 10^2 \text{ Joules}$$

Now you try it!

On a separate sheet of paper, using the example above, calculate the Kinetic Energy for the following objects:

1. A plane that is landing has a Mass of 5,669 kg and a velocity of 60.5 m/s
2. A vehicle preparing to stop has a Mass of 1,200 kg and a velocity of 20.0 m/s

Sources:

http://hyperphysics.phy-astr.gsu.edu/hbase/ke.html

http://www.physicsclassroom.com/Class/energy/u5l1c.cfm

NEWTON'S LAWS OF MOTION

Law # 1 – The Law of Inertia

Newton's Law of Inertia indicates that an object at rest tends to stay at rest, while an object in motion will stay in motion, unless the object is acted upon by an outside, unbalanced force.

On Earth, one of the greatest forces interfering with continuous motion is GRAVITY. In outer space, if someone were to throw a ball, its motion would continue until it bumped into another object or was caught in a planet's gravitational pull. On Earth if someone were to throw a ball its motion would continue only until the force of gravity began to slow it down causing it to eventually drop to the ground and stop moving. The motion can also change if it makes contact with another object, changing its direction or stopping its motion completely (like a baseball coming in contact with a swinging baseball bat – the collision of the two objects changes the direction of the ball).

An object's inertia is directly related to the object's mass – the larger the mass, the higher the object's inertia will be.

TRY THIS:

To conduct this experiment you will need the following:
a) a glass soda bottle filled half way with water, b) an index card and c) a stack of coins.

1) First place your soda bottle filled half way with water in the middle of the table.
2) Next, place your index card over the top of the bottle.
3) Now place a single coin on top of the index card, and in line with the neck of the bottle.
4) Pulling only to the side (lifting up, or down will alter the experiment), quickly slide the index card out from underneath of the coin.

If the card is removed without lifting up or down, the coin will remain in position over the neck of the bottle, offering proof that an object at rest tends to stay at rest unless acted upon by an unbalanced force. Repeat this experiment, but add an additional coin to the top of the bottle each time. How many coins can you get up to before they come toppling down when you remove your card?

LET'S TALK S.T.E.M.

What do science, technology, engineering and math (S.T.E.M.) have to do with Aerospace & Defense?

Law #2 – Acceleration is produced when a force acts on a mass

In order for an object to accelerate, an outside force must act upon it. The greater the mass of an object, the more force it will take to put the object in motion. Newton's law of acceleration indicates that an increase in mass or acceleration will equal an increase in object force. Let's conduct an experiment to better understand the laws of acceleration.

TRY THIS:

To conduct this experiment you will need the following:

a) Three (3) balls of varying mass (a ping pong ball, a marble and a racket ball are some options), b) two rulers with a center groove (our ruler will act as a track for the balls to travel on), c) a stationary object that will be moved by the force of the balls (a foam dice is a great option), d) stacking UNIFIX cubes (legos, or other stacking objects can be used as well) and e) a gram scale.

a) To start, we must determine the mass of all three balls. Record the mass of each ball below:

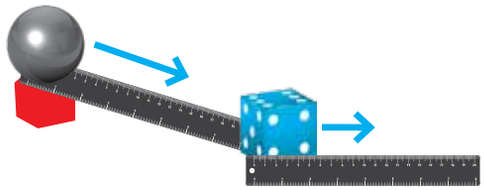
Ball # 1 _____ Grams

Ball # 2 _____ Grams

Ball # 3 _____ Grams

It is important to note that MASS is the variable in the first portion of this experiment.

b) Create a ramp using one of your rulers and a single cube. Place your stationary object at the base of your ramp. Place your second ruler next to your stationary object so that you can measure any force caused by the balls acceleration. Your experiment should look something like this:



c) Take turns letting each of the three balls roll down the ramp and measure the force by recording the distance that your stationary object has moved in inches.

Ball # 1 – Force measured _____ inches

Ball # 2 – Force measured _____ inches

Ball # 3 – Force measured _____ inches

In terms of Mass, which ball had the greatest measurable force?

_____

d) Now let's measure the force but look at velocity as the variable. Choose ONE (1) of the three balls and place the other two off to the side. Now we are going to measure this one ball's force at varying velocity rates by adjusting our ramp. Take three different force measurements, each time raising your ramp by one block.

Ramp #1 (2 Blocks) – Force measured _____ inches

Ramp #2 (3 Blocks) – Force measured _____ inches

Ramp #3 (4 Blocks) – Force measured _____ inches

Each time we add a block to our ramp, we are increasing the objects velocity. In terms of velocity, which ramp produced the greatest measurable force?

_____

Resources:

https://www.youtube.com/watch?v=cEhFmbehhco

Law #3 – For every action there is an equal and opposite reaction

Newton's third law of motion states that for every action there is an equal and opposite reaction.

This is an important concept when trying to understand an aircraft's takeoff. According to NASA, Newton's third law of motion, "helps to explain the generation of lift from an airfoil. In this problem, the air is deflected downward by the action of the airfoil, and in reaction the wing is pushed upward." This principle is also at work with jet engines. The backwards thrust of the engine propels the plane forward.

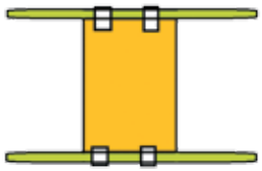
TRY THIS:

What you will need:

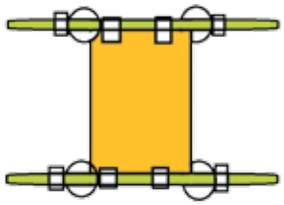
a) construction paper
b) 4 life-savers, tape
c) a rubber band
d) 3 straws
e) 1 balloon
f) scissors

To begin this activity we are going to make the base of our homemade car. Take your construction paper and fold it in half, hamburger style. Use the new crease in the paper as a line to cut along. Next, take one of the two pieces and fold it in half, hot dog style. Cut along this new crease in the paper. Now, keep one of the two remaining pieces to use as the base of your car.

Next – take two of your straws and 4 pieces of tape. Lay your piece of paper down on the desk in front of you. Lay one straw in line with the top of your paper and the other in line with the bottom. Use two pieces of tape to secure your straw at the top and two pieces of tape to secure your straw at the bottom. Your creation should look like something like this:



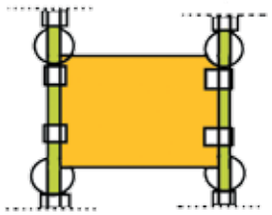
Now take 4 life savers and thread them over the straws in each corner of your paper to form "wheels" for your car. Place a piece of tape on the straw at the outside of each life saver. Like this:



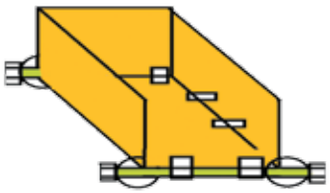
LET'S TALK S.T.E.M.

What do science, technology, engineering and math (S.T.E.M.) have to do with Aerospace & Defense?

Next, using your scissors, snip the excess straw on each of the four corners. Like this:

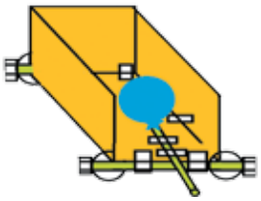


Next, take the other half of the paper used for your base and fold it into a rectangle box like shape that only has three sides and fasten it to your base using tape, like so:



Next, take your balloon, your leftover straw and your rubber band. Place the end of the balloon over one end of the straw. Use your rubber band to fasten the balloon to the straw (NOTE: the rubber band needs to be tight enough that you can use the straw to blow up the balloon without air escaping, but not too tight as it can restrict the flow of air if it is crushing the straw). Your balloon and straw should look like this:

Next, fasten your balloon and straw to your car with the balloon facing the closed end of the car and the straw pointing out towards the open end, like this:



Now use your straw to blow up your balloon until it fills up your car (hold your thumb over the end of the straw to hold the air inside of the balloon). Place your car on a table or desk, release your finger from the end of the straw and watch what happens when your balloon deflates.

What did you learn?

What happened when the air began to escape from your car's balloon?

What direction was the air from the balloon being released towards?

Did your car travel in the same direction as the air being released? Why do you think that is?

Resources:

http://teachertech.rice.edu/Participants/louviere/Newton/law3.html
http://www.grc.nasa.gov/WWW/K-12/airplane/newton3.html
https://www.youtube.com/watch?v=5eirTBWOrpI

OBJECT MOMENTUM = Mass x Velocity

The momentum of an object is dependent upon two things: 1) the mass of that object and 2) the velocity (or speed) that the object is moving at. The larger an object is and/or the faster it is moving, the higher the object's momentum will be.

To determine an object's momentum we use the following formula:

Mass = M Velocity = V Momentum = P

$$P = M \times V$$

Momentum relates to Newton's second law of motion (Remember: In order for an object to accelerate an outside force must act upon it. The greater the mass of an object the more force it will take to put the object in motion). Remember our experiment where we measured the velocity of different balls based on changes in velocity versus changes in mass.

LET'S DO THE MATH!

If the boulder weighs 45.36 k/g (100 lbs) and is moving at a velocity of 2 miles per hour, what is the momentum of the boulder being rolled?

$$P = 45.36 \text{ k/g} \times 2.0 \text{ m/h}$$
$$P = 90.72 \text{ k/g} \cdot \text{m/h}$$

If the rock weighs .02 k/g (.044 lbs) and is moving at a velocity of 2 miles per hour, what is the moment of the rock being rolled?

$$P = .02 \text{ k/g} \times 2.0 \text{ m/h}$$
$$P = .04 \text{ k/g} \cdot \text{m/h}$$

Now you try it!

1) Both a softball and a baseball are thrown at 90 miles per hour. The softball weighs .2 k/g and the baseball weighs .15 k/g. Find the momentum for each ball. Which ball would need a higher momentum to reach 90 miles per hour when pitched?

2) Both a car and an airplane are traveling at 100 miles per hour. The car weighs 1200 k/g and the plane weighs 5,660 k/g. Find the momentum for each mode of transportation. Which mode of transportation would need a higher momentum to reach 100 miles per hour?

AEROSPACE & DEFENSE:

25 Prominent Employers in the Aerospace & Defense Industry

(List provided by The Oklahoma Department of Commerce)

- Tinker AFB
- American Airlines
- Spirit Aerosystems
- NORDAM • Boeing
- Asco • AAR • ARINC
- Northrop Grumman
- L-3 • Lufthansa Technik
- FAA • Altus AFB
- Vance AFB • McAlester AAP
- Ft. Sill • Pratt & Whitney
- Veteran's Administration
- FlightSafety International
- Triumph Aerostructures
- Southwest Airlines
- Raytheon • Limco Airepair
- Precision Castparts
- Waldens Machine/Primus

The following is an overview of the number of jobs currently available within the Aerospace & Defense industry as well as a projection of future jobs in the state of Oklahoma (list provided by The Oklahoma Office of Workforce Development):

INDUSTRY	2015 Jobs	2020 Jobs
Federal Government, Military	35,580	35,517
Engineering Services	7,958	8,771
Administrative Management and General Management Consulting Services	5,727	6,670
Machine Shops	5,710	6,486
Aircraft Manufacturing	5,280	6,340
Scheduled Passenger Air Transportation	5,160	3,950
Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	4,387	4,889
Custom Computer Programming Services	4,259	4,628
Computer Systems Design Services	3,527	4,355
Other Support Activities for Air Transportation	2,977	3,393
Other Scientific and Technical Consulting Services	2,515	3,386
Fabricated Structural Metal Manufacturing	1,795	2,024
Other Computer Related Services	1,557	1,812
Other Aircraft Parts and Auxiliary Equipment Manufacturing	1,540	1,622
Plate Work Manufacturing	1,510	1,375
Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	1,248	1,353
Testing Laboratories	1,244	1,406
Process, Physical Distribution, and Logistics Consulting Services	1,231	1,440
Motor and Generator Manufacturing	1,220	1,163
Flight Training	1,065	1,081
Marketing Consulting Services	1,050	1,119
Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	962	718
Electroplating, Plating, Polishing, Anodizing, and Coloring	952	1,003
Computer Storage Device Manufacturing	911	1,045
Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	793	903
Human Resources Consulting Services	786	956
Other Technical and Trade Schools	713	776
Prefabricated Metal Building and Component Manufacturing	711	674
Rubber Product Manufacturing for Mechanical Use	690	744
All Other Miscellaneous Fabricated Metal Product Manufacturing	599	288
Research and Development in Biotechnology	538	437
Fabricated Pipe and Pipe Fitting Manufacturing	522	282
Industrial Mold Manufacturing	514	565
Other Airport Operations	453	565
Paint and Coating Manufacturing	442	433

Industry Profile

INDUSTRY	2015 Jobs	2020 Jobs
Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	438	443
Nonscheduled Chartered Passenger Air Transportation	436	559
Machine Tool Manufacturing	420	423
Transportation Equipment and Supplies (except Motor Vehicle) Merchant Wholesalers	400	385
Other Management Consulting Services	378	232
Aircraft Engine and Engine Parts Manufacturing	329	151
All Other Miscellaneous Electrical Equipment and Component Manufacturing	276	286
Relay and Industrial Control Manufacturing	274	291
Computer Facilities Management Services	273	173
Plastics Material and Resin Manufacturing	261	260
Other Electronic Component Manufacturing	253	227
Printed Circuit Assembly (Electronic Assembly) Manufacturing	244	297
Air Traffic Control	229	169
Rolling Mill and Other Metalworking Machinery Manufacturing	216	247
Cosmetology and Barber Schools	203	207
Totalizing Fluid Meter and Counting Device Manufacturing	190	230
Other Engine Equipment Manufacturing	185	<10
Scheduled Freight Air Transportation	168	261
Other Measuring and Controlling Device Manufacturing	147	142
Switchgear and Switchboard Apparatus Manufacturing	130	66
Metal Heat Treating	111	66
Other Nonscheduled Air Transportation	99	165
Special Die and Tool, Die Set, Jig, and Fixture Manufacturing	82	68
Turbine and Turbine Generator Set Units Manufacturing	69	29
Computer Terminal and Other Computer Peripheral Equipment Manufacturing	69	<10
Apprenticeship Training	66	74
Power, Distribution, and Specialty Transformer Manufacturing	65	53
Cutting Tool and Machine Tool Accessory Manufacturing	59	56
Electromedical and Electrotherapeutic Apparatus Manufacturing	59	53
All Other Rubber Product Manufacturing	51	32
Electronic Connector Manufacturing	41	<10
Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	38	38
Small Arms, Ordnance, and Ordnance Accessories Manufacturing	37	47
Electronic Computer Manufacturing	33	24
Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	33	22
Synthetic Rubber Manufacturing	23	<10
Analytical Laboratory Instrument Manufacturing	20	<10
Ball and Roller Bearing Manufacturing	19	15
Nonscheduled Chartered Freight Air Transportation	16	10
Mechanical Power Transmission Equipment Manufacturing	13	12
Bare Printed Circuit Board Manufacturing	10	12
TOTALS	**112,641**	**118,065**

The Aerospace & Defense industry is rapidly growing in the state of Oklahoma. In 2014 a list of the top 100 Critical Occupations was published by The Oklahoma Department of Commerce and within that list were 15 jobs that directly pertain to the Aerospace & Defense Industry.

15 Critical Occupations within the Aerospace & Defense Industry:

Avionics Technician

Aircraft Mechanics & Service Technicians

Aircraft Structure, Resurfaces, Rigging & Systems Assemblers

Aerospace Engineers

Computer Specialists

Electrical & Electronic Engineering Technicians

Mechanical Engineering Technicians

Computer Software Engineers

Computer Systems Analysts

Network & Computer Systems Administrators

Welders, Cutters, Soldiers & Braziers

Welding, Soldering & Brazing Machine Setters, Operators & Tenders

Structural Metal Fabricators & Fitters

Electricians

Sheet Metal Workers

Critical Occupations -
occupations that are critical to the success of the state's five strongest ecosystems

HISTORY: AEROSI

Resources: http://www.airforce.com/learn-about/history/part1/ | http://orgs.utulsa.edu/sp

U.S. Army Signal Corps formed an Aeronautical Division.

The Aeronautical Division accepted its first airplane delivery from the Wright Brothers.

The 1st Aero Squadron is formed under the leadership of Capt. Benjamin D. Foulois

THE DAILY MISSOURIAN

U.S. OFFICIALLY AT WAR

WILSON SIGNS RESOLUTION AT 1:15 O'CLOCK TODAY

The U.S. entered into World War I in alliance with the "Allied Powers" (this included Britain, France, Italy & Russia)

The Army established the Aviation Section of the Signal Corps and World War I begins

President Woodrow Wilson implements the Army Air Service as a division of the War Department. In less than a year the Air Service had grown by 19,000 officers and 178,000 enlisted service members.

The State of Okl founds two airline Oklahoma City A and Southwest A Express (S.A.I

1907

1909

1913

1914

1917

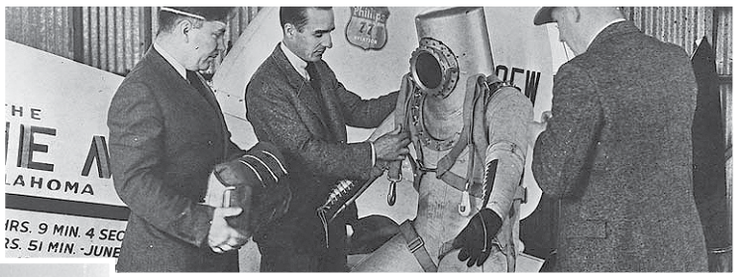
1918

1927

PACE & DEFENSE

ocol/?p=2798 | http://www.tinker.af.mil/shared/media/document/AFD-100701-035.pdf

lahoma
es: Tulsa-
Airways
ir Fast
F.E.)



American Aviator Wiley Post breaks aviation records with his round-the-world flight.

THE DAILY OKLAHOMAN

POST-ROGERS AIR CRASH IN PICTURES

Will Rogers and Wiley Post died in a plane crash near Barrow, Alaska.

Wiley Post develops the first pressure suit allowing him to fly to an altitude of 50,000 ft.

The department of War created the Army Air Forces and under the leadership of Gen. Henry H. Arnold, the Army Air Forces initiated the largest air armada of all time in response to the attack at Pearl Harbor.

The Army Air Forces awards Oklahoma City the Douglas Assembly plant employing 24,000 people. The Chamber of Commerce suggests naming the plant Tinker Field in memory of Maj. Gen. Clarence L. Tinker

The U.S. Air Force is formed and becomes an independent installation of the Armed Forces pairing with the U.S. Army and U.S. Navy.

Tinker Land Fund Nears $2 Million

Moore Hospital For Aged Aired

Moore Proposed As Building Site

The Oklahoma City Chamber of Commerce raises $2,121,000 for the purchases of 4,270 acres to increase usable space at Tinker AFB.

Tinker Field becomes known as Tinker Air Force Base.

1933 1934 1935 1941 1942 1947 1948 1956

SECTORS OF THE INDUSTRY

Aircraft Design

Individuals that decide to work in the Aircraft Design sector of the Aerospace & Defense industry will hold positions that pertain to the actual design of various types of aircraft. There are multiple design phases that go into making a useable aircraft, including the conceptual design phase and the structural design phase.

The conceptual design phase can also be referred to as the planning stage; planning focuses on what the aircraft will be capable of by determining aircraft size, using mathematics to determine lift/thrust calculations, creating three dimensional drawings of the aircraft, calculating expected performance, performing weight and balance stability checks, and producing a layout of all aircraft components.

The structural design phase focuses on designing each individual component of the aircraft to ensure optimal performance. Throughout this process prototypes are created and tested and various aircraft components are assembled and tested.

According to Career Focus – Aerospace Careers, some of the many positions that contribute to Aircraft Design include:

- Engineers
- Designers
- Scientists
- Mathematicians
- Specialists

Some of the various types of engineers involved in the designing of an aircraft include (Career Focus):

- Computational Fluid Dynamics Engineers
- Design Engineers
- Aeronautical Engineers
- Electronics Engineers
- Equipment Engineers
- Power Plant Engineers
- Systems Engineers

TRY THIS:

Visit https://designyourown.newairplane.com/

Here, you can experience what it might feel like to put the final design touches on an aircraft by designing your own airplane.

Aircraft Inspection and Testing

Individuals that work in Aircraft Inspection and Testing are focused on ensuring the safety of the aircraft. Inspectors and testers focus on aircraft materials, components and structural integrity to ensure the safety of all crew and passengers. Careers in this sector of the industry may include (Career Focus):

- Failure Analysis Engineers
- Flight Operations Specialists
- Performance Engineers
- Test Engineers
- Weight & Balance Engineers
- Maintenance Inspectors
- Crash Site Investigators
- Electronics Inspectors
- Aircraft Maintenance Inspectors
- Engineering Flight Test Inspectors
- Flight Safety Research Specialists

Flight Crews

Flight crews for commercial airlines, focus on passenger safety, cargo logistics, in flight communications and the piloting of the aircraft itself. Each member of the crew carries out a specific task to contribute to the safety of all crew members and on board passengers. Careers in this sector of the industry may include (Career Focus):

- Air Cargo Pilots
- Airline Captains
- Check Pilots
- Test Pilots
- Pipeline Patrol Pilots
- Co-Pilots
- Corporate Pilots
- Flight Engineers
- Crop Dusters
- Air Taxi Pilots
- Flight Instructors
- Helicopter Pilots
- Flight Attendants
- Flight Simulator Instructors
- Load Masters
- Skywriters/Sign Draggers
- Stunt Pilots
- Traffic Control Pilots
- Navigators
- Aerial Sight-Seeing Pilots

Unmanned Aerial Systems (UAS) & Unmanned Aerial Vehicles (UAVS)

Unmanned Aerial Systems and Unmanned Aerial Vehicles are types of aircrafts that have been designed in such a way that they can be controlled remotely. This type of aircraft allows a pilot to manage all systems from afar allowing new opportunities to navigate areas that are extremely dangerous and would otherwise put the pilot at risk. Careers in this sector of the industry may include (Career Focus):

- UAV Operators
- UAV Systems Specialists
- UAV Pilots
- UAV Camera Payload Designers
- UAV Design Engineers
- Flight Trainers
- Sensor Developers
- Surveillance Specialists
- Sheet Metal Specialists

Aircraft Manufacturing

Once an aircraft is designed, and prototypes are finalized, it comes time to manufacture all of the pieces. Manufacturers are responsible for producing everything from the wheels for the landing gear, to the engine, to the steering wheel that the pilot uses to steer the plane. The number of parts needed to build a functioning aircraft might come as a shock to most people. Careers in this sector of the industry may include (Career Focus):

- Manufacturing Engineers
- Assemblers
- Draftsman/CAD Operators
- Fabricators
- Model Builders
- Sheet Metal Fabricators
- Inspectors
- Tool Designers
- Tool and Die Makers
- Wind Tunnel Technicians
- Technical Illustrators
- Manufacturing Inspectors
- Welders
- Electrical Technicians
- Electronic Engineering Technicians

Aircraft Repairs

Aircraft, much like the vehicles we use on the ground, require a great deal of maintenance to ensure that the engine and all of the various components remain in working order. Unlike a motor vehicle, which remains on the ground, an aircraft cannot simply pull into an emergency lane off to the side if something stops working. This makes the upkeep and general maintenance of an aircraft crucial to the safety of all crew and passengers. Careers in this sector of the industry may include (Career Focus):

- Aircraft Mechanics
- Flightline Mechanics
- Missile Mechanics
- Electromechanics
- Avionics Technicians
- Aircraft Radio Technicians
- Propeller Specialists
- Parachute Packers
- Aircraft Instrument Mechanics
- Electrical Technicians
- Electronics Maintenance Technicians

Resources:

Career Focus – Aerospace Careers, Curriculum and Instructional Materials Center, Oklahoma Department of Career and Technology Education

http://www.aircraftdesigns.com/designing-aircraft.html

https://designyourown.newairplane.com/

CAREER PATHWAYS

In 2013, according to the Social Security Administration, the National Average for salaries across the United States was $44,888.16. To follow is a list of careers within the Aerospace & Defense industries that require varying levels of education. Every career listed offers an annual salary that exceeds the National Average. Let's check it out:

Position Title	Education	Avg. Income
Aviation Consultant	Bachelor's Degree	$71,000.00
Aircraft & Avionics Mechanics	FAA Aviation Maintenance Technician School	$55,230.00
Aircraft Dispatcher	FAA Aircraft Dispatcher Certification	$41,000.00
Aviation/Avionics Technician	FAA-Approved Aviation Maintenance Technician School	$47,000.00
Welding/Sheet Metal Technician	Welding Certification/Sheet Metal Certification/Associate's	$42,000.00
Machinists	FAA Technical Training/ Certification	$44,000.00
Aviation Safety Inspector	FAA Certification - Aircraft Inspector Authorization	$63,680.00
Aviation Planner	A & P License	$41,000.00
Acquisition Specialists	Certified Procurement Officer (CPO) Certification	$62,000.00
Air Traffic Controller	2-4 year Air Traffic Collegiate Training Initiative Program	$122,530.00
Logistics & Supply Chain Management	Bachelor's Degree in Business or Logistics or 4 yrs of exp.	$65,000.00
Contract Specialists	Bachelor's Degree or 4 years of exp.	$66,000.00
Community Planners	Bachelor's in Community Planning or 2 yrs of exp.	$68,000.00
Electrical Engineer	Bachelor's Degree	$95,000.00
Aerodynamicist	Bachelor's Degree	$103,720.00
Aerospace Engineer	Bachelor's Degree	$103,720.00
Mechanical Engineer	Bachelor's Degree	$84,000.00
Structural Engineer	Bachelor's Degree	$92,000.00
Industrial Engineer	Bachelor's Degree	$88,000.00

Position Title	Education	Avg. Income
Software Engineer	Bachelor's Degree	$92,000.00
Information Technicians (IT)	Associate's Degree or 2 years of technical training	$47,000.00
Electronics Technicians	Associate's Degree or 2 years of technical training	$49,000.00
Commercial Pilot	Commercial Pilot's License/ Airline Transport Pilot Certificate	$98,410.00
Private Pilot	Pilot's License	$82,000.00
Military Aircraft Pilot	Bachelor's Degree (Can be obtained while serving)	$81,000.00
Electrical & Avionic Systems Repairs	10 Wks of Combat Training & 24 weeks on-the-job instruction	$54,000.00
Air Traffic Control Equipment Repairs	10 Wks of Combat Training & 38 weeks on-the-job instruction	$62,000.00
Aircraft Electrician	10 Wks of Combat Training & 19 weeks on-the-job instruction	$46,000.00
Aircraft Powertrain Repairer	10 Wks of Combat Training & 18 weeks on-the-job instruction	$50,000.00
Aviation Officer	Aviation School, Basic Combat Training, Specialized Training	$66,000.00
Aviation Operations Specialist	10 Wks of Combat Training & 8 Wks of on-the-job instruction	$55,000.00
Aerospace Ground Equipment	8.5 Wks of Basic Training & 95 days of specialized instruction	$65,000.00
Aerospace Maintenance Specialist	8.5 Wks of Basic Training & specialized instruction based on job function	$62,000.00
Aerospace Propulsion Specialist	8.5 Wks of Basic Training & 34-51 days of specialized training	$73,000.00
Aviation Resource Management	8.5 Wks of Basic Training & 26 days of specialized training	$62,000.00

Resources:

http://www.ssa.gov/OACT/COLA/AWI.html
http://www.indeed.com/salary
http://www.goarmy.com/careers-and-jobs/browse-career-and-job-categories/transportation-and-aviation.html
http://www.airforce.com/careers/#interest:aircraft

Career Focus—Aerospace Careers, Curriculum and Instructional Materials Center, Oklahoma Department of Career and Technology Education

WOMEN IN THE INDUSTRY

There are a number of women in the Aerospace & Defense industry that have paved the way for women today to take on a wide variety of roles related to Aerospace & Defense. Both Shannon Lucid and Lieutenant Colonel Arminta Harness are examples of women who have made significant contributions to the industry.

STUDENT ACTIVITY:

Do your research and identify a woman in the United States that has made a significant contribution to the Aerospace & Defense Industry.

Create a 3-minute presentation using at least 2 credible resources and offer an overview of that woman's life including her background, education, career and specific contributions.

For a chance to win a free iPad for both yourself AND your teacher, submit a video of you giving your presentation or provide a narrative script of your presentation via NIE's online portal at:

http://nie.newsok.com/soaring-oklahoma-aerospace-defense-contest-entry

All submissions are due by January 29, 2016.

Shannon Lucid (Astronaut)

Shannon Lucid, Ph.D., grew up in Bethany, Oklahoma and is a graduate of Bethany High School. After High School, Lucid went on to attend the University of Oklahoma where she earned a Bachelor of Science degree in Chemistry as well as a Master of Science and Doctor of Philosophy degree in biochemistry. Dr. Lucid belonged to the first class of women astronauts selected by NASA.

Resources:

http://www.jsc.nasa.gov/Bios/htmlbios/lucid.html

Lieutenant Colonel – Arminta Harness (Aeronautical Engineer)

Lt. Col. Arminta Harness obtained an Aeronautical Engineering degree from the University of Southern California in 1955 making her the first female engineer in the United States Air Force. During her 24 years of service, Lt. Col. Harness received the National Defense Service Medal, the Air Force Commendation Medal, a Joint Services Commendation Medal and the Air Force Meritorious Service Medal. In 1971 she also received additional recognition from the Institute for the Advancement of Engineering when she was awarded the Engineering Achievement Merit Award.

Resources:

http://societyofwomenengineers.swe.org/membership/history/2-uncategorised/43-swe-women-harness

IN THE INDUSTRY

Full Name: Brig Gen. Ben Travis Robinson, USAF (R)

Occupation: President/Owner of Sentry One LLC, an Oklahoma City based aerospace consulting company

Length of time serving in current position: Five years with Sentry One LLC but over 40 years in the aerospace and defense industry.

Education Level: BS in Industrial Management, MA in Industrial management, MIT Fellowship

When did you decide that you wanted to do this? Probably in elementary school was when I knew what I enjoyed but I did not decide I wanted an aerospace career until much later.

What challenges and obstacles did you face to get to where you are today? Early on in my education, no one wanted to or was capable of discussing career opportunities or relevant education and training, career pathways. I had to discover things all on my own.

What advice do you have for students who want to work in the industry? Learn as much as you can about all aspects of the industry. In aerospace, there is engineering, business, technical specialties, innovation, manufacturing, etc. Find one that interests you. Develop a career path with that career as a goal. Work to get the right education, training and experience in that part of the aerospace industry. Make it your dream career and have fun.

Full Name: Justin Heid, A.A.E.

Occupation: Airport Director, Guthrie-Edmond Regional Airport

Length of time serving in current position: 3 Years with Guthrie-Edmond Regional Airport

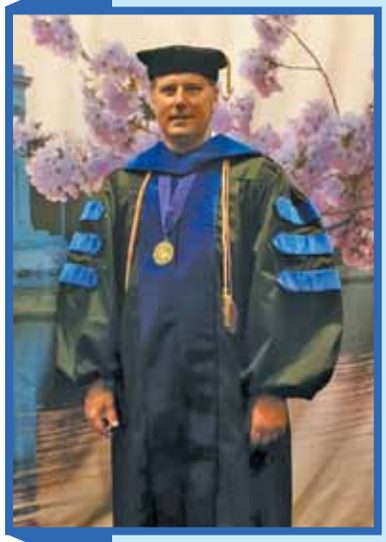
Education Level: Accredited Airport Executive (A.A.E.) - American Association of Airport Executives; Master's Degree - Aerospace Administration and Logistics - Southeastern Oklahoma State University; Bachelor's of Science - Aviation Management with a Business Minor - University of Oklahoma; Associate's of Science - Aviation Operations - Community College of the Air Force

When did you decide that you wanted to do this? Growing up, I always knew that I wanted to be involved with aviation. I love to fly, and managing an airport allows me to be at the airport every day, while allowing me to be home every night. For this reason, I chose airport management as a career, so that I could be around aviation, fly for fun, and still be home every night with my family.

What challenges and obstacles did you face to get to where you are today? One doesn't just become a CEO or Director of an organization. There are steps to getting where you want to go. I held multiple internships and positions, some unpaid, and joined organizations that would be beneficial in networking within my industry to gain experience. It can be a challenge to build a career relevant resume. Additionally, education can be an obstacle for many, and it takes a large amount of perseverance and dedication to achieve your goals. To achieve this sometimes it means just putting one foot in front of the other, and keep moving towards the end-goal. Paying for school was a large obstacle that I overcame with the GI Bill through the Air Force. While in the military, I had time to mature and get my barrings on exactly what I wanted to do; and once I was out, I went straight to school and treated it like a job. My time in the service helped give me direction and clarity. There was a time when I would never have imagined I would hold the certifications and degrees that I do. But pretty soon you are able to look back and see everything you have done and it will amaze you. It is important to remember the old saying: "How do you eat an elephant...One bite at a time."

What advice do you have for students who want to work in the industry? For those students wanting to work in the industry I would recommend that they get involved, network, and take positions that are relevant to the careers they desire. Some jobs may be taken for what you can LEARN and not necessarily what you can EARN. Volunteer and job shadow with organizations and businesses within the industry. It ads to your resume and shows businesses how bad you want something. Organizations today are looking for dedicated individuals, so make yourself stand out. It is important to remember that your future bosses were once in your position trying to break into the industry. To be a good employee, all you have to do is your job. To be recognized as a star, just do a little bit more.

IN THE INDUSTRY



Full Name: Dr. John Vonhof

Occupation:
Project Management specialist

Length of time serving in current position:
25 years with the Boeing Company

Education Level:
PhD in Organizational Behavior and Management

When did you decide that you wanted to do this?
I decided I wanted to work in aerospace when I was in college and looking for a job. I have always liked airplanes – they truly are fascinating. Additionally, my brother-in-law is a Marine, and I wanted to be a part of a company that helped our warfighters.

What challenges and obstacles did you face to get where you are today?
I have been blessed to have had the opportunity to work on many different aircraft platforms. Some challenges include long hours, extended travel and time away from my family. My biggest obstacle was health-related – I had a minor stroke, which took six months to recover from. I am glad to say I was able to recover and carry with me gratitude for my family, health, and the opportunities Boeing provides me.

What advice do you have for students who want to work in the industry?
My advice is follow your dreams, and don't be afraid to fail. I left home when I was 20 and moved from Ohio to California, even though I didn't really know anyone. I had hopes of one day living by the ocean and having an ocean view out my office. Somewhat paradoxically, I also wanted to work with airplanes, have a cattle ranch and ride horses. When I left my previous office to move here, I could see the ocean. And now that I'm in Oklahoma, I have a cattle ranch and horses, and still work with airplanes. So don't be afraid to dream, or to fail. Boeing is a great company to work for - they paid for my education and provided me with many opportunities to advance my career.

Full Name:
Patrick Kanaly (Pat)

Occupation:
Engineering & System Support Analysis

Length of time serving in current position:
Been with Boeing 19.5 Years

Education Level:
Bachelors – Embry Riddle / MBA – Webster University (in-work)

When did you decide that you wanted to do this?
In High School, I had a fascination with aircraft in general and was technically inclined but academically short. My parents could not afford college - and to be honest my grades probably would not have opened many doors at a University. So I joined the Air Force and was assigned to the AWACS squadron at Tinker. That decision launched my career.

What challenges and obstacles did you face to get where you are today?
My biggest challenge early in my career was to find time to go back to school to get the required Degrees to further my career – I moved around my first 14 years with Boeing, from Saudi Arabia to Hawaii, Maryland, Texas, Nebraska and Oklahoma. Finding time to earn a Bachelors was difficult, but was always my underlying objective. Now that I am halfway through my career and a bit more settled, I see further opportunity and a renewed focus to continue towards a MBA.

What advice do you have for students who want to work in the industry?
This industry is vast and offers many opportunities, so define what you want before you begin the journey. If something else comes up that offers something different and sparks an interest, don't be afraid to venture out and explore that new opportunity. In the end it will make you a well versed and well-rounded individual with a lot of stories to tell!

When I Grow Up… Exploring Careers in Aerospace & Defense

When exploring your chosen career, you will need to do the following:

1) Identify the education requirements for entering into your chosen career.

2) Identify at least 3 Educational Institutions within the state of Oklahoma that you could attend to retain the required education for your chosen position.

3) Find 3 different real life job listings within the state of Oklahoma for your chosen career (you can use Monster.com, Indeed.com, USAjobs.gov, etc. to locate job listings). Identify a list of required skill sets that are common among all three job listings.

4) Create a list of 5 questions that you have regarding what it would be like to work in the career you have chosen. Choose one of the 3 job listings that you have already identified and research that company's Human Resource contact information. Contact the human resource department for that company, identify yourself as a student doing research and seek answers to your 5 questions.

5) Summarize your findings. Write a 1 – 2 page summary of your findings including an introduction explaining why you chose the career that you did and a conclusion indicating whether or not you are interested in learning more about the career you have chosen to research or if you would prefer to look at other career opportunities.

For a chance to win a free iPad for both yourself AND your teacher, submit your 1-2 page summary via NIE's online portal located at: http://nie.newsok.com/soaring-oklahoma-aerospace-defense-contest-entry/

All submissions are due by January 29, 2016.

2016 AVIATION ART CONTEST – AIR SPORTS IN HARMONY WITH NATURE

Enter this year's Aviation Art Contest! For full contest details and an entry form visit: http://bit.ly/1XCPdXC

This statewide competition offers all entrants the opportunity to move on to a national and international competition.

THEME:

This year's theme is "Air Sports in Harmony with Nature". Artwork is judged, at least in part, for its creative use of this year's theme in relation to the aviation world.

DEADLINE:

Entries must be sent to your state's sponsor office and must be postmarked by Friday, January 22, 2016.

Cheyenne Jones - Porum, Oklahoma, 2nd Place Senior Division

ELIGIBILITY:

All children in the age groups show below are encouraged to participate in the contest, even if they are related to officials or employees of the FAI or any of its member organizations.

AGE GROUPS:

Group I – Junior Category
(Born between Jan 1, 2006 and Dec 31, 2009)

Group II – Intermediate Category
(Born between Jan 1, 2002 and Dec 31, 2005)

Group III – Senior Category
(Born between Jan 1, 1998 and Dec 31, 2001)

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afsoco.afciviliancareers.com/public/content/tinker-afb-oklahoma-city-ok

Oklahoma's Aviation & Aerospace Industry

- Average salaries of $63,400!
- Provides 120,000 direct and indirect jobs!
- Oklahoma's #1 exporter!
- One of 5 industry ecosystems in the state!
- Home of world's largest military (Tinker AFB) and commercial (American Airlines) aircraft repair facilities!

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