Mechanical Engineering Learning Community

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Ohio University

NotesBook web-published for
UC 1900 Mechanical Engineering Learning Community

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Dr. Bob's ME Learning Community, Fall 2012

Atkinson and OU EE Freshmen, 1902
media.library.ohiou.edu

UC 1900 ME NotesBook

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1. Ohio University History

This chapter presents a select history of Ohio University, with ensuing subsections for the history of engineering at OU, plus a list of OU presidents and engineering deans, OU sports, music, party school history, haunted Athens, and the Ridges. The first several of these sections can be found on-line as seen below.

1.1 General Ohio University History

ohio.edu/people/williar4/html/PDF/OUHistory.pdf

1.2 History of the Engineering College at OU

ohio.edu/people/williar4/html/PDF/OUHistory.pdf

1.3 History of the Mechanical Engineering Department at OU

ohio.edu/people/williar4/html/PDF/OUHistory.pdf

1.4 Famous Ohio University Graduates and Attendees

ohio.edu/people/williar4/html/PDF/OUHistory.pdf

1.5 Ohio University Sports History

ohio.edu/people/williar4/html/PDF/OUHistory.pdf

1.6 Ohio University Music History

ohio.edu/people/williar4/html/PDF/OUHistory.pdf

1.7 Ohio University Party School History

- In 1854 Athens voted to outlaw the sale of liquor.

- Please note that the legal drinking age in Ohio is 21, the same nationwide in the U.S. If you are in this class, you are likely under 21, so the best approach is to abstain from alcohol 100% until you turn 21. OU has draconian regulations against underage drinking and will not hesitate to enforce them, even for first-time offenders.

- Many respected presidents of many famous universities in the U.S. are currently leading a major effort to lower the nationwide drinking age to 18. The reason they are supporting this movement is to reduce underage-drinking-related problems on their campuses. Perhaps they are looking back in history to see what a disaster prohibition was in curtailing drinking – it had exactly the opposite effect and organized crime got involved when drinking was illegal.

- Athens' Court Street, immediately adjacent to OU's College Green, has the highest number of bars per capita in the world. If you have dreams of staying in Athens after graduation by opening another bar, you'd better get in line – it is nearly impossible to get a liquor license in Athens; new establishments must get their liquor license transferred from another bar going out of business.

- In the late **1950s** and **1960s** the St. Patrick's Day celebration in bars around OU was nationally-known, with Athens being called the Fort Lauderdale of Ohio.

- A decades-long tradition of spring riots started with the Orange Riot of **1958**, wherein 4,000 male students (after the female students were confined to their dorms for the night) rampaged through OU and Athens, starting with two students throwing oranges from the cafeteria at each other.

- Ohio University has been on various non-scientific Top Ten Party Schools lists many times.

- In the **1970s** and **1980s** Ohio University made the Playboy Magazine list of top ten party schools, often at the #1 spot. This was such a regular occurrence that one fine year, when OU did not even place in the top ten, an inquiry was made to Playboy Magazine who responded that OU could no longer be considered for list since we had gone professional!

- On **April 5, 1997**, when clocks were set forward for Daylight Savings Time, students leaving the bars one hour early rioted, recalling the decade of spring riots in the **1970s**.

- A house was set on fire during Palmer Fest in Spring **2012**.

- Brigham Young University, a private Mormon university in Provo Utah, consistently ranks as the #1 'Stone Cold Sober' school, i.e. dead last on any Party School list.

- There is no doubt that OU is a fun place. But if you make partying your focus, you will not survive in engineering school for long and might as well transfer to business right now.

OU Halloween Party History (The Post 10/25/12; The Athens News 10/27/12)

- The Athens Kiwanis Club and Junior Chamber of Commerce sponsored a Halloween Court Street community party on **October 29, 1940**.

- Halloween Weekend has been a major party since Tuesday **October 31, 1974**, when Court Street was taken over illegally and unexpectedly by a mob of OU students for two hours around midnight. They blocked a semi-truck trying to make a delivery to Baskin-Robbins which was on Union Street at that time.

- In **1976** 500 partygoers left a campus party in old Baker Center and took over Court Street, forcing Athens officials to close it down for 4 hours. The crowd was unruly and there was violence between the police and revelers. The Athens Police were mad at then-mayor Donald Barrett who forbade them from removing these Halloween revelers by force.

- In **1977** 7,000 dancers and revelers again force the closure of Court Street at Halloween. This is the first year the City of Athens and OU were involved in planning for Halloween, though it was not sanctioned. There was music, a 4'x8' cake from OU Food Services, and the Marching 110 played at the Courthouse.

- In **1978** OU tried to limit the number of out-of-town visitors for Halloween (every year the arrests made involve mostly outsiders and few OU students). They failed miserably, since 20,000 Halloween revelers took over Court Street that year.

- By **1979** Athens' Halloween Celebration is known as the 'Mardi Gras of the Midwest'.

- **1985** is known as the most destructive Athens Halloween on record, when $350,000 damage resulted from a fire in the Convo, windows were broken, and property defaced. This was despite the newly-formed Athens Clean and Safe Halloween Committee and despite a smaller crowd of 12,000. Then-dean of students Joel Rudy worried that if an emergency happened during the uptown block party, it could not be handled since all resources were focused on uptown.

- Finally in **1990** the annual Athens Halloween Block Party was officially sanctioned by the City of Athens, and Court Street was closed intentionally, as it has been every year since. The attendance estimate was 24,000.

- In **1999** the giant jack-o-lantern made its debut, descending slowly at midnight, and it has appeared every year since.

- In **2000**, according to the event organizer Jonathan Holmberg, a Jackie O's bartender, the annual Athens Halloween Block Party was 'mellow', perhaps the calmest ever. During daylight on Saturday, Rev. Jesse Jackson and filmmaker Michael Moore both made public appearances on Court Street.

- In **2005** Athens City Council proposed fencing off Court Street during Halloween and charging admission, but this was rejected. In **2008** and **2009** there was a beer garden.

- In **2010** the event was again relatively calm, but it did suffer from a roof fire at the Athena Grande, a suicide attempt, a missing juvenile, and a stolen toilet was found outside Scripps Hall.

- In **2012** the costume-judging contest returned, and local bands again entertained on two stages. OU noticed a large drop in outside visitors registering to stay with friends in the dorms, so they increased the fees to make up for lost revenue.

- Annually, most of the weekend's arrests are of out-of-town partiers – be sure to keep it that way as OU students! Enjoy, but stay sober and use common sense. Do not give cops a hard time and absolutely no slugging of innocent police horses.

Athens Halloween Block Party 2012

athensnews.com/ohio

1.8 Haunted Athens / Ohio University

- The area in and around Athens Ohio is said to be one of the most haunted places in the country and world.

- Bush Hall is said to be haunted, where you can hear the sound of marbles dropping, footsteps in the halls, and even doors opening.

- Crawford Hall is thought to be haunted by a girl who fell to her death there in 1993.

- Washington Hall is said to be haunted by a female basketball team that had died in a bus crash after returning from a basketball camp that they attended during the summer at Ohio University. Residents have reported hearing basketballs being dribbled, laughing, and talking in the hallways, especially in the arch that connects Washington and Read Hall.

- A resident in Shively Hall in the 70's was drawn to specific parts of rooms and the building itself by a force that pulled her where it wanted. After numerous incidents of this, her friends plot a line of where the source might be coming from or where it might be taking her. The line that was plotted, when matched with a map, lead directly to one of the cemeteries in the country near Athens.

- Five major cemeteries in the countryside near Athens form the points of a pentagram.

- Moonville Tunnel (near Lake Hope State Park west of Athens), near Raccoon Creek, is thought to be haunted by the ghost of a railroad brakeman killed by a train at the site when he was drunk. Almost nothing can be seen of the original town of Moonville, so it is has become a ghost town!

1.9 The Ridges

- The Ridges is a beautiful property owned by OU, housing various offices, overlooking Athens. Up until the late 1980s, it was the site of a state mental health hospital.

- The Athens Lunatics Asylum was built just after the American Civil War – many of the original buildings are still standing. This mental health institution was much ahead of its time in terms of humane treatment of patients. They also strove to be self-sufficient with farms, animals, and orchards, encouraging outside work by patients to support themselves.

- The Ridges is said to be haunted by former patients. The Ridges cemetery has recently seen efforts to identify patients buried under numbers rather than names.

- Despite being ahead of their time, the Athens Lunatic Asylum used various treatments that sound barbaric by today's standards, but were state-of-the-art in the day:
    - In water treatment, patients were submerged under ice-cold water for long periods of time.
    - With electric shock therapy, electric shocks were administered to patients submerged in water tanks or directly to the temples.
    - With a lobotomy, patients' skulls would be cracked open and their neural passages would be surgically separated midway through the brain.
    - In trans-orbital lobotomy, patients would be knocked out through shock therapy and would have metal pins hammered through their tear ducts and into the brain (many patients died from this 'treatment').

Athens Lunatic Asylum, 1920

Alligator in Asylum Fountain, 1921

Lobotomy Operation

Lin Hall on The Ridges

1.10 References

ohio.edu/advancement/employment/traditions.cfm

ohio.edu/rsps/conference/funfacts.html

ohio.edu/students/history.cfm

ohio.edu/athens/history/people

2. Ohio University Campus Organizations

2.1 Student Organizations

- Ohio University supports over 350 student organizations:

  ohio.edu/involvement/studentorganizations/directory.cfm

- Every opening weekend OU hosts an Involvement Fair for all of the freshmen to get involved in different clubs and teams.

- OU has a Student Activities Commission (SAC) which is responsible for allocating funds for programs and events to registered student organizations.

- If you don't find a club or organization you like, you can create your own.

Here is a small sampling of the active student organizations at Ohio University:

- **Arnold Air Society**: a society that supports the community and also the United States Air Force.

- **Backdrop Magazine**: a magazine at OU that is run by students.

- **Budo Club**: a club that does Japanese Martial Arts.

- **Engineers Without Borders**: a group with a goal to help the local community and other countries with problems that engineers can solve.

- **Flying Bobcats**: OU competition aviation group that competes against other collegiate aviation groups.

- **Game Show Appreciation Society**: there goal is to understand game shows by observing, discussing, and participating in them.

- **Gang Green**: a student section that cheers for the OU Hockey Team.

- **Golf Club**: a club where you play golf at a competitive level.

- **Little Monsters**: a charity organization who raise funds based on the philanthropic work of Lady Gaga.

- **Medieval Society**: study and practice of the arts, sciences, lifestyles of the medieval period.

2.2 Club Sports

Here is a list of club sports offered at Ohio University:

- Basketball, Men's
- Basketball, Women's
- Crew, Men's
- Crew, Women's
- Cycling
- Equestrian, Hunt
- Equestrian, Western
- Fastpitch
- Fencing, Duello
- Fencing, Olympic
- Gymnastics
- Kendo
- Lacrosse, Women's
- MMA
- Paintball
- Rugby, Men's
- Rugby, Women's
- Soccer, Men's
- Soccer, Women's
- Swimming
- Synchronized Skating
- Tae Kwon Do
- Tennis
- Triathlon
- Ultimate, Men's
- Ultimate, Women's
- Volleyball, Men's
- Volleyball, Women's
- Water Polo, Men's
- Water Polo, Women
- Waterski
- Wrestling

ohio.edu/recreation/club/

2.3 Recommended Clubs for Engineering Students

Tired of just doing homework?
Get Involved!

Engineering Clubs/Organizations
American Society of Mechanical Engineers - ASME
Society of Automotive Engineering – SAE
Society of Women Engineers – SWE
Theta Tau – Professional Engineering Fraternity *
Tau Beta Pi – Engineering Honors Fraternity *
Biomedical Engineering Society
National Society of Black Engineers – NSBE
Student Advisory Board for Mechanical Engineering – SAB
Engineers Without Boarders – EWB
Leadership
Robe Leadership Institute – RLI *
Global Leadership Center – GLC *
Army ROTC (Reserve Officer Training Corps) *
Air Force ROTC (Reserve Officer Training Corps) *
Other
Service Planning and Renewing Communities – SPARC (Volunteer)
Ralph and Luci Schey Sales Centre – Sales Certificate program *
Skydiving Club

* Selective Entry – Application and/or interview may be necessary

Complete list: ohio.edu/involvement/studentorganizations/directory

2.4 References

ohio.edu/involvement/studentorganizations/directory.cfm

ohio.edu/recreation/club/

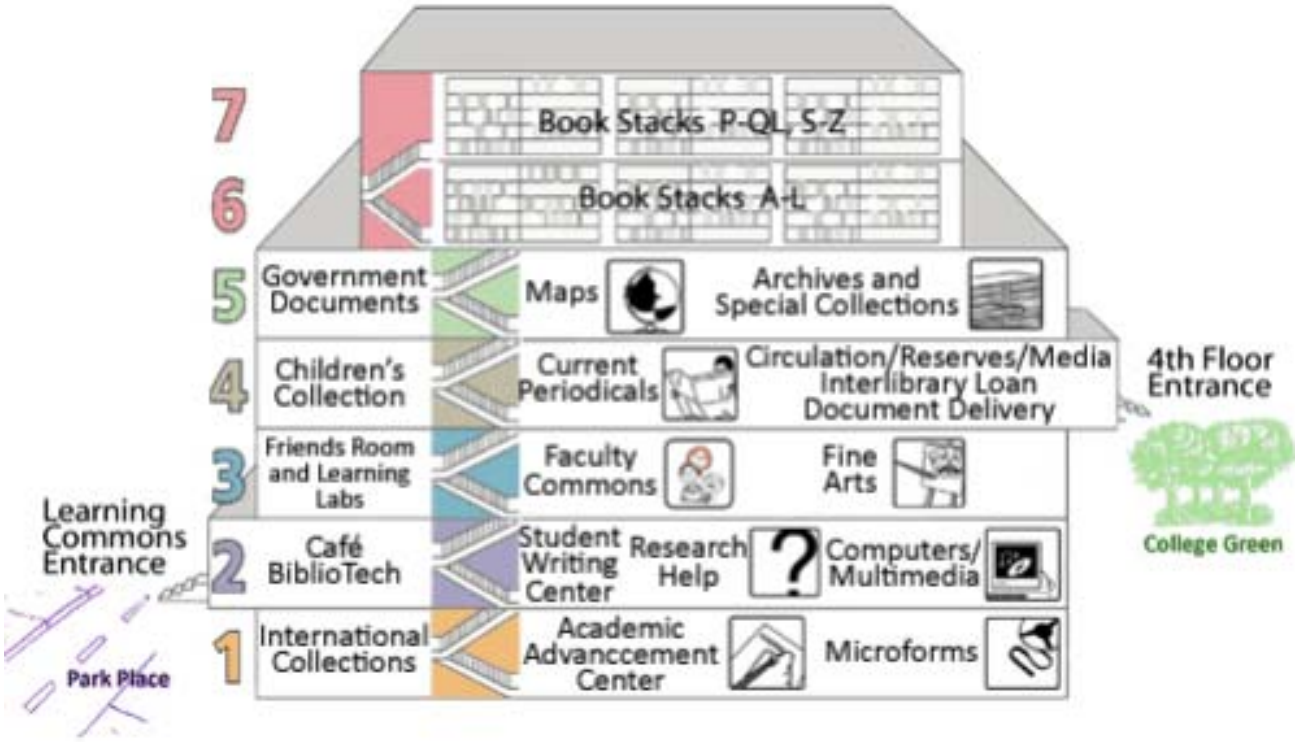
3. Ohio University Campus Resources

3.1 Academic Resources

- **Academic Advancement Center (AAC)** – in Alden Library, designed to help you get ahead in your classes or catch up if you're behind. The AAC offers academic support through a variety of programs such as tutoring, group study sessions, and learning strategies courses. Students with disabilities are provided with free peer tutoring through the AAC. Tutor availability is not guaranteed. Tutors may be requested online.

- **Academic and Research Center (ARC)** – meeting place engineering students go to do homework together. Able to reserve small study rooms for study groups. It has numerous rooms for groups and organizations to meet and work, also it serves as a great refuge between classes when you live on South Green and a lot of your classes are up on West Green.

- **Alden Library** – located on the College Green, one of the main resources for students. It offers a vast library of books, maps, DVDs, as well as many electronic resources. The library is used for study groups, writing papers, doing homework, among other services. 2,000,000 printed volumes, 2.3 million units of microfilm, and 13,500 current subscriptions.



Alden Library Floor Plan

- **ALICE** – online Alden Library and beyond catalogue.

- **Allen Student Help Center** – Baker Center, provides students with academic advising, academic success skills, study skills assistance and more. The staff may also be able to help you identify the campus resources which best fit your needs. Services are available by either scheduling an appointment or on a walk-in basis.

- **Campus Involvement Center** – helps students get connected with the campus and the community. They will help you find things such as campus programs, community service opportunities and Greek life.

- **Chubb Hall** – location of University College, plus a the registration and financial center for Ohio University. You need to get your breakage card for CHEM lab there.

- **College Adjustment Program (CAP)** – helps students with their academic development, as well as meeting basic college requirements. It also helps to motivate students to work towards the successful completion of an undergraduate degree.

- **Disability Services** – for those who require special assistance in their classes, or for physically handicapped who need help traversing the campus.

- **Language Resource Center** – dedicated to learning language. Housed on the first floor of Gordy Hall, it is open every day but Saturday.

- **Learning Communities** – groups of students with the same major that meet and study and help each other on school work. A bunch of students can get together and talk about OU and their major. It is a good way to make friends and it makes being social a little bit easier.

- **Math Center** – provides free help with any kind of math that you are doing. You can make an appointment to meet with someone one-on-one, have a daytime meeting with a tutor or attend the drop-in sessions.

- **Military Personnel & Veterans Resources** – created to assist Ohio national Guardsmen, military reservists, and any type of military veteran enrolled at Ohio University.

- **Multicultural Resources** – provides multicultural students opportunities to visit the campus through informative programs, and also provides many multicultural organizations. Multicultural center in Baker community lounge, an art gallery, a multi-purpose room, a computer lab, a resource library, and offices for students and staff.

- **Peer Lead Team Learning (PLTL)** – an excellent way to better your understanding of the course you are taking, such as CHEM 1510, and also a good way to meet people.

- **Scholarships Office** – Chubb Hall, guide and support students that are applying for or are eligible for financial assistance.

- **Shostak Adaptive Equipment Room** – Alden Library Learning Commons, designed to offer additional support to students, faculty, and staff who may need additional assistance in accessing the library. Equipment is available to assist patrons with mobility or physical impairments as well as those in need of study or learning aids.

- **Stocker Computer Labs** – computer resources for engineering students. Print up to 75 pages per week.

- **Student Writing Center** – located in Alden Library and will help you in any part of your writing process. You can walk in and have a face-to-face appointment or you can schedule one over the Internet. The Student Writing Center offers individual in person or online assistance to assist you with paper writing in any subject area. Assistance can be provided to develop ideas, organize the paper, or try to meet specific assignment expectations. The service is free to Ohio University students and is available by scheduling an appointment or on a walk-in basis.

- **Study Abroad** – helps students who want to travel to a different country for education.

- **Supplemental Instruction (SI)** – SI sessions are free out of class sessions for courses that are known to be difficult. They are led by someone who has completed the course and provide a place for students to study with assistance from peers.

3.2 Technology Resources

- **Blackboard** – OU electronic class website used in many, but not all, courses

- **Catmail** – OU e-mail service

- **My Ohio** – on-line area where you can access blackboard, contact professors, and also view any financial aid or your class schedule.

- **Ohio Information Technology (OIT)** – an office on the ground floor of Baker Center that helps with computer hardware and software technology problems or questions.

- **Virtual Desktop** – remote access to software programs OU/Engineering owns like AutoCAD

3.3 Transportation Resources

- **Airport Shuttle –** to/from OU and CMH Airport in Columbus Ohio.

- **Go-Bus –** an off-campus bus traveling to Marietta, Columbus, and Cincinnati. There are tickets available online and their most favored partner is Greyhound Bus.

- **Parking Services** – responsible for campus parking. Also responsible for the validation of accessible parking placards issued by the state in order to permit parking in accessible spaces around campus. Parking Services can also provide the most accurate information regarding the location of accessible parking spaces.

- **Ride Board** – posts listings of students who are either drivers or passengers stating where they are going or where they need to go each week/weekend. A typical listing will show the student's name, their destination, time of departure, time of return, price, and either an email address or phone number for contact.

- **Transportation Services** – coordinates and provide regular Campus Area Transit Service (CATS) bus service around campus and some nearby residential areas. CATS buses are fully accessible. Transportation Services also runs the CATCAB shuttle system designed to serve people with temporary injuries or permanent disabilities that may have difficulty accessing the CATS Bus.

3.4 Health and Safety Resources

- **Counseling and Psychological Services –** Hudson Health Center, available to provide confidential counseling and psychological therapy. Counseling needs may include personal problems, career objectives, or education concerns. Each student is eligible for 12 free counseling sessions per year.

- **Emergency Phones** can be seen around campus from the blue light on top of each. If you are walking home late at night you can call the phone and someone will walk you home or if there is an emergency you can use the phones.

- **Environmental Safety** – OU has a webpage designed to share environmental, lab safety, and radiation safety resources.

- **Psychology and Social Work Clinic** – Porter Hall, offers an array of services including intelligence and neuropsychological assessment; psychological testing; attention deficit/hyperactivity disorder assessments; and, learning disability assessments. Graduate student clinicians under the direct supervision of licensed psychologist faculty members provide these services. Please contact the Clinic to discuss their fees.

- **Student Health Services –** Hudson Health Center, clinics for normal health problems during the week, business hours only. Go to the O'Blenness Hospital Emergency Room for emergencies and off-hours health issues.

3.5 Career/Job Search Resources

- **Bobcat CareerLink** – key place to go to find information on jobs, employers, workshops and events.

- **Bobcat Mentor Network** – database of more than 600 alumni willing to help students develop their career.

- **Career Services** – committed to providing comprehensive career development assistance to all Ohio University students and alumni as well as offering programs and services to assist employers with their human resource and college relations needs.

- **Co-operative Education Program** – enables students to obtain job experience while still in college.

3.6 Miscellaneous Resources

- **Campus Recreation** – dedicated to provide the best recreational facilities for students.

- **Communications and Marketing** – a resource that sends out significant OU news and achievements.

- **Culinary Services** – all the dorm dining halls, catering, grab-n-go, convenience stores and the areas where food is processed and prepared.

- **Human Resources** – a group that helps the faculty and staff with a variety of services.

- **Ping Personal Trainer –** you sign up at ping and you are assigned a personal trainer and they charge you $25 per session. This is a helpful resource for becoming physically fit, for those rare students who can afford it.

- **Student Legal Services –** lawyers available to help students with normal legal issues.

3.7 References

facilities.ohiou.edu/parking/disabled.htm

facilities.ohiou.edu/trans/index.html

library.ohiou.edu

library.ohiou.edu/services/persons-disabilities

library.ohiou.edu/services/writing-tutoring

lrc.ohio.edu

my.ohio.edu/portal

ohio.edu/aac/cap/index.html

ohio.edu/aac/math.cfm

ohio.edu/aac/supins

ohio.edu/admissions/multicultural

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ohio.edu/careers/students/jobSearchResources.cfm

ohio.edu/disabilities/current/resources.cfm

ohio.edu/food/about/profile.cfm

ohio.edu/helpcenter/index.cfm

ohio.edu/students/veterans

ohio.edu/tutoring

ohio.edu/writing

ohioupsychology.com/Clinic.html

4. Activities at Ohio University, Athens, and Southeast Ohio

4.1 Ohio University Activities

- **Aquatic Center** – located directly behind the Bird Arena hockey rink, the aquatic center is free to students and is an indoor pool that's 50meter by 25 yards and has 2 three meter and 2 one meter diving boards. You can hold parties, lap swim, dive, or recreationally swim most days from 9 a.m. to 3 p.m.

- **Bird Arena** –ice arena, home of the national champions, the Ohio University men's hockey team. They also offer recreational skating, lessons, intramural broom hockey, and private rentals to the university and community. They are open from late September to March.

- **Climbing Wall** – the climbing wall in Ping Center is free to all registered students and it is 36 feet tall. You can take a class to get a belay certification.

- **Disc Golf** – located in the old Hocking River bed near Ping Center, it is a relatively short 9-hole course with baskets.

- OU has various **Family Weekends**: Parents' Weekend, Sib's Weekend, Dad's weekend, and Mom's Weekend.

- The Baker Center has **Friday Night Movie Nights** that are free.

- **Golf Course / Driving Range** – OU has a quality 9-hole golf course near Ping Center, available to students with a greens fee charge. The golf course also has a disconnected driving range for students to work on their swing and golfing skills in general, on W. State Street.

- **Humans vs. Zombies** – an exciting game where kids run around campus shooting each other with Nerf guns and sock balls in order to fight off the zombies. It usually lasts about a week.

- **Kennedy Museum of Art** – in Lin Hall on The Ridges, offers a wide range of permanent collection and traveling exhibitions, educational programming, and special tours.

- **Local Trips** – OU students get together and plan trips that are relatively close to campus. They do trips like backpacking in Hocking Hills and going climbing. During Dad's weekend they will have multiple activities such as zip-lining and a cave hike.

- **Malaysian Museum** at Ohio University contains many artifacts from Malaysia.

- **New Adventures** – this is a group of people that get together to travel away from OU to do new adventures for students. Some activities they do are ones like canoeing and going rock climbing in Red River Gorge.

- **Ping Center** – athletic center for students. Offers a quality climbing wall, five basketball and soccer courts, exercise equipment, two weight lifting centers, and an indoor track for running/walking. Located near South Green, Baker Center, and Peden Stadium. It's a great place to work out, run, play basketball, racquetball, climb, among other activities. It's usually open from 6:30 in the morning to 12 at night, except on the weekends where its open from 12 to 12.

- **The Ridges** – The old Athens Lunatic Asylum with historic cemeteries, beautiful old trees, and amazing architecture. This is a living biological laboratory for Ohio University so no mountain biking is permitted on the trails, but hiking and running is allowed.

- **Sand Volleyball Courts** – on South Green.

- **Scuba** – you can take classes with a fee to pay for the instructor and equipment use and get certified to scuba dive and also they go on 4 dives through the course

- OU has 33 Sororities and Fraternities on campus.

- OU has many **Sporting Events** that students can attend. Some of which include football, basketball, volleyball, baseball, softball, and many more.

- **Ultimate Frisbee**.

4.2 Athens Activities

- **Art** – Athens has been recognized as a top Art Community in the country with OU's Memorial Auditorium, Nelsonville's Stuart's Opera House, The Dairy Barn Center, The Kennedy Museum, and more.

- **Arts West** – community arts center with activities including musical shows and plays, dance, DJ , photographers, musicians, and actors.

- **Athena Cinema** – in uptown Athens, movie screenings all year, less-watched films, host of the yearly Athens Film Festival. For standard Hollywood blockbusters see the Athens Grand on East State Street (near our cute little toy mall) and/or Movies 10 off Route 33 on the way to Nelsonville.

- **Athens City Pool** – Beat the summer heat in the months of June-August.

- **Dairy Barn Arts Center** – year-round art-related activities and exhibits. The Dairy Barn Arts Center, former working dairy barn for The Athens Lunatic Asylum is well-known outside of Athens.

The Dairy Barn near The Ridges

ohio.edu/people/cookt

- **The Elm Golf Course** – 3950 Ladd Ridge Road, Athens Ohio, public golf course. Decent quality, reasonable greens fees, and lightly played.

- The Athens **Farmer's Market** is held every Wednesday and Saturday on 1000 East State Street from 10 a.m. to 1 p.m., practically year-round. Called one of the nation's best by Audubon Magazine.

The Athens Farmer's Market

ohio.edu/people/cookt

- The Athens and OU **Music Scene** is perennially vibrant and healthy. The quality of local musicians and bands plus regional and national bands visiting Athens/OU is excellent, even when compared to larger cities.

- Athens provides many **Outdoor Recreation Activities**, including running, cycling, motorsports, hunting, water sports, and horseback riding. Field and Stream Magazine recently listed Athens County's Wayne National Forest as America's Best Public Deer Hunt. Other game includes wild turkey, squirrel, rabbit and birds.

- **The Ridges** – hiking, picnicking, ropes course (outdoor challenge course for leadership training and team building), miniature golf, softball, The Kennedy Museum.

- **Sell's Park** – hiking, picnicking, mountain biking.

- Athens has a 17,000 square foot **Skatepark** located on East State Street behind the Athens Community Center. One of the most innovative and challenging skate parks in the eastern U.S. Skateboard legend Tony Hawk filmed here not long after it opened.

- **Stroud's Run State Park** – hiking, camping, picnicking, boating rentals (canoes, kayaks, and water bikes), mountain biking, beach area, swimming.

4.3 Southeast Ohio Activities

- **Blue Moon Acres Trail Riding Adventures** – specialize in guided horse tours for couples and small groups, on all types of trails.

- **Burr Oak State Park**

- **Fast Traxx** – off Route 33 towards Nelsonville, a motocross track that dirt bike or quad rides can race.

- **Fox Lake Park**

- **Frogwood Lake** – fishing spot, named by a fifth grader in a competition to name the lake, Wayne National Forest, 13700 US Highway 33 Nelsonville, OH 45764.

- **Geocaching** – there are more than 80 geocaches in Athens County. They provide entertainment for anyone who enjoys being out in nature and is good because it has brought more business to Athens through tourists coming to geocache. The goal of geocaching is to find containers (called geocaches) that have been filled with small items and hidden at a set of longitude/latitude coordinates. Once you find a geocache you can take one of the items out of it and leave an item behind for someone else to discover.

- **Hiking** – There are many excellent places to hike around Athens, including the state parks (Stroud's Run, Lake Hope, Burr Oak, Hocking Hills), Wayne National Forest, Zaleski Backpack Trail, The Ridges (which used to be the Athens Lunatic Asylum), Sell's Park, and the bike path.

- **Hockhocking-Adena Bike Path** – runs over 20 miles one direction from East State Street in Athens to Rocky Boots in Nelsonville. This bike path is a rail-trail going around the campus of OU, through the campus of Hocking Tech, and through beautiful woods must of the way. No motor vehicles allowed.

- **Hocking Hills** – hiking, camping, biking, boating, climbing, picnicking, etc.
    - **Ash Cave**
    - **Cantwell Cliffs** is supposed to be one of the best places for scenic views in Hocking County, a region known for its natural beauties. Cantwell Cliffs is one of the best places to visit in Ohio and is one of six natural areas located at Hocking Hills State Park. Cantwell Cliffs is the farthest north of any of the sights, so it keeps many of the visitors away.
    - **Cedar Cave**
    - **Lake Logan** in Hocking Hills State Park covers 400 acres, 320 acres of which is dry land. The lake was created in 1955 for recreational purposes.
    - **Old Man's Cave**
    - **Rock House**

- **Lake Hope State Park**

- **Lake Snowden Park**

- **Moonville Tunnel Trail** – will extend from Red Diamond (near the Village of Zaleski), through the hills of Vinton County, and end in Athens, connecting to the Hockhocking Adena Bike Path.

- **Mountain Biking** – the Athens area has a city park (Sell's Park), two state parks (Stroud's Run and Lake Hope) and Wayne national forest that all have miles of trails for mountain biking. The terrain changes with each park ranging from tights and twisty in Stroud's Run to smooth and fast at Lake Hope.

- **North Pole Nelsonville**

- **Road Biking** – the Athens area is well-known for road biking with many miles of county roads. Watch out for dogs everywhere!

- **Rock Climbing and Bouldering** – Athens' rugged terrain contains many large rocks and jutting cliffs. With friends try Sell's Park and the Pepsi Rocks. Be very cautious!

- **Running** – there are paths and trails all over campus, hiking trails, The Ridges, and county roads.

- **Stuarts Opera House** in Nelsonville is one of the last remaining opera houses in Ohio and regularly hosts local, regional, and national musical acts.

- **Touch the Earth Adventures** – hiking, biking, and kayaking with lessons and tours for the public.

- **Tours** – Quilt Bar tour, Route 33 Audio Tour.

- **Watersports** – the Athens area has many opportunities such as canoeing on the Hocking river, canoeing and kayaking at Dow Lake (Stroud's Run State Park), Lake Snowden, Lake Hope, fishing from a pontoon boat in the lake at Burr Oak State Park, and boating on the Ohio River.

- **Wayne National Forest**

- **Ziplining**

4.4 Yearly Festivals

- **Appalachian Color in the Hills Festival**

- **Ark Fest** – held on Stewart Street backlots. Ark Fest was once canceled for a few years but has been brought back by some of the student population.

- **Congo Fest** – hosted along Congress Street.

- **Dad's Weekend** – a tradition most colleges participate in, where the fathers of students come up and visit their sons/daughters for the weekend, participating in all sorts of activities. This year Ohio University is hosting it on the 9th of November.

- **Elliot Fest** – huge parties on Elliot Street. An estimated 10,000 people attend.

- **Halloween in Athens** – its origins date back to 1974 when Athens had to close Court Street for the mass amount of people lining the road. Now, there are an estimated 30,000 people who attend this massive party.

- **Little Cities of Black Diamonds Day** – commemorates the coal mining industry in Southeast Ohio.

- **#Fest** – the number fest is one of the largest parties, aside from Halloween, where a lot of bands play outdoors. This is generally held near Athens in a farmer's field.

- **Oaktober Fest** – a large party hosted on Oak Street in October. An estimated 10,000 people attend this fest.

- **OU Homecoming Week** – many alumni return to Athens. The Marching 110 is one of the main draws in the annual Homecoming Parade, prior to the football game.

- **Smoked Meat and Barbecue Festival**

4.5 References

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ohio.edu/recreation

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5. Engineering History

5.1 History of Engineering and Technology

- **Engineering** has been around for a long time in human history and prehistory, with developments including the pulley, lever, and wheel.

- The first formal branch of engineering was **military engineering**. The term engineer literally means 'one who operates an engine', i.e. a war machine.

- **Engine** derives from the Latin **ingenium** meaning 'innate quality, mental power, clever invention'. In French, the word for 'engineer' literally means 'creator'.

- According to experiencefestival.com , "It is a myth that ***engineer*** originated to describe those who built engines. In fact, the words ***engine*** and ***engineer*** (as well as ***ingenious***) developed in parallel from the Latin root ***ingeniosus***, meaning 'skilled'. An engineer is thus a clever, practical, problem solver. The spelling of ***engineer*** was later influenced by back-formation from ***engine***. In some languages, such as Arabic, the word for '**engineering'** also means '**geometry'**".

- **Civil Engineering** became the second branch of engineering, focusing on civilian structures such as buildings, bridges, dams, etc. These are the targets for the military engineers.

- **Imhotep** was an early civil engineer in ancient Egypt, designing and supervising the Djoser Pyramid in 2600 BCE and using columns in architecture.

- **Archimedes** of ancient Greece was one of the first mechanical engineers, before the field formally existed (mechanical engineering arose with the Industrial Revolution in the nineteenth century). His inventions include epicyclic differential gearing, still in use today.

- **Chinese**, **Greek**, and **Roman** armies developed artillery, the trireme, the ballista, and the catapult. The trebuchet was developed for military purposes in the Middle Ages.

- **William Gilbert** is the father of **electrical engineering**, around **1600**, and he coined the term **electricity**.

- **Mechanical engineer Thomas Savery** built the first **steam engine** in **1698**, which enabled the **Industrial Revolution**, and the ensuing mass production and interchangeable manufacturing.

- **Engineering** arose as a profession in the **eighteenth century**.

- The **first engineering Ph.D.** in the U.S. was awarded to **William Gibbs** by **Yale** in **1863**.

- The **Wright Brothers** of Dayton Ohio achieved the first heavier-than-air powered flight in Kitty Hawk NC in **1903**. Then aeronautical engineering played a major role in WWI a decade later.

- The first **Internet search engine** was developed in **1990** by **Alan Emtage**, a computer engineer.

The Pyramids at Giza

The Great Wall of China

Seven Wonders of the Ancient World

1. The Great Pyramid of Giza
2. The Hanging Gardens of Babylon
3. The Statue of Zeus at Olympia
4. The Temple of Artemis at Ephesus
5. The Mausoleum at Halicarnassus
6. The Colossus of Rhodes
7. The Lighthouse of Alexandria

Wonders of the Modern World

1. The Channel Tunnel (Chunnel)
2. The Clock Tower (Big Ben) in London, England
3. The CN Tower in Toronto, Canada
4. Eiffel Tower in Paris, France
5. The Empire State Building in New York City, USA
6. The Gateway Arch in St. Louis, USA
7. The Golden Gate Bridge in San Francisco, USA
8. The High Dam in Aswan, Egypt
9. Hoover Dam in Arizona/Nevada, USA
10. Itaipú Dam in Brazil/Paraguay
11. Mount Rushmore National Memorial in South Dakota, USA
12. The Panama Canal
13. The Petronas Towers in Kuala Lumpur, Malaysia
14. The Statue of Cristo Redentor in Rio de Janeiro, Brazil
15. The Statue of Liberty in New York City, USA
16. The Suez Canal in Egypt
17. The Sydney Opera House in Australia

Forgotten Wonders of the World

1. Abu Simbel Temple in Egypt
2. Angkor Wat in Cambodia
3. The Aztec Temple in Tenochtitlan (Mexico City), Mexico
4. The Banaue Rice Terraces in the Philippines
5. Borobudur Temple in Indonesia
6. The Coliseum in Rome, Italy
7. The Great Wall of China
8. The Inca city of Machu Picchu, Peru
9. The Leaning Tower of Pisa, Italy
10. The Mayan Temples of Tikal in Northern Guatemala
11. The Moai Statues in Rapa Nui (Easter Island), Chile
12. Mont-Saint-Michel in Normandy, France
13. The Throne Hall of Persepolis in Iran
14. The Parthenon in Athens, Greece
15. Petra, the rock-carved city in Jordan
16. Roman Aqueducts
17. The Shwedagon Pagoda in Myanmar
18. Stonehenge in England
19. Taj Mahal in Agra, India
20. The Temple of the Inscriptions in Palenque, Mexico

5.2 Timeline of Major Technological Developments

- Humanoids could control fire around **1,000,000 BCE**.

- The **Ishango Bone** is a piece of a bone approximately **25,000** years old. It is the second oldest mathematical object in existence (the oldest is the **Lebombo Bone**, circa **35,000 BCE**, discovered in the 1970s in the Lebombo mountains between South Africa and Swaziland). The Ishango Bone is from the Upper Paleolithic Era, and it was found in 1960 in the Belgian Congo (at the present-day border of Uganda and Congo). The Ishango Bone is deliberately carved with notches and has a piece of quartz jammed into the top. The bone is interesting because it seems to count 4 things: 1. One row of notches signify a resemblance to 10 (10-1, 20-1, 20+1, 10+1). 2. All the prime numbers between 10 and 20 are notched in 2 rows. Additionally, both of these rows add up to 60 individually. 3. The final row hints at multiplication by two, grouping 3 with 6 notches together, 4 and 8, and 5 and 10. There are also an additional 7 notches with no apparent function or grouping. 4. The most interesting thing is that it also appears to count a 6 month lunar cycle. African women could very well have been the first mathematicians, tracking their menstrual cycles. It resembles calendar sticks still used by people in neighboring tribes of the region today.

- The first fishhook appeared in East Timor around **22,000 BCE**, allowing deeper fishing without spearing.

- The invention of the wheel was in **4000 BCE**.

- By **3500 BCE** Egyptian hieroglyphics were developed.

- The invention of the abacus, the first counting machine, was in **3000 BCE** in Babylon.

- The flush toilet and sewer system first appeared in India around **2600 BCE**.

- The wheelbarrow was invented in **407 BCE**.

- Archimedes' screw, a simple water pump, was developed in, **300 BCE**.

- The first canal lock was built in the ancient Suez Canal, **283 BCE**.

- The water wheel was invented in Greece in **280 BCE**.

- A Seismometer was made in the Han Dynasty of China, in **132 CE**.

- The English alphabet descends from the Roman Latin alphabet, developed around **500 CE**. The decimal Arabic numeral system also appeared around **500 CE**, including the symbol for zero and positional notation. Numerical zero was developed in ancient India.

- Porcelain was developed by the Tang Dynasty in China in the **600s**.

- Gunpowder was invented in **800s** China, ironically by alchemists trying to develop the elixir of immortality.

- Movable type was invented in the Song Dynasty of China in **1088**.

- A fuel choke for furnaces was developed in the Song Dynasty of China in **1100**.

- A mariner's compass was built in the Song Dynasty of China in **1119**.

- The land mine was developed in China, **1277**.

- Eyeglasses were first made in Italy, in **1286**.

- A floating crane was made in Rhineland, HRE, in the **1300s**.

- In **1450** Johannes Gutenberg invented the printing press based on screw presses. The printing press could easily reproduce images repeatedly, allowing books and documents to be printed to help disseminate and preserve them. This ability to reproduce books helped education because more people could own books to read and schools had more books to study from. This machine sped up the printing process exponentially so that it was much easier to spread news and knowledge.

Gutenberg Printing Press

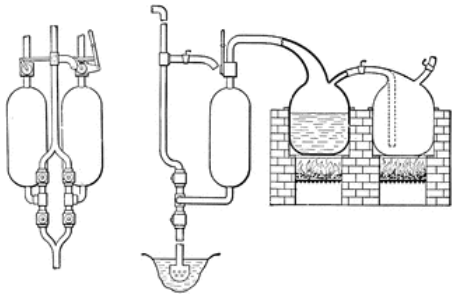
- A floating dock first appeared in **1560** in Venice.

- The first microscope was made by eyeglasses craftsmen in **1590** in the Netherlands.

- The first telescope appeared in **1608**. Various crafters can be credited with early microscopes and telescopes, but Hans Lippershey appears on both lists.

- In **1698** Englishman Thomas Savery invented the steam engine, for removing water from mines. Savery's invention paved the way for Englishmen Thomas Newcomen's and James Watt's later

steam engines, allowing the beginning of mechanized transportation and the industrial revolution. Watt is the namesake for the SI unit of power.

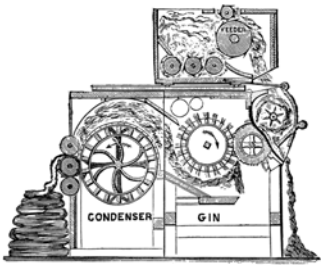


etc.usf.edu/clipart

- Daniel Fahrenheit invented the alcohol thermometer in **1709**.

- The first flight of a human being, in a hot-air balloon, was in **1783**.

- In **1794** Eli Whitney invented the cotton gin. Before the cotton gin all cotton seeds were pulled by hand, often times by slaves or indentured servants. The cotton gin separated the seeds, hulls, and other unwanted materials.



apushistory.yolasite.com

- Electromagnetic radiation, other than visible light, was first discovered in the **early 1800s**. Applications today are widespread in medicine, communications, science, engineering, and, unfortunately, nuclear weapons.

- In **1809**, Humphry Davy (English chemist) invented the first electric light.

- In **1814** Joseph Nicephore Niepce created the first photographic image with a camera obscura. Each image required eight hours of light exposure and later faded away. The first practical camera came in **1837**.

Camera Obscura

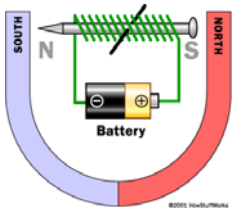
- In **1816** Scottish minister Robert Stirling invented the Stirling Engine, that has been a 4+ decades' effort of Sunpower Inc. of Athens Ohio, started by former OU ME faculty member William Beale in **1965**.

- The German draisine in **1817** was the hobby-horse precursor to the bicycle, named in France in the **1860s**. As seen in the right photograph below, today's basic bicycle design was already finished in **1886**, by the Swift Bicycle Company. In the **1930s** a recumbent bicycle dominated a certain bicycle race, so the International Bicycle Racing Commission responded by outlawing recumbents in racing, setting back bicycle designs by decades (all current bicycle land-speed record holders are recumbent bicycles).

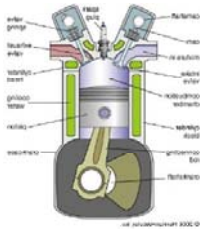
Draisine

1886 Swift Safety Bicycle

- In **1825**, William Sturgeon invented the electromagnet. Soon after it was used to create successful telegraph systems, allowing for better communication over distances. It is also used in many other common things such as electric motors, stereo speakers or MRI machines.



electronics.howstuffworks.com



barclayphysics.wikia.com

- The first sewing machine was invented by French tailor Barthelemy Thimonnier in **1830**. In **1834**, Walter Hunt made America's first sewing machine. Elias Howe patented the first lockstitch sewing machine in **1846**. Isaac Singer invented the up-and-down motion mechanism. In **1857**, James Gibbs patented the first chain-stitch single-thread sewing machine. Helen Augusta Blanchard patented the first zig-zag stitch machine in **1873**.

- In **1858** Etienne Lenoir invented an internal combustion engine that could be used in motor vehicles. This was a great advancement because it allowed for faster and more efficient travel. People could transport supplies and personal goods easily and it increased trade among companies, causing the economy to grow.

- In **1866**, Mahlon Loomis, an American dentist, successfully demonstrated "wireless telegraphy.

- In **1868**, printer John Wesley Hyatt developed Celluloid, the first U.S. plastic. Today the plastics industry is a multi-billion dollar industry.

- Julius Hock builds the first internal combustion engine that runs on liquid gasoline in **1870**.

- Elisha Gray and Alexander Graham Bell both independently designed devices that could transmit speech electrically (the telephone) in **1870**. It allowed news to travel faster and clearer than before and also allowed for easier communication between individual people over great distances. Many famous pioneers worked on the telephone such as Innocenzo Manzetti, Antonio Meucci, Johann Philipp Reis, Elisha Gray, Alexander Graham Bell, and Thomas Edison. Bell was the first to be awarded a patent for the electric telephone in **1876**. There has been controversy as to who should have credit for inventing the telephone so many lawsuits have been filed against telephone patents.

ralphcarlsonblog.com

- Before antibiotics were discovered in the **1870s** common bacterial-based illnesses could easily kill humans. In **1875** English scientist John Tyndall described the activities of fungi on bacteria. This information was used in **1928** by Alexander Fleming when he discovered that a fungus Penicillum had an antibiosis effect against bacteria. In 1948 Andrew Moyer patented the first method of industrial production for penicillin. Elmer Gaden, Father of Biochemical Engineering, enabled the large-scale manufacture of antibiotics such as penicillin, and was awarded the Russ Prize in Bioengineering for this in **2009**.

- Electricity has been known for centuries. The harnessing of electricity was in the **early 1800s** and the golden age of electrical engineering was in the **late 1800s**. The English word electricity comes from the Latin for ‘amber’ since early experiments involved rubbing amber for static electricity.

- The first working phonograph was invented in **1877** by Thomas Edison.

- Nikolaus Otto invented a four-stroke internal combustion engine in **1877**.

- In **1879** Thomas Edison developed the carbon fiber filament that created the modern light bulb. Edison made the filament out of carbon allowing it to burn for a much longer amount of time. In **1878**, English physicist Joseph Wilson Swan developed a long-lasting electric light bulb, 14

hours. Edison's carbon filament lasted for forty hours. Edison and his team had hundreds of failures before succeeding!

didyouknow.org

- In **1884**, Paul Nipkow sent images over wires using a rotating metal disk technology with 18 lines of resolution. Television then evolved along two paths, mechanical based on Nipkow's rotating disks, and electronic based on the cathode ray tube. American Charles Jenkins and Scotsman John Baird followed the mechanical model while Philo Farnsworth, working independently in San Francisco, and Russian émigré Vladimir Zworkin, working for Westinghouse and later RCA, advanced the electronic model. Which path won?

- Gottlieb Daimler invented the first supercharger in **1885**.

- The world's first practical automobile was designed and produced in **1885** by Karl Benz. This car was the first to use an internal combustion engine. This paved the way for the practical automobile.

Benz Automobile

Ford Model T

- Henry Ford builds his first automobile in Michigan in **1886**. The Ford Model-T was the first affordable, mass-produced car that enabled travel by the middle class in America, in **1908**. Ford's main innovation is the assembly line for rapid and standardized, interchangeable manufacturing.

- Arguably the greatest electrical engineer of all time, Nikola Tesla's inventions include fluorescent lighting in the **1890s**, the Tesla coil, the induction motor in **1888**, and 3-phase electricity. He developed the AC-current generation system comprised of a motor and a transformer.

- Acetylsalicylic acid (aspirin) was developed by Felix Hoffmann in **1897**.

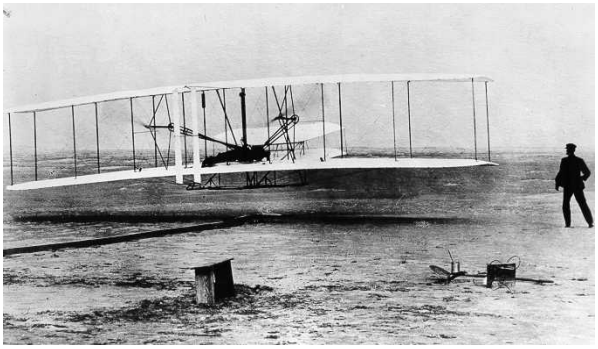
- Ferdinand Porsche introduces the first hybrid gasoline/electric vehicle, in **1899**.

- In **1900** the creation of the dispensable and portable Kodak Brownie Camera enabled everyone to take pictures.

- In **1900**, the telescope shock absorber, was developed, consisting of a piston and a cylinder. A one-way valve allows liquid or air to move freely in one direction but stops flow in the opposite direction. This method is still in use today's bicycle shocks and automotive hydraulic suspensions.

- In **1901**, Samuel Pierpont Langley builds a gasoline-powered version of his tandem-winged "Aerodromes." the first successful flying model to be propelled by an internal combustion engine. As early as 1896 he launches steam-propelled models with wingspans of up to 15 feet on flights of more than half a mile. Langley was the best professor of the day, heavily funded by the U.S. government to fly a human for the first time. Langley finally gave up in frustration, saying humans would not fly for more than ten years into the future, and only then with massive federal investment.

- Then in **1903**, two uneducated, unfunded, bicycle builders from Dayton Ohio, Orville and Wilbur Wright, achieved the first powered heavier-than-air flight.



- A new steam turbine generator requiring one tenth the space, weighing one eighth, and producing much more power than the original was created in **1903**.

- The electric clothes washing machine was invented in **1907**.

- The first solar energy collector, **1908**, used copper coils and an insulated box.

- The first commercially successful electric toaster was produced in **1910**, with a single heating element with no dials or sensors. The toast had to be flipped by hand.

- Rene Lorin invents the ramjet in **1913**.

- Leonard Dryer invents what is now known as the Crower Six-Stroke engine in **1915**.

- In **1920** Boston Edison's Edgar Station was the first high-pressure steam power plant to produce 1kw/h of electricity per 1 lb of coal. This was 5x – 10x more efficient than its predecessor. This technique worked by operating a turbine with 1200 psi steam pressure.

- In **1921** lead was added to gasoline to eliminate engine knock.

- In **1923** hearing aids are invented.

- The transistor, a semiconductor device that enabled the computer revolution, was first developed in **1925** by Julius Edgar Lilienfeld.

- In **1934** Leó Szilárd patented the concept of a nuclear chain reaction. The Manhattan Project culminates in **1945** with the dropping of atomic bombs Little Boy and Fat Boy over Hiroshima and Nagasaki Japan, respectively.

- The first aircraft to fly with a jet engine is in **1939**.

- Russian émigré Igor Sikorsky developed the VS-300 helicopter for the U.S. Army in **1939**, the first practical single-rotor helicopters.

- Metallurgists developed nickel-based superalloys in the **1940s** that are extremely resistant to high pressure, temperature, and other stresses. Chromium, titanium, and aluminum have made jet engines and other developments possible.

- The first launch of a ballistic missile was in **1942**.

- U.S. Air Force pilot Captain Charles "Chuck" Yeager becomes the fastest man alive when he pilots the Bell X-1 faster than sound for the first time in **1947** over the town of Victorville, California.

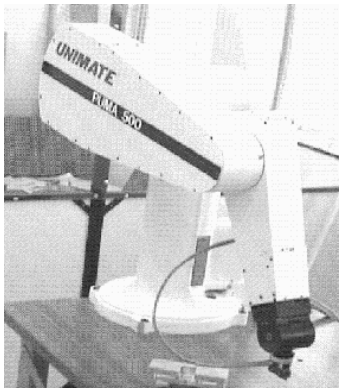
- Nuclear power is first used to power houses in Idaho in **1951**.

- The first commercially-successful general-purpose computer is made in **1953**.

- The first color television system began commercial broadcasting in **1953**.

- The first artificial satellite, Sputnik, was launched by the USSR in **1957**.

- Joseph Engleberger and George Devoe were the fathers of industrial robots. Their company, Unimation, built the first industrial robot, the PUMA (Programmable Universal Manipulator Arm, a later version shown below), in **1961**.



PUMA Industrial Robot

- The first personal computer (PC) was released in **1965** and was called the Programma 101. It was produced by an Italian Manufacturer Olivetti. At the time this computer was only capable of calculating the four basic arithmetic functions and it cost $3,200. This is $23,360 in 2012 currency!

- In **1966** the first electronic fuel injection system carefully delivers controlled amounts of air and fuel to an engine in order to operate at maximum efficiency. It was developed in England.

- ARPAnet opened and the Internet began in **1969**.

- The personal computer appeared in the **1970s**, mostly for business use. Steve Wozniak and Steve Jobs of Apple Computers were credited with creating the first computer for home use. This allowed documents to be digitalized and stored as well as opening the door for numerous other things such as the Internet. Soon after Bill Gates started stealing their best ideas and the rest is history!

- The first CD ROM appeared in **1985**.

engadget.com

- The World Wide Web, HTML to create web pages, http, and URLs are introduced in **1989**.

- In the **1990s** regenerative braking used to resupply hybrid vehicle motors.

- Boeing debuts the twin-engine 777 in **1995**, the biggest two-engine jet ever to fly and the first aircraft produced through computer-aided design and engineering. Only a nose mockup was actually built before the vehicle was assembled—and the assembly was only 0.03 mm out of alignment when a wing was attached.

- The first Smartphone, the iPhone, is created in **2007**.

A cautionary tale from the real world:

Actual conversations from a Learning Community lunch at Casa Nueva, 10/8/2013:

Dr. Bob (seeing 3 male students clicking on their smart phones instead of interacting with humans): "I guess it's not just the ladies who like their smart phones."
Male student (whose smart phone is on the table but currently inert): "Yeah, it's an epidemic."

Female student: "It is amazing that each of us carries more computing power in our phones than NASA used to get to the moon . . ."
Dr. Bob (interrupting): "Yeah, that's cool!"
Female student: "No, I meant to say, it is amazing that each of us carries more computing power in our phones than NASA used to get to the moon and we do so little with it."

The U.S. National Academy of Engineering published the following list of the most important technological developments of the twentieth century (greatachievements.org):

1. Electrification
2. Automobile
3. Airplane
4. Water supply and Distribution
5. Electronics
6. Radio and Television
7. Mechanized agriculture
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household appliances
16. Health Technologies
17. Petroleum and Petrochemical Technologies
18. Laser and Fiber Optics
19. Nuclear technologies
20. Materials science

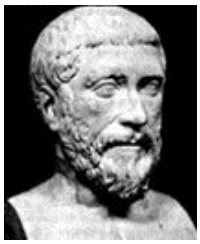
Not on the list is mass production and standard interchangeable manufacturing, which contributed to many of the technologies above.

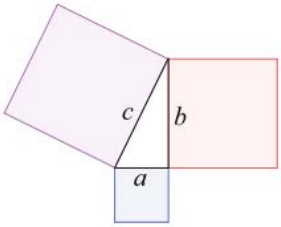
The following is a list that may turn out to be part of the most important technological developments in the twenty-first century:

1. NASA Mars Exploration Rovers
2. Broadband Internet access
3. Biotechnology
4. quantum computers
5. nanotechnology
6. bioengineering,
7. nuclear fusion
8. advanced materials (e.g., graphene),
9. scramjet (along with railguns and high-energy beams for military uses)
10. superconductivity
11. memristor
12. green technologies such as alternative fuels (e.g., fuel cells, plugin hybrid cars)
13. more efficient LEDs, solar cells and integrated circuits.
14. particle physics
15. quantum gravity: M-theory, superstring theory, and loop quantum gravity
16. Orion Spacecraft
17. James Webb Space Telescope
18. International Space Station
19. manned mission to Mars
20. Variable Specific Impulse Magnetoplasma Rocket (VASIMR)

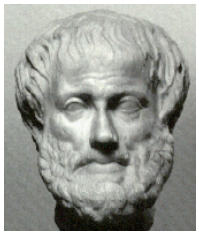
5.3 Famous Names in Mathematics, Science, Medicine, and Engineering

Pythagoras (570–495 BCE) was an Ionian Greek philosopher and mathematician. He developed the Pythagorean Theorem which states that in a right triangle, the length of the hypotenuse squared is equal to the sum of the squares of the other two side lengths, $c^2 = a^2 + b^2$. He may have been the first person to call himself a philosopher (lover of wisdom).

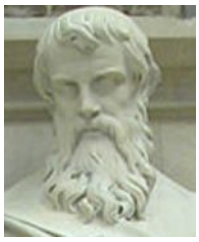




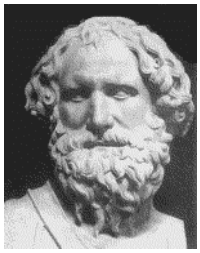
Aristotle (384–322 BCE), Greek, is the Father of Kinesiology. His treatises, *Parts of Animals*, *Movement of Animals*, and *Progression of Animals*, described the actions and geometric analysis of muscles for the first time. He first analyzed and described walking. Further, he presented a precursor of Newton's three laws of motion.



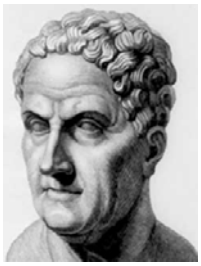
Euclid (325–265 BCE) was a Greek mathematician in Alexandria Egypt and is known as the 'Father of Geometry'. He was the first to prove that there are infinitely many prime numbers, he stated and proved the unique factorization theorem, and he devised *Euclid's algorithm* for computing the greatest common divisor (gcd). He introduced the Mersenne primes and the concept of axioms. The length of a vector is known as the Euclidean norm.



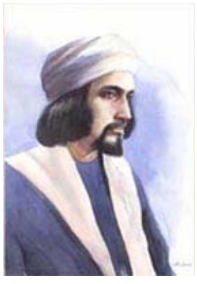
Archimedes (287–212 BCE) is acknowledged to be the greatest of ancient mathematicians. He derived formulae for the volume and surface area of a sphere, and may have been first to prove the relationship between a circle's circumference and area. π is often called Archimedes' constant. His buoyancy principle states that an object will float if the weight of liquid displaced by its submerged volume is greater that the weight of the object. Archimedes anticipated integral calculus, including determining the centers of mass of a hemisphere and cylindrical wedge, and the volume of two intersecting cylinders.



Galen (131–201), Roman, is the first team physician in history (gladiators). His treatise *De Motu Musculorum* distinguished between motor and sensory nerves, agonist and antagonist muscles, described tonus, and introduced terms such as diarthrosis and synarthrosis. He thought muscular contraction resulted from the passage of 'animal spirits' from the brain through the nerves to the muscles. His treatise is the first textbook on kinesiology and he is the Father of Sports Medicine.



Badi'al-Zaman Abū al-'Izz ibn Ismā'īl ibn al-Razāz al-Jazarī (1136–1206) was a Kurdish scholar, inventor, mechanical engineer, craftsman, artist, and mathematician from the Islamic Golden Age. He invented many different mechanisms, water-raising machines, automata, and clocks (such as the Elephant Clock). He wrote "The Book of Knowledge of Ingenious Mechanical Devices" in **1206**.

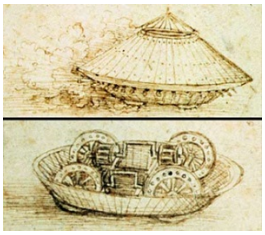


The Elephant Clock

en.wikipedia.org

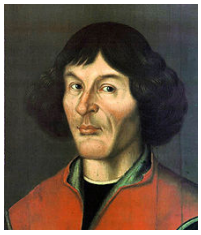
Leonardo da Vinci (1452–1519) was a true Renaissance man: painter, sculptor, architect, musician, scientist, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist, and author. As an engineer, he developed concepts ahead of his time. He kept notes of designs for flying machines, instruments of war, solar power, a calculator, an early theory of plate tectonics, and the double hull for ships, among many other concepts. He designed mechanical devices for manufacturing, war,

transportation, and mapped out the human body's internal organs, muscles and bones more thoroughly than anyone before him. Swiss bridge builders use the same methods from da Vinci's notebooks to build arched wooden bridges. He advanced knowledge in anatomy, astronomy, civil engineering, optics, and hydrodynamics. His last commissioned work was a mechanical lion that could walk and open its chest to reveal a bouquet of lilies. Leonardo's last name is not da Vinci – this simply means 'of Vinci', i.e. he was born in this village of the Tuscany region of present-day Italy.

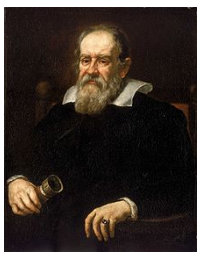




history-computer.com

Nicolas Copernicus (1473–1543) was a Renaissance astronomer and the first person to formulate a sun-centered solar system, which displaced the Earth as the center of the universe, much to the displeasure of the Catholic Church.



Galileo (1564–1642) was an Italian physicist, mathematician, astronomer, and philosopher who was important in the Scientific Revolution. He proved that the trajectory of a projectile through a non-resistant medium is a parabola. His work led to the study of mechanical events in mathematical terms. He became known for his treatise on the center of gravity of solid bodies. His conclusions were contradictory to the prevalent belief system and foreshadowed Newton's laws of motion. His achievements include improvements to the telescope and consequent astronomical observations and support for Copernicanism. Galileo has been called the 'father of modern observational astronomy'. He was tried by the Inquisition, found suspect of heresy, forced to recant, and spent the rest of his life under house arrest. During this house arrest Galileo wrote a book on kinematics and strength of materials.



Johannes Kepler (1571-1630) compiled Mars data which helped him propose the Three Laws of Planetary Motion.

William Harvey (1578–1657), English, first demonstrated blood circulation through the body, although he attributed to the heart the function of recharging the blood with heat and 'vital spirit'.

Rene Descartes (1596–1650) is the father of analytic geometry. He developed the Cartesian coordinate plane. Please note Cartesian is capitalized, since it is named for him. Descartes was the first to use superscripts for exponents in mathematics. He paved the way for the development of calculus. He was the first to use algebra to describe geometry. He identified the laws of reflection and refraction.

Francesco Maria Grimaldi (1618–1663), Italian Jesuit, was the first to hear sounds made by contracting muscles. *Physicomathesis de Lumine, Coloribus, et Iride, Aliisque Annexis*, was written 300 years before technology was available for studying these sounds.

Blaise Pascal (1623–1662) is the creator of Pascal's triangle (a partial one is shown below). He developed into a mathematics genius by age 12, created the first calculator by age 19, and he also created the barometer and syringe.

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1

Sir Isaac Newton (1642–1727) invented calculus, and discovered the mathematical laws of gravity. He laid the foundation of modern dynamics in *Principia Mathematica Philosophiae Naturalis*, with his three laws of rest and movement. He developed these three universal laws of motion in **1687**, and they are still in widespread use in mechanical engineering today:

Newton's First Law

An object at rest tends to stay at rest and an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an unbalanced external force.

Newton's Second Law

The acceleration *a* of an object as produced by a net force *F* is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass *m* of the object; $F = ma$ (assuming constant mass).

Newton's Third Law

For every action, there is an equal and opposite reaction.

Niels Stensen (1648–1686), Danish, made the then-sensational declaration that the heart was merely a muscle, not the seat of 'natural warmth' nor of 'vital spirit'. He wrote *Elementorum Myologiae Specimum*, an 'epoch-making' book on muscular function. He asserted that a muscle is a collection of motor fibers; that the center of a muscle differs from the ends (tendons) and is the only part that contracts. Contraction of a muscle is merely the shortening of its individual fibers and is not produced by an increase or loss of substance.

Nicolas Andry (1658–1742), French, coined ‘orthopedics’ from the Greek ‘orthos’ (straight) and ‘pais’ (child). Andry believed skeletal deformities result from childhood muscular imbalances.

Leonhard Euler (1707-1783) is considered the king of mathematics. He is credited with introducing mathematical notation and the concept of a function written as $f(x)$. The e for the base of the natural logarithm stands for the Euler constant.

Amedeo Avogadro (1776–1856) was an Italian scientist who first proposed that the volume of a gas at a given pressure and temperature is proportional to the number of atoms or molecules. Avogadro's Number was named in his honor in 1909. This is the number of particles (atoms or molecules) in a mole of a substance. Avogadro's Number is 6.02214×10^{23} particles/mol.

Carl Frederick Gauss (1777–1855), the ‘Prince of Mathematics’, published *Disquisitiones Arithmeticae*, possibly the greatest pure mathematics book, at age 24. Gauss developed the theory of complex numbers into its modern form, including the notion of "monogenic" functions which are now ubiquitous in mathematical physics. He made significant contributions to the field of statistics.

Georg Simon Ohm (1789–1854) developed the well-known Ohm's Law for resistors in electrical circuits, $V = iR$ (i.e. the voltage V across a resistor is proportional to the current i and the proportionality constant is the resistance R). The SI unit of electrical resistance was named after him.

Michael Faraday (1791–1867) discovered induction (electricity can be created by moving a magnet through a wire coil). He developed the first electric motor, built the first generator and transformer, and introduced the terms ion, electrode, cathode, anode. The SI unit of capacitance was named for him (the Farad). He was the first person to come up with theories that reflect the modern theory of the electromagnetic field. Faraday developed the laws of electrolysis and the relationships between light and magnetism.

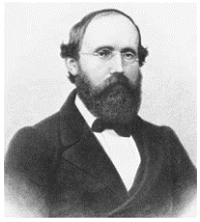
Samuel Colt (1814–1862) was an industrialist and firearms designer who patented one of the first mass-produced revolvers. He also produced waterproof wiring. Considered to be one of the founders of firearms engineering, Colt made several simple but crucial leaps in the evolution of firearms. The company he founded is still in business today.

James Prescott Joule (1818–1889) was a physicist and brewer who developed Kinetic Theory. The SI unit of work or energy is named after him. He was the first to derive the heat in a resistor resulting from current flow, in **1840**, and the first to observe magnetostriction. Joule also developed the conservation of energy principle.

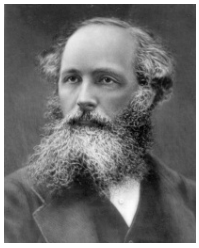
Louis Pasteur (1822–1895) discovered in **1854** that bacteria caused things such as wine, beer or milk to sour and that the bacteria can be killed through a process of heating and cooling, known today as pasteurization. He also made contributions in medicine such as the vaccines for rabies, anthrax, cholera, and smallpox.

Lord Kelvin (**William Thompson**, 1822–1907) invented the Kelvin temperature scale, based on absolute zero, in **1848**. He also contributed to a transatlantic telegraph cable that soon broadened to submarine communication. He also headed an international commission for the design of the Niagara Falls power station.

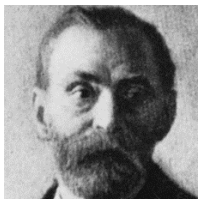
Bernhard Riemann (1826–1866) was a German mathematician who introduced Riemann integrals, Riemann surfaces, and Riemann geometry. Riemann's other works include differential geometry, tensor analysis, the theory of functions, and the theory of manifolds. He generalized the notions of distance and curvature and, therefore, described new possibilities for the geometry of space itself. Several important theorems and concepts are named after Riemann, e.g. the Riemann-Roch theorem, a key connection among topology, complex analysis and algebraic geometry. His work paved the way for later development of Relativity.



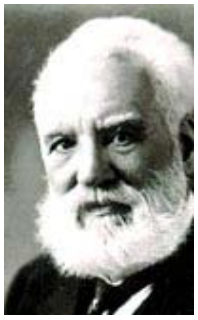
James Clerk Maxwell (1831–1879) is the father of modern physics. In **1865** he published the first book about electromagnetism, showing the relation and movement between electric and magnetic charges in nature.



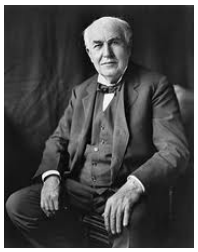
Alfred Nobel (1833–1896) vowed to create a safer explosive after his younger brother was killed experimenting with unstable explosives. In **1867** he created and patented a mixture of nitroglycerin and an absorbent substance now known as dynamite. Feeling guilty about the destructive potential of his invention, Nobel set aside a bulk of his estate to establish the Nobel Prize to honor men and women for outstanding constructive achievements in physics, chemistry, medicine and literature.



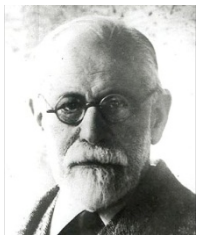
Alexander Graham Bell (1847–1922) invented the telephone in **1876**. He also worked in medical research and invented techniques for teaching speech to the deaf. In **1888** he founded the National Geographic Society.



Thomas Edison (1847–1931) patented 1,093 inventions in his lifetime. Besides his famous light bulb innovation in **1879**, Edison developed the phonograph and the kinetoscope, a small box for viewing moving films. He also improved upon the original design of the stock ticker, the telegraph, and Alexander Graham Bell's telephone.



Sigmund Freud (1856–1939) made significant psychological advances working with the unconscious mind. He believed dreams were key to the subconscious mind.



Nikola Tesla (1856–1943) emigrated to the U.S. from present-day Croatia to work for Thomas Edison. Arguably the greatest electrical engineer in history, his inventions include fluorescent lighting in the **1890s**, the Tesla coil (used in the first Niagara Falls hydroelectric plant), the induction motor in **1888**, and 3-phase electricity. His patents and theoretical work paved the way for the development of radio. He developed the AC-current generation system comprised of a motor and a transformer. Tesla accidentally captured one of the earliest known X-rays in **1894**. Despite making fortunes from his patents, he died penniless due to the expense of various experiments. Tesla fell into obscurity until the **1990s** when his reputation was resurrected.

Heinrich Hertz (1857–1894) confirmed in **1887** Maxwell's theories about the existence of electromagnetic radiation, proving that electricity can be transmitted in electromagnetic waves. Hertz accidentally discovered the photoelectric effect in which light falling on special surfaces can generate electricity. The SI unit of frequency is named after him (Hz = cycles/second).

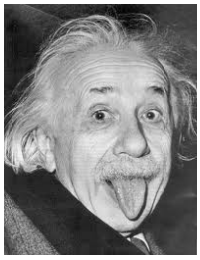
Rudolf Diesel (1858-1913) used his understanding of thermodynamics and theoretical plus practical fuel efficiency constraints of to create a more efficient motor, the diesel engine.

Daniel Hale Williams (1858–1931) was the first African-American cardiologist. In **1893** he performed the first successful open-heart surgery in the U.S., on a knife-wound patient.

Marie Skłodowska-Curie (1867–1934) was a French-Polish physicist and chemist, famous for her pioneering research on radioactivity. The unit of radioactivity is named for her.

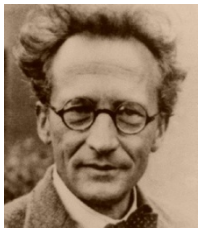
Elliot P. Joslin (1869-1962) was the first U.S. doctor to specialize in diabetes. He developed the Diabetes Self-Management Education approach in **1918** which is now used throughout the world.

Albert Einstein (1879–1955) earned his doctorate in physics in **1905** and published four influential research papers, including the Special Theory of Relativity ($e = mc^2$), the same year. In **1915**, Einstein completed the General Theory of Relativity and in **1921** he was awarded the Nobel Prize in Physics. His discoveries led to the atom bomb. An engineer as much as a scientist!



Niels Bohr (1885–1962) was a Danish physicist who made foundational contributions to understanding atomic structure and quantum mechanics, for which he received the Nobel Prize in Physics in **1922**.

Erwin Schrödinger (1887–1961) took the Bohr atom to the next level. He used mathematical equations to predict the odds of electron placement. This model introduced Schrödinger's wave in **1926**, the mathematical equation of wave mechanics which explained how the quantum state of a physical system changes in time. He is famous for the Schrödinger's cat thought experiment in quantum physics.



Beulah Louise Henry (1887–1973) was known in the 1920s and 30s as 'the lady Edison' for the many inventions she patented, including a vacuum ice cream freezer, a typewriter that made multiple copies without carbon paper, and a bobbinless lockstitch sewing machine. Henry founded manufacturing companies to produce her creations, making a fortune in the process.

Edwin Howard Armstrong (1890–1954) invented wide-band frequency modulation, i.e. FM radio, in **1933**.

Charles Lindbergh (1902–1974) made the first solo transatlantic airplane flight in 1927, from the Long Island NY to Paris France.

Charles Richard Drew (1904–1950) developed ways to process and store blood plasma in blood banks in 1938, and applied this to large blood banks in WWII.

Philo T. Farnsworth (1906–1971) was inventor of the Television.

Jonas Edward Salk (1914–1995) was an American virologist, best known for his development of the first polio vaccine in **1955**.

Richard Phillips Feynman (1918–1988) was an American theoretical physicist known for quantum mechanics, quantum electrodynamics, superfluidity, and particle physics. He received the Nobel Prize in Physics in **1965** for quantum electrodynamics. He contributed to the atomic bomb development and was a member of the panel that investigated the Space Shuttle Challenger disaster. Feynman also pioneered the field of quantum computing and nanotechnology. He was known to be a popularizer of physics through both books and lectures.

Neil Armstrong (1930–2012) became the first man to set foot on the moon, in **1969**. He had degrees in aeronautical and aerospace engineering. Despite his fame he remained a nerdy engineer and retired to his family farm in west-central Ohio, near Wapakoneta.

Stephen Hawking (b. 1942) is known for furthering Einstein's theory of general relativity with quantum theory. At 21 Hawking was diagnosed with Amyotrophic Lateral Sclerosis (ALS). Despite this debilitating illness, he has accomplished innovative research in physics and strives to make science accessible to everyone. Hawking said "My goal is simple. It is a complete understanding of the universe, why it is as it is and why it exists at all".

Bonnie Dunbar (b. 1949) was a NASA astronaut who earned her BS and MS degrees in ceramic engineering and doctorate in mechanical/biomedical engineering. While working at Rockwell International, Dr. Dunbar helped to develop the ceramic tiles that enable space shuttles to survive re-entry. She has had an opportunity to test those tiles first hand as a five-time astronaut, including a stint on the first shuttle mission to dock with the Russian Space Station Mir.

Steve Wozniak (b. 1950) is a computer engineer who founded Apple Computer in **1976** along with Steve Jobs and Ronald Wayne. Wozniak is given credit for single-handedly creating the Apple 1 and Apple 2 computer. The Apple 2 was first computer with colored graphics. Wozniak left Apple in 1987 and he founded CL9, the company that created the universal remote.

Bill Nye (b. 1955) earned a mechanical engineering degree from Cornell University. He worked for Boeing before becoming the 'science guy'.

Ampere

Boyle

Isambard Kingdom Brunel

Franklin

Galvani

Heaviside

Werner Heisenberg

Otto

Max Planck

Prandtl

Reynolds

Steinmetz

Leo Szilard

Volta

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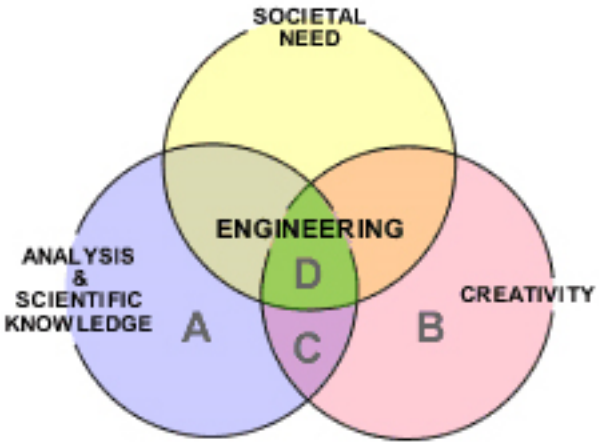
6. Engineering



Venn diagram: the relationship of engineering to societal need, scientific knowledge, analysis and creativity

Engineering Definition

Engineering is the science, skill, and profession of acquiring and applying scientific, economic, social, and practical knowledge, in order to design and also build structures, machines, devices, systems, materials and processes.

Engineering is the study of innovation and the application of technology to make life easier. This may consist of research for new energy sources, development of more efficient machines, or even finding the cure for cancer. These are just a few of the topics engineers work on. An engineer applies math, chemistry, physics, and how all of these tie together to create or discover something that can change the world. Thus, engineering is a profession that a nation depends on, and it is about time we get the respect normally due to the medical and legal professions.

Engineering definition by the American Engineer's Council for Professional Development: "The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation or safety to life and property."

en.wikipedia.org/wiki/Engineering

Some Cool Engineering Quotes

"Scientists study the world as it is; engineers create the world that never has been."
– scientist and engineer Theodore von Karman

"To the **engineer** falls the job of clothing the bare bones of science with life, comfort, and hope."
– Herbert Hoover

"Science no longer paves the way for **engineering**; usually it's the other way around. It is the final triumph of Edison over Einstein."
– Don E. Kash

(n.b. Engineering has ALWAYS paved the way for science: The steam engine preceded the development of the science of thermodynamics, and the Wright Brothers heavier-than-air flying machine preceded the development of the science of aerodynamics. – Dr. Bob)

"Engineering is the art of modeling materials we do not wholly understand, into shapes we cannot precisely analyze so as to withstand forces we cannot properly assess, in such a way that the public has no reason to suspect the extent of our ignorance."
– Dr. E. H. Brown

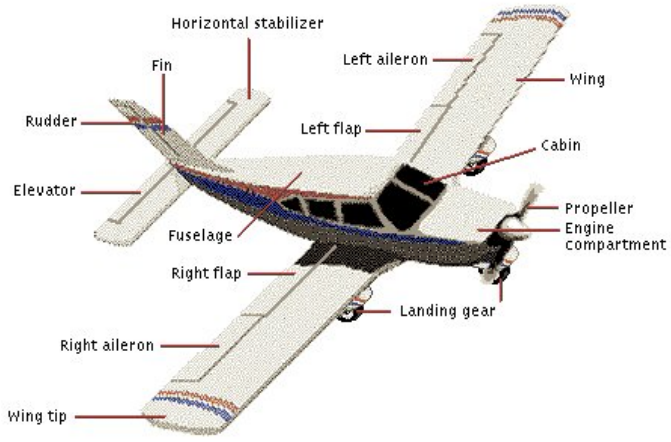
"When Young Rossum took a look at human anatomy he saw immediately that it was too complex and that a good **engineer** could simplify it. So he undertook to redesign anatomy, experimenting with what would lend itself to omission or simplification."
– Karel Capek, R.U.R. (Rossum's Universal Robots), 1920

6.1 Branches of Engineering

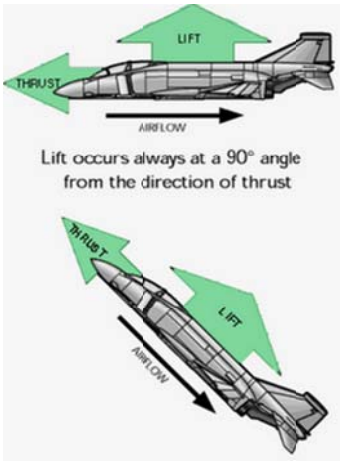
Aerospace Engineering

Aerospace Engineering
Aeronautics / Astronautics

An **Aerospace Engineer** deals with the design, construction, and study of the forces and physical properties of aircraft, rockets, flying craft, and spacecraft. This field of engineering looks at the aerodynamics of objects and deals with airfoils, lift, drag and things like that. Aerospace engineers design and develop some of the world's most marvelous machines. Commercial airplanes, military fighter jets, and space telescopes are all products of aerospace engineers. Aerospace technology also has earthbound applications, such as aiding in the design of race cars and golf balls.

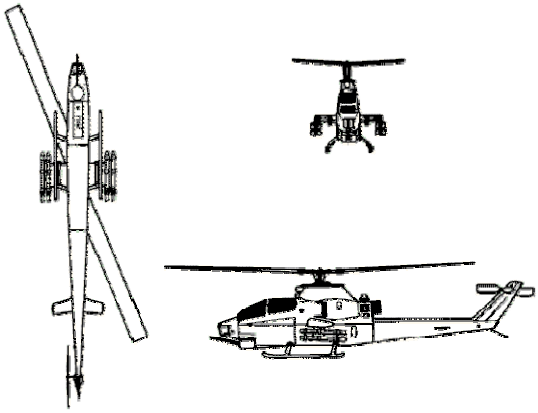


mitianaeronauts.blogspot.com



web.mit.edu/cheme/research/areas/systems

Aeronautical engineering is the branch of engineering that deals with designing and construction of aircraft. It is the study of how things fly and how to build aircraft and missiles. Aeronautical engineering involves research and development, testing, assembly, and maintenance of aircraft and missiles. The average starting salary of an aeronautical engineer is $54,000 about the average salary for the field is about $114,000. Some examples of aeronautical engineer's work are the F-15 fighter jet, the B-52 Bomber, and the AH-1 Helicopter.



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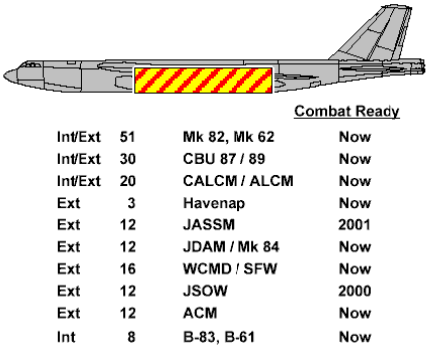
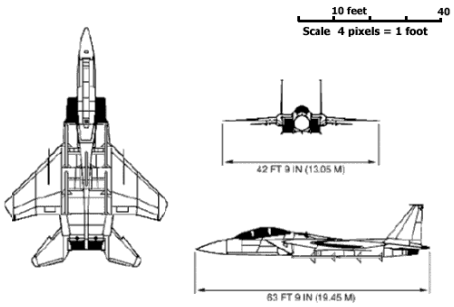


B-52 Bomber



F-15

fas.org/man/dod-101/sys/ac

Pratt & Whitney F100 turbofan engine for F-15 Eagle and F-16 Falcon
newworldencyclopedia.org/entry/Aerospace_engineering

Artist's depiction of the space shuttle
ehow.com/about_5485290_qualifications-aeronautical-engineer

Agricultural Engineering

Agricultural engineers design farm and food processing equipment, construct crop storage and livestock buildings, and develop systems for drainage, irrigation, and waste disposal. Sometimes agricultural engineers work in labs like EPCOT's Land Pavilion, where they experiment with promising indoor farming techniques such as hydroponics-the science of growing plants in fluids without dirt.

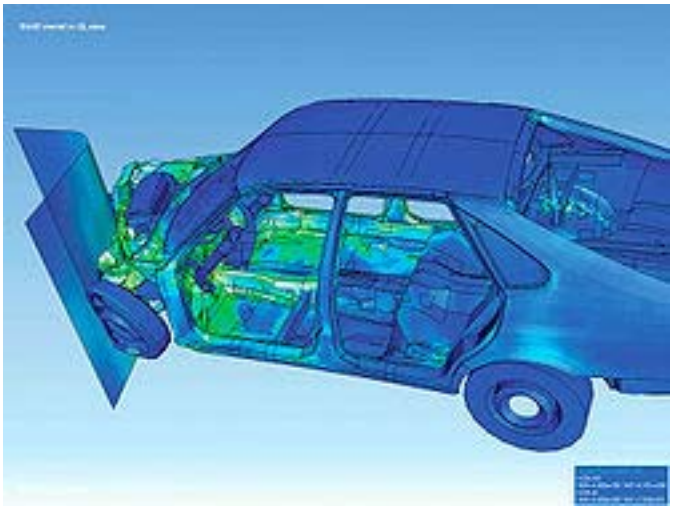
Architectural Engineering

Working alongside architects, **architectural engineers** focus on the safety, cost, and construction methods of designing a building. For example, as the United States population grows in the Southwest, more and more architectural engineers are investigating new ways to build on land where there is only sand and sagebrush.

Burj Khalifa in Dubai – tallest building in the world
828 m (2,717 ft) and 160 stories

Automotive Engineering

Automotive engineers apply other engineering fields to design and manufacture motorcycles, automobiles, buses and trucks. Automotive engineering incorporates elements of mechanical, electrical, electronic, software and safety engineering. **Product engineering** within automotive engineering focuses on the important factors in designing and manufacturing a car. This includes fuel economy, safety engineering, performance and durability. A **development engineer** is responsible for coordinating the delivery of attributes mandated by the manufacturer or government. All the different branches of automotive engineering all coordinate with one and another so the automobile comes together as one system.

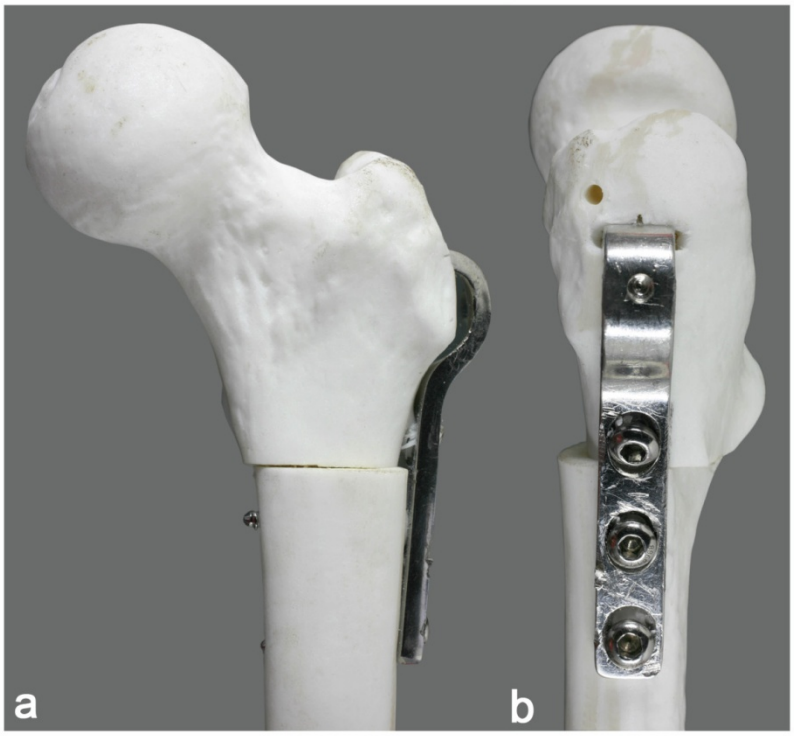


At the university level, Automotive Engineering originated in the 1970s at Minnesota State University, in their Industrial Technology program.

Biomedical Engineering

Biomedical engineering is the combined use of mechanical, chemical, and electrical engineering principals and biological knowledge to better understand how these areas intersect and how they can be used together to improve human quality of life. Research in BME is both experimental and theoretical, traversing many domains: biodesign, biofluidics, molecular/cell/tissue mechanics, movement biomechanics, biorobotics, mechanobiology, orthopaedic biomechanics, cardiovascular biomechanics, and mechanics of hearing and vision.

Biomechanics is a field of engineering that studies the mechanics of how humans run, walk, sit, stand, and also how joints move and apply that to design safety equipment, comfortable products and enhance human performance. Some of the products they design are car seats, shoes, backpacks and clothing.



biomedical-engineering-online.com

Biomedical engineers need an understanding of biology and medicine along with their engineering skills. They design and build anything from medical diagnostics machines to medical instruments to prosthetics.

Biomimetics is a branch of biomechanical engineering that looks to find structures and functions in nature that can be applied to engineering of machines and materials.

Ceramics and Materials Engineering

These engineers create better or new products that are useful to everyday life. This field uses a lot of creativity along with practical thinking and efficiency.

sweetandnerdy.com


rainydaymagazine.com

Chemical Engineers

Chemical engineering is The branch of engineering that deals with chemical production, and the technology and manufacture of products used in chemical processes.

Chemical engineers deal with design, construction, and operation of machines and plants that perform chemical reactions to solve practical problems or make useful products. Chemical engineers use math, physics, and economics to solve technical problems. Chemical Engineering is the branch of engineering concerned with the design, operation, maintenance, and manufacture of the plant and machinery used in industrial chemical processes.

Chemical engineers take raw materials and turn them into the products that we use every day. They produce pharmaceuticals, soft drinks, and makeup, among many other products. Many chemical engineers work with **petroleum** and **plastics**, although both of these are the subject of independent disciplines. The term **environmental engineering** also applies to certain areas of chemical engineering, such as pollution control.

Civil Engineering

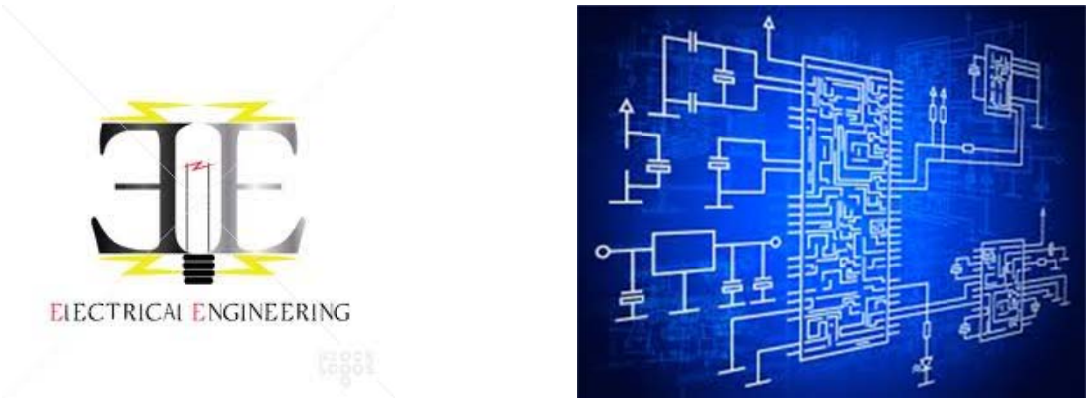
Civil engineers work on designing structures such as buildings and bridges. Civil engineers design roads, buildings, airports, tunnels, dams, bridges, or water and sewage systems. A civil engineer will most likely oversee a job site or be a city/county engineer. Civil engineers normally work in cities where there is manufacturing and business.

Civil Engineers collapsed a full scale dyke in the Netherlands. The test dike was embedded with advanced sensors and traditional measurement instruments, and results of the study are expected to help validate powerful new technologies for monitoring the health of aging flood-control infrastructure.

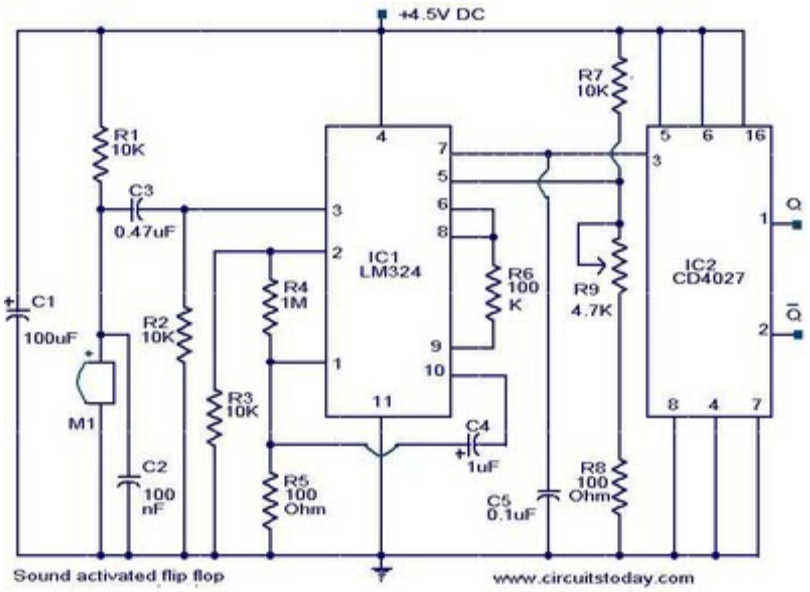
bdcuk.com

This is a model from a website of a civil engineering company. A civil engineer may design something on software and then build a model like this one.

Electrical Engineering



Electrical engineering, the discipline that employs the largest number of engineers, covers everything related to electrical devices, systems, and the use of electricity. It is the branch of engineering that deals with technological aspects of electricity, including power generation and distribution to the user. Electrical engineers work on power plants, computers, and other electrical devices. Electrical engineers are designing the dashboard computers that will monitor engine functions on automobiles of the future. Electrical engineers deal with the wiring of circuits and how to make the energy flow most efficiently.

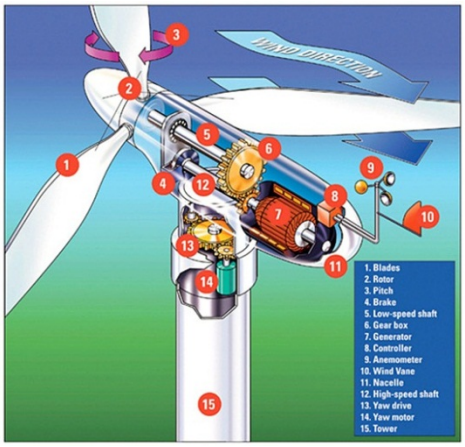


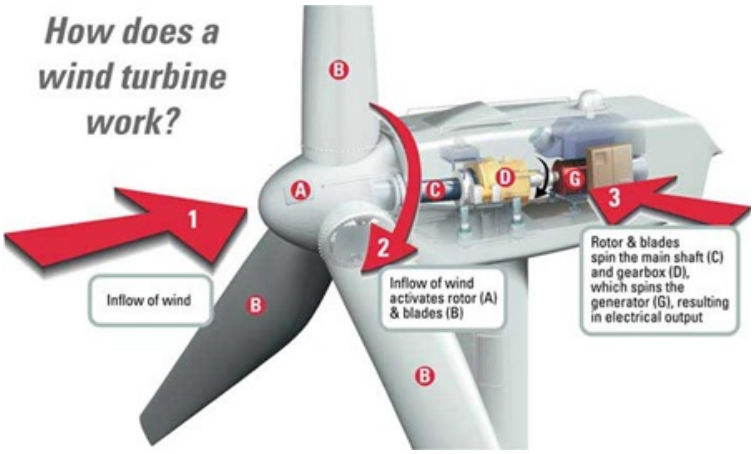
afiata.com

This is a “simple” circuit diagram of what an electrical engineer may have to deal with.

Energy Engineers

Energy engineers are primarily mechanical, electrical, petroleum, nuclear, and chemical engineers. They can review building designs to make them more thermally efficient for more economic and environmentally-sound heating/cooling. Energy engineers also design better ways in which factories could be set up to maximize efficiency and save money. They create new and improved systems for storing/capturing energy. They find new ways of utilizing renewable energy or making current ways more efficient

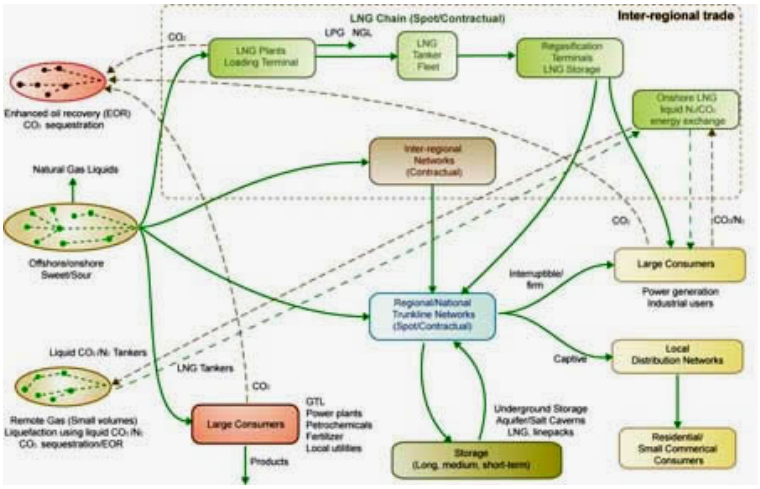




mechanicalengineeringblog.com

These pictures are from a mechanical engineering energy site and show the working parts to a wind turbine designed by a mechanical engineer.

An example of energy/mechanical engineering that is widely used today is the use of the solar panel. There is heavy focus on harvesting solar energy and working to make it more efficient than ever before. This efficiency could result in an alternative fuel source from fossil fuels. This would eliminate America's reliance on foreign oil and greatly improve the economy.



web.mit.edu/cheme

This is a schematic of a natural gas value chain. Mathematical models for the design and operation of energy supply chains can significantly improve security of energy supply and help in managing their environmental impact

Environmental Engineering

Environmental engineers study ways to protect our environment. These engineers might come up with better ways to recycle and dispose of waste, ways to clean up the rivers or oceans or anything that has to do with the environment.

nationalgeographic.com

psdgraphics.com

Firearms Engineering

Firearms engineering deals with the design, testing, and evolution of firearms such as rifles, pistols, shotguns, etc. It is a specific field within mechanical engineering. Firearms engineering historically has swayed the tide of power during war time.

- Mikhail Kalashnikov: Soviet tank commander, designer of the AK47 assault rifle.
- John Browning: designer of the M2 heavy machine gun and of the 1911 pistol.
- Samuel Colt: considered to be one of the founders of firearms engineering, he made several simple but crucial leaps in the evolution of firearms.
- Eugene Stoner: provided the original design for the M16 assault rifle.
- Sergei Nagant: co-designer of the Soviet Mosin-Nagant sniper rifle.
- Fedor Tokarev: designed the SVT40, one of Russia's first semi-automatic rifles.

Geotechnical Engineering

Engineering that is about the earth, it deals with rocks, soils, metals, minerals and fuels.

Industrial Engineering

Industrial engineers mainly focus on the work output of factories and the more management or business side of engineering. The branch of engineering that deals with the utilization of machine and materials necessary for optimized manufacturing. Industrial engineers also deal with human factors, ergonomics, and operations research.

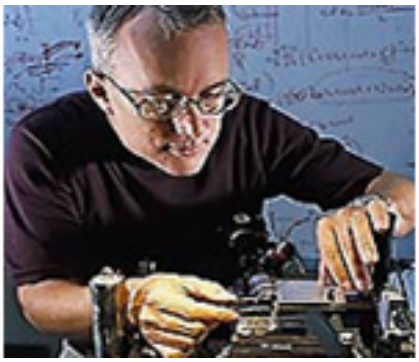
Mechanical Engineering

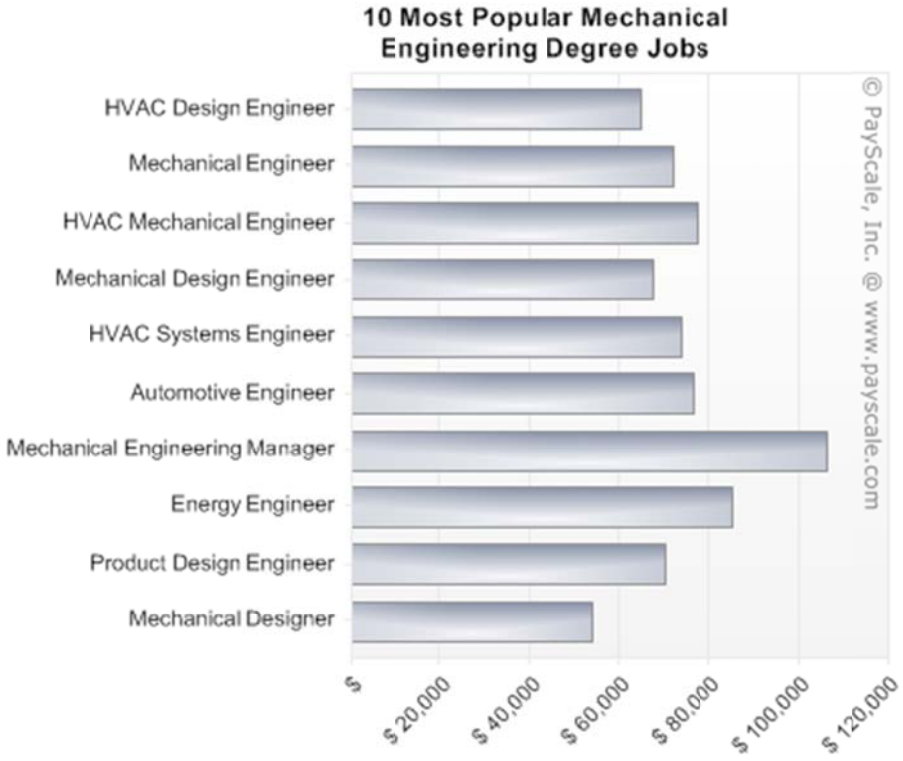
The discipline of engineering that applies the principles of physics and materials science for analysis, design, manufacturing, and maintenance of mechanical systems. The branch of engineering that encompasses the generation and application of heat and mechanical power and the design, production, and use of machines and tools. Mechanical Engineering delves into the use of mechanics, material sciences, and design with hopes of designing useful mechanical systems and the analysis of efficient and quality manufacturing. Mechanical engineers use mechanics and energy principles to design machines such as engines and motors. Many mechanical engineers work in the areas of air-conditioning and refrigeration, automotive, manufacturing, welding, and robotics. It is hard to look around and not see something designed by a mechanical engineer.

Mechanical Engineering emerged in 18th century Europe during the industrial revolution but it can be traced back much further in time, to Leonardo da Vinci and even much earlier. As a mechanical engineer you can design and analyze things like watercraft, robotics and medical devices plus many more. To be part of this field you have to have an understanding of design, mechanics, kinematics, thermodynamics, material science, structural analysis, and electricity.

In 2009 there were 1.6 million engineers employed in the US. 239,000 of these were mechanical engineers (15%). For the field of mechanical engineering, starting salary is $58,800, and the median salary is $74,900 (as of 2009).


MECHANICAL
ENGINEERING
(DOING OUR PART FOR GLOBAL DOMINATION)




10 Most Popular Mechanical Engineering Degree Jobs
HVAC Design Engineer
Mechanical Engineer
HVAC Mechanical Engineer
Mechanical Design Engineer
HVAC Systems Engineer
Automotive Engineer
Mechanical Engineering Manager
Energy Engineer
Product Design Engineer
Mechanical Designer
$
$ 20,000
$ 40,000
$ 60,000
$ 80,000
$ 100,000
$ 120,000
© PayScale, Inc. @ www.payscale.com

The Bloodhound, a 1000 mph car, attempted (and failed) to break the land speed record on South Africa's Hakskeen Pan on October 3, 2013. Another attempt for 2015 was delayed to late 2017.

A mechanical engineer could:

Design a safety harness for an upside-down amusement park ride.

Model the bending and twisting displayed by solar panels on a space telescope.

Design surgical robots that improve precision and reduce incision size and healing time.

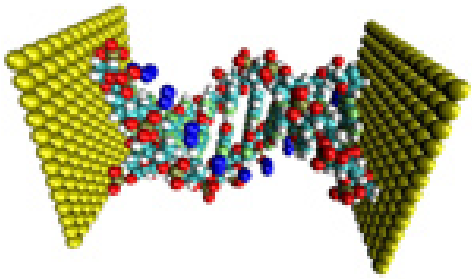
Design carbon fiber prosthetic blades for high-speed running.

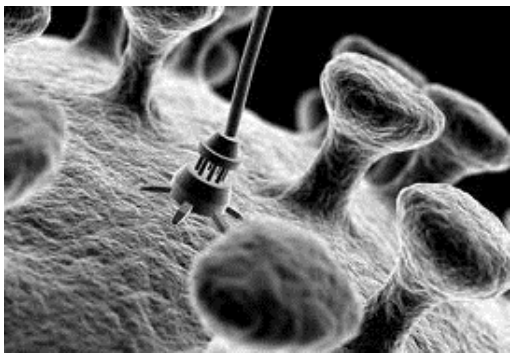
The Skateboard

This is a hydrogen fuel powered vehicle that doesn't need fossil fuels to run. Not only is it innovative in its fuel economy it is innovative in its aesthetics and mechanical upgrades as well. The skateboard could be modified easily to fit any body of any car or truck. Also upgrades could be applied to make it run like you want. Plus you could have the option of sitting where ever you please. You could drive with a steering wheel our joy stick or even a computer mouse. Not only is it good for the environment with the only waste product being water, but it's good or the public because you only need one car and could just buy separate bodies and modifications for it.

Nanoengineering

Nanoengineering is practice of engineering on an atomic, or nano-, scale. It is named from the nanometer unit (billionth of a meter). Some of the applications of this branch of engineering include molecular assembly, that is, the creation of structures on an atomic level. Using a machine called a scanning tunneling microscope, scientists are able to view and manipulate something as small as a single atom. This technology allows engineers to create new materials with the precise properties they require. This includes a new type of solar cell which is more cost efficient, produces more power, or is lighter and more flexible. The possibilities with nanoengineering are almost endless. There are also some dangers related to engineering on a nano scale. Some forms of nanofiber can cause the symptoms of many life-threatening diseases such as mesothelioma, cancer, and lung disease.

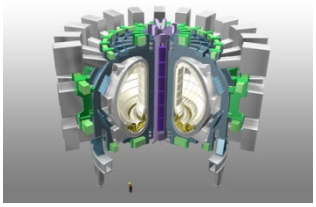




Another technique is using Molecular self-assembly to create arbitrary sequences of DNA to create custom proteins or amino acids. This field is very important for the future because of the promising future of nanomedicine.

Nuclear Engineering

Nuclear engineering deals with fission and fusion of nuclei at the atomic level. These engineers deal with nuclear reactions, radiation, and thermodynamics among other things. This field requires a chemistry background but a medical background is also useful for radiation. These engineers work to develop products that efficiently use the benefits of the atom. Some examples are working with fusion reactors, creating better radiation detection equipment, or developing a better X-ray machine.



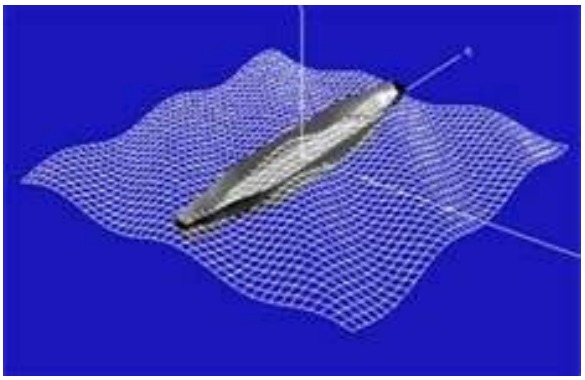
zdnet.com

dimensionsinfo.com

Ocean Engineering

Ocean Engineering is the study of the relationship among ocean phenomena, the marine environment, and human society and technology. You can develop a new way of preventing coastal erosion, design jetties and seawalls, or become a naval architect. Ocean engineering is based in five areas of concentration: coastal engineering, hydrographic engineering, marine vehicles (naval architecture), marine materials and corrosion, and underwater technology. Engineers in this field are multidisciplinary to harness the oceans' resources and explore the ocean safely. Ocean engineers design, build, operate, and maintain many objects dealing with the ocean like offshore structures, ships and boats, underwater robots, and sonar sensors. Part of their job is to study the workings of the ocean and its effects on materials put into the ocean.

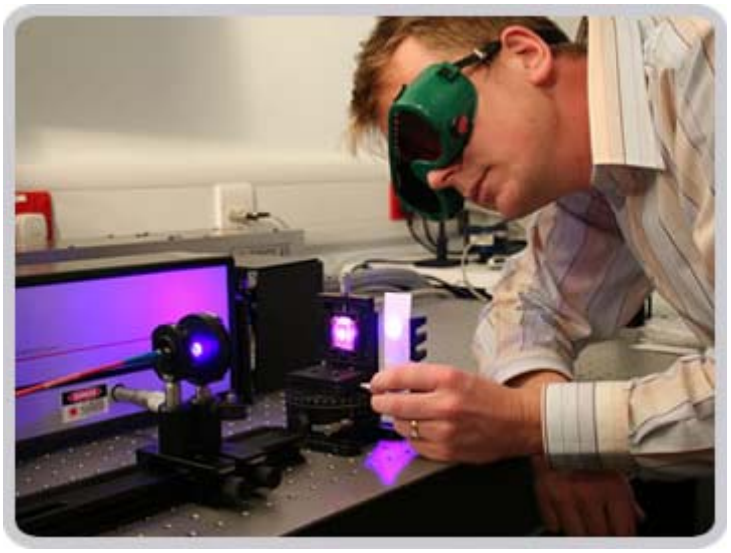
Naval engineering is a subdivision of mechanical engineering and focuses on the design and construction of ships, offshore structures, and marine vehicles. Some examples of naval engineering are designing ships strong enough to survive a typhoon, overseeing the burial of fiber optic cables along the sea floor, the design of new ship hulls to better handle waves and storms at sea, and creating new types of submarines to reach further depths and pressures. Below is a CAD simulation with wave dynamics against a submarine.



nativeaccess.com

Optical engineering

This is the field of study that focuses on applications of optics. Optical engineers design components such as lenses, microscopes, and telescopes. This field includes any equipment that utilizes the properties of light. Optical engineers must understand and apply the science of optics in great detail to meet what is physically possible. Metrology can be applied in optical engineering, using optical equipment to measure micro-vibrations.

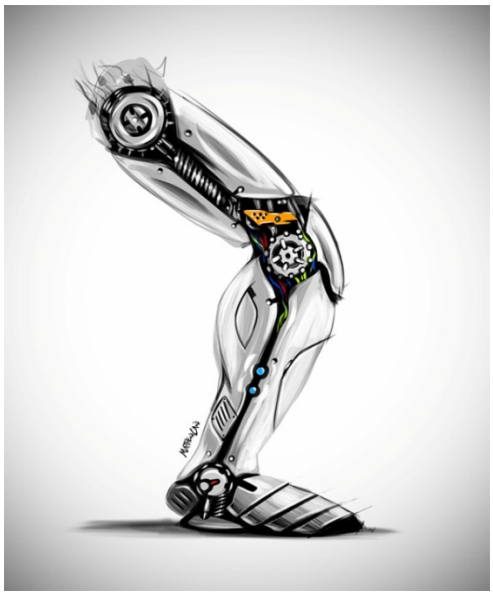


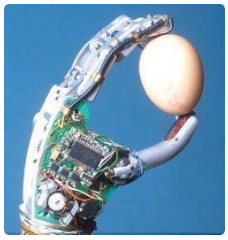
Petroleum Engineering

This is the branch of engineering that deals with designing and supervising the process of extracting oil and natural gas from the ground to storage, and refining it for transportation, industrial, and commercial purposes.

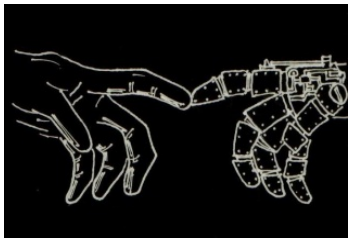
Robotics Engineering

These multidisciplinary engineers (mechanical, electrical, and computer science) deal with designing, building, and controlling robot systems. They range from conventional robots to perform industrial assembly lines and manufacturing, to remote applications in space and undersea, to the service industry, to building mechanical humans.





interestingengineering.com



eujobcentre.com

6.2 American Society of Mechanical Engineers (ASME)

- The American Society of Mechanical Engineers (ASME) has more than 120,000 members.
- The ASME has gone worldwide in over 150 countries.
- It is located in New York City and the official language used in this society is English.
- This is a non-profit membership society in which they promotes the science, the practice of multidisciplinary engineering and allied sciences.
- This society was first founded as an engineering organization that was original focused on mechanical engineering in North America but now it is multidisciplinary and global.
- The founding of ASME was in 1880 by Alexander Holley, Henry Worthington, John Sweet, and Matthias Forney and the reason was because of the multiple failures of steam boiler pressure vessels. This led them to start setting the codes and standards for mechanical devices.
- Core values of this society are to embrace integrity and ethical conduct, plus promote the benefits of continuing education and engineering education.
- ASME conducts one of the world's largest technical publishing operations.

districts.asme.org

en.wikipedia.org/wiki/ASME

6.3 Society of Women Engineers (SWE)

- In the late **1940s** the Society of Women Engineers began through student-organized groups at Drexel Institute of Technology, Cooper Union, and City College of New York.

- The main reason the society was started was because while all of the men were off to fight in WWII the women were the ones doing all of the hard labor. For this reason women were educated and employed like never before. The women who became engineers began to organize local meetings and activities so that they could address their concerns and exchange information.

- It wasn't until the **1960s** that women were truly accepted into the engineering schools because Sputnik had made the US government's commitment to technological research and development more extreme.

- Even though the number of women becoming engineers was increasing, it was still rare for a woman to be able to rise to a management or other high level position.

csulb.edu/org/college/swe

Some Famous Women in Engineering

- **Bonnie Dunbar** – NASA astronaut from Sunnyside, WA. BS in Ceramic Engineering from UW, PhD from U. Houston. Developed ceramic tiles to protect space capsules on re-entry at Rockwell before joining NASA. Named Rockwell Space Division Engineer of the Year. Flew on several NASA space missions.

- **Katherine Stinson** – inspired by Amelia Earhart, she became the first woman to get BS in ME with an aerospace option from NC State University. She was the first female engineer to work for the Civil Aeronautics Administration that later became the FAA. She earned the FAA Sustained Superior Performance Award, helped organize SWE and served as president, and was named as the Aviation Pioneer of the Year in 1987.

- **Lillian Gilbreth** – is considered a pioneer in the field of time-and-motion studies, showing companies how to increase efficiency and production through budgeting of time, energy, and money. Dr. Gilbreth received her Ph.D. in psychology from Brown University and was a professor at Purdue's School of Mechanical Engineering, Newark School of Engineering and the University of Wisconsin. She is "Member No. 1" of the Society of Women Engineers. She and her husband used their industrial engineering skills to run their household, and those efforts are the subject of the book and family film "Cheaper by the Dozen."

- **Beatrice Alice Hicks** – she was elected President of SWE. She was Vice President and Chief Engineer of her own company, Newark Controls. She pioneered the design, development, and manufacture of pressure and gas density controls for aircraft and missiles. She was the first official president of SWE. First woman admitted to MIT in **1871**, earning a degree in **1873**. This opened the door for other women to attend.

- In **1947**, only 0.3% of all engineers in the US were female. By **2009**, the number rose to 17.8%, still well below half.

- Why haven't the numbers of women been more significant in engineering? In a ten-year study, it was found that it actually has nothing to do with the nature of the work, and that rather the more likely cause was simply because it was a male-dominated field. "Women are drawn to fields where the social relevance is high," said director Dian Matt, of Women in Engineering ProActive Network.

- Women throughout history have made numerous scientific contributions that they were not credited for. But throughout the last half-century or so they have made considerable gains in the fields of science and technology and are expected to make more than ever in the coming century. It's going to be very different for women in engineering in the coming decades.

Beatrice Alice Hicks

Katherine Stinson

societyofwomenengineers.swe.org

che.wsu.edu/~millerrc
societyofwomenengineers.swe.org
thetalleygroup.com
jstor.org
it-jobs.fins.com

6.4 Engineer Salaries

2011 average undergraduate starting salaries by college

College	Rank	Starting Salary	% of Engineering
Engineering	1	$61,872	100
Computer Science	2	$60,594	98
Business	3	$48,144	78
Health Sciences	4	$44,955	73
Math and Sciences	5	$40,204	65
Communications	6	$39,577	64
Education	7	$37,830	61
Humanities and Social Sciences	8	$35,503	57

2011 average undergraduate starting salaries by engineering major

Engineering Major	Rank	Starting Salary	% of Chemical
Petroleum	1	$93,000	144
Chemical	2	$64,800	100
Nuclear	3	$63,900	99
Computer Engineering	4	$61,200	94
Electrical	5	$60,800	94
Mechanical	6	$60,620	94
Aerospace	7	$59,400	92
Industrial	8	$58,200	90
Applied Mathematics	9	$56,400	87
Computer Science	10	$56,200	87
Biomedical	11	$54,800	85
Physics	12	$50,700	78

6.5 Engineering Majors at Ohio University

Aviation

The Aviation Flight Option offers a four-year, BS degree in aviation. The flight option gives you the opportunity begin training your first year to become a pilot and obtain a pilot certification through Ohio's FAA- approved flight program. It does not tell you though that you will owe an extra $80,000 after graduation.

If you are interested in becoming a pilot but don't have the money to afford the flight option you can try the aviation management option. This options offers a BS degree in aviation and provides students with a well-rounded background in aviation history and business aviation. Aviation courses include aeronautics, aviation law, aviation safety and weather.

Aviation Technology majors primarily do two types of work. Some help in the construction of new aircraft, while others repair damaged parts in older planes. This is a two-year degree and students can choose to go on for either four-year degree after the two years.

Chemical and Bimolecular Engineering

A BS degree in chemical engineering offers the option to focus on other tracks such as bioengineering or energy. Undergraduate studies begin with chemistry, biology, physics and mathematics.

Biological Track – chemical engineering with biological technical electives.

Energy and the Environment Track – technical electives with the energy and environment side of chemical engineering.

Materials Track – technical electives for chemical engineering towards the design and production of materials.

Civil Engineering

A BS degree in civil engineering focuses on building a strong foundation on basic sciences and mathematics. Civil Engineering deals with the design, construction, and maintenance of the physical and naturally-built environment, including projects like roads, bridges, canals, dams, and buildings.

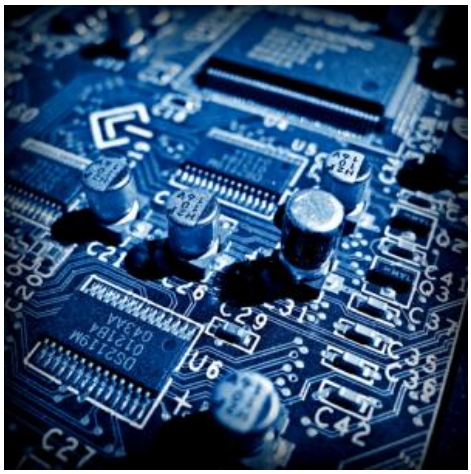
Electrical Engineering and Computer Science

Electrical engineering offers three tracks: electrical engineering, computer engineering, and computer science. Electrical engineers design devices such as GPS, cell phones, electrical power, and many other things.

Electrical Engineering Track –engineering of the latest electronics along with the electrical generation of the future.

Computer Engineering Track – develops the design and development of computer hardware with implementing the electrical engineering involved in computer science.

Computer Science Track – an important major for our technological age; all the web browsing and email was made by software engineers and computer science majors. Computer Science Majors create new computer programs and solve complex business/computer issues. In addition, computer science professionals also develop software programs that entertain and educate consumers.



Engineering Technology and Management

Industrial Technology – learn how things are made and how to optimize performance of production and manufacturing. Industrial Technology major prepares individuals to apply basic engineering principles and technical skills in support of engineers and managers in industry.

Industrial and Systems Engineering

Industrial and Systems Engineering – focus on optimizing industrial supply, production, and manufacturing. Focusing on human factors, operations research, and ergonomics, industrial engineers must be experts in probability and statistics.

Mechanical Engineering

Mechanical Engineers design any machine or mechanical device for needs such as industry, transportation, recreation, etc.

Undecided Engineering

Undecided Engineering students study the basic engineering courses for the first year or two until they decide which major to pursue in the engineering college.

ohio.edu/majors/undergrad/russ

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en.wikipedia.org/wiki/Nanoengineering

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sciencedaily.com

wallpapers.free-review.net

wisegeek.com/what-is-aeronautical-engineering

7. Cooperative Engineering Education

Cooperative engineering education, or co-op, allows students to alternate work terms with university terms in order to obtain a more practical education for engineering in industry. This is a five-year program, but it well-worth the extra year invested in terms of experience, finding what you like and don't like to do in industry, and in obtaining your first job in engineering after graduation. Also, unlike most majors at OU that require internships, engineering internships and co-ops are paid positions!

The co-op program at OU allows students to work/study in alternating semesters during their sophomore, junior, and second junior years. As an alternative, consider summer internships which also provide valuable experience, but the program can be finished in four years.

This chapter briefly presents the history of cooperative engineering education, the OU RCENT co-op program and requirements, and a partial list of OU engineering co-op employers.

7.1 History of Cooperative Engineering Education

- Professor Herman Schneider devises a plan for engineering/technical cooperative education (co-op) in **1901** at Lehigh University. Herman Schneider thought traditional classroom-only education didn't work well for engineering students, noticing that students who worked during college were more successful.

- The University of Cincinnati hires Schneider in **1905** and allows him to try his co-op plan with the engineering program and it is a success. Today the five-year co-op program is required by all engineering majors at UC.

- Northeastern University becomes the second university to add co-op to its engineering program, in **1909**.

- Dean Schneider, with others, forms the Association of Cooperative Colleges (ACC) in **1926**.

- In **1929**, the American Society for Engineering Education (ASEE) formed the Division of Cooperative Engineering Education in conjunction with the ACC.

- Cooperative engineering education is a structured method of combining classroom-based education with practical work experience in industry. It provides academic credit for structured job experiences. Cooperative education is important in helping young engineers make the school-to-work transition, in service learning, and in experiential learning initiatives. It has spread to many universities in all states today, plus in 43 countries outside the U.S.

7.2 OU Cooperative Engineering Education Program

- The OU RCENT Cooperative Education Program is an optional five-year program that combines classroom learning with paid, career-related work experience away from OU. The pay range is $9.25 to $22.00 per hour. One-semester and back-to-back two-semester co-ops are available.

- At OU there are about 240 different employers that participate in the Co-op Program. About 25% of OU engineering students participate in the five-year co-op program during their sophomore and next two years. Mechanical engineering students have the most co-op students by far. ME students must be on campus their entire freshman and senior years, but alternate work and school for the middle three years.

- Co-op Program requirements: You must be a full-time degree-seeking student in engineering, CS, or ETM, have with 30 credit hours earned, have a minimum 2.5 GPA, and take ET 1500 (which is required for all students to graduate regardless of co-op). The co-op student must register for one credit hour during each semester on the job, during which time they are considered a full-time student; there are no additional fees.

- Late freshman/early sophomore year is the best time to enter the co-op program; junior and senior years are too late. Schedule an appointment with the coordinator for career programs and learn job search skills, resume writing, and interviewing techniques in ET 1500. Create a profile on eRecruiting and upload your critiqued resume. Apply and interview for positions in eRecruiting. Obtain co-op schedule approval from faculty co-op advisor (Dr. Bayless in ME).

7.3 OU Cooperative Engineering Employers

- American Electric Power (AEP)
- Boeing
- British Petroleum (BP)
- Cooper Tires
- Delphi
- Diebold
- Energy Resource Solutions
- Ford Motor Company
- General Electric (GE) – Aircraft Engines and many other divisions
- Honda of America
- International Business Machines (IBM)
- Kroger
- Lincoln Electric
- Mitre
- NASA
- Ohio EPA
- Owens Corning
- Parker Hannifin
- Stellar
- Timken
- Toyota Motor Manufacturing
- US Coast Guard
- US Engineering Company

7.4 References

ohio.edu/engineering/coop/employer

ohio.edu/engineering/coop/student

en.wikipedia.org/wiki/Cooperative_education

8. Habits of Successful Engineering Students

The Choice is Yours

8.1 Good Habits for Engineering Students

Keep up, don't fall behind

- Attend every class
- Read book chapters, even if the lecture appears the same.
- Take notes, and review them after class, and before the next class.
- Study regularly, some each day. Slow burn, let it simmer, not boil.
- Work in the days, less in evenings, don't stay up too late. Treat it like a 9-6 job, every work day.
- Start early in a class, rather than "push it off" and try to catch up.
- Successful students don't delay studying until the last minute. Study over shorter periods of time. Try to plan your studying for the same time and same place to ensure it becomes habit.
- Always review your notes before starting homework to get a quick refresher and maximize your efforts in time.
- Don't cram all your studying into one session. If you learn small amounts more often then there is a greater chance you will retain the information.

Practice

- Nearly all instructors assign homework. Do it.
- If it's only graded for completeness? If it's optional/not graded? Do it anyhow.
- Do other homework problems in the book. Make up problems. Share them with friends.
- Practice (study) away from distractions—make work time be work time.
- Learn <u>your</u> nature, how and when you study and concentrate best.

Network

- Work with your fellow students both formally and informally. Work in teams as much as you can. In your career you will be sure to work in teams so it is good practice ahead of time.

- Use study groups. Groups can help you understand topics more deeply and complete homework assignments more efficiently and correctly than by yourself. However, make sure your group stays focused, otherwise this can backfire.
- Develop good people and communication skills.
- Join student groups and organizations
- Go to Career Fairs. Learn to meet new people and get your name out there so employers get to know you.
- Develop your own "board of directors", people you feel comfortable with and are able to ask advice from.
- Stay within honor code boundaries.

Seek help

- When stuck, see the professor.
- Get help at the first sign of trouble before it gets really bad.
- Use other resources, such as SI.
- Find your flaws and fix them. When working in groups it is important to get feedback from them on your performance to always better yourself, in order to be the best partner in a group you can be.
- If you get negative feedback or things you did wrong you change them or yourself to correct them and be better and get ready for the next task.
- Admit your mistakes and when you err and try to fix the issue by facing rather than ignoring it.
- Get feedback from others so you can find your flaws as a group member so that you can improve upon them.
- Don't be afraid to ask for help from a fellow student or a professor. There is always help available if you are having difficult issues.

Take care of yourself

- Keep regular sleeping hours, study earlier, rather than very late.
- Have fun, but have it after work is done. Work hard now and play later (play some everyday).
- Focus always on proper nutrition and hydration. Avoid artificial energy enhancers.
- Exercise regularly.
- Make friends.
- Stay curious, involve yourself with other stuff. Clubs, exercise, good friends: have stress relievers that don't involve alcohol.

Aim high

- Look down the road, be mindful of grades, but concentrate on learning.
- Got a B in a class with an easy professor? Go for the A. Got an A when you really don't feel pushed? Try harder. Do you have a 92 average, and can you drop a quiz? Study like it still "matters", because it does.

- Take pride in your work and yourself. When you put your name on it make sure it's the best you can do with the given resources.
- Seek informal leadership roles
- Identify famous engineers to inspire you. Research what helped them become successful so you can apply some of these ideas and techniques to your education and career.
- Develop a Portfolio of projects so you can look back at what you have done. Use your portfolio in co-op, internship, and permanent job interviews with prospective employers.
- Start with your most difficult assignment because that's when you have to most mental strength and mental energy. Once you pass the very difficult work you will find the easier work to be a breeze.
- Consider taking a business class because engineers should also be business savvy. Take a visual design course, so you know how to communicate your ideas graphically.
- Make your summers productive by working in co-ops or internships. Permanent employers value new hires with work experience.

8.2 Good Habits for Practicing Engineers

Good engineers require:

- An accredited degree (OU is ABET-accredited)
- Fundamentals of engineering exam
- Professional engineering licensure
- Confidence and competence
- Sufficient skill, knowledge, and experience.
- Communication
- Character / Integrity
- Passion / Drive
- Leadership skills
- Management / Motivate others

Good engineers:

- Know the process
- Generate concepts
- Focus on steps required to achieve goals.
- Focus only on the most important things
- Document the baselines
- Even for crazy ideas, write them down and explore all options.
- Use equations and tools to maximize your potential and be more effective
- Network and Communicate Results
- Solicit multiple people's ideas.
- Keep learning
- Don't assume they know enough, they always think of and accept new ideas.
- Share their knowledge

Good engineers should:

- Be proactive – search for new solutions and never give up on a good idea. Be thoughtful of the pressing problems
- Begin with the end in mind; always remember the final goal of the project. Think in terms of goals and outcomes.
- Put first things first – prioritize steps in the engineering process.
- Don't get down when your first plan doesn't work.
- Think first to understand, then to be understood-understand the problem before you try to make others understand your solution. We have 2 ears and 1 mouth; use them to that proportion.
- Synergize – communicate ideas between others. See the interconnections of complex systems.
- Sharpen the saw – always keep learning. Keep up with new technology created over the years
- Be willing to do the right things for the right reasons.
- Answer both problems of producing efficient and economical designs.

8.3 References

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jrothman.com/successful-engineering-management-7-lessons-learned

usnews.com/education/10-tips-for-success-for-engineering-students

Dr. David Bayless, OU ME, lecture notes

Dr. John Cotton, OU ME, lecture notes

9. Personal Finance

- Spend less than you earn!

- Demand that your governments follow this rule also, at all levels, especially the U.S. Federal Government!!

9.1 General Financial Tips

- **Make sure you get paid what you're worth.** Being underpaid is common; if you aren't getting paid as much as you should you are throwing money away. Check related jobs to yours, both in your company and other companies and after a self-evaluation, if you aren't making enough confront your boss about it or take a job elsewhere.

- **Spend less than you earn.** This sounds simple, but a lot of people have trouble with this. Even cutting out a little here and there can add up to big savings. Plus, it's "easier to spend less than it is to earn more", not to mention less stressful (Mo' money mo' troubles, according to the rappers).

- **Use credit cards wisely and pay off credit card bills every month.** After graduation you should definitely get and use one or two credit cards regularly – it's free money for a month and helps establish good credit history. You MUST pay off the entire balance every month. Do not buy anything you cannot pay cash for today (exceptions: house, car, Gibson Les Paul Customs). Many, many Americans, even of sufficient means, get trapped in the hopeless credit card debt cycle, so the only approach is to not get in the hole in the first place. And certainly – if you find yourself in a hole, stop digging! (Someone please inform Washington about this common sense.)

- **Invest your money.** It may seem like you're losing money at the moment but it will grow over time. The business majors say buy low and sell high. If you panic in the stock market and sell when everyone else is selling at low prices, then buy a lot when the market is booming at high prices, this is exactly opposite of what you should be doing.

How to budget money

1. **Track your income and expenses**

    a. First off you need to determine your overall income and identify how you spend your money.
    b. Add up the amounts of your regular expenses and subtract it from your paycheck amount.

2. **Create your budget**

    a. Set financial goals as well as budget goals, short term and long term.
    b. Make a list of what you need to pay for; Using technology can help.

3. **Maintain your budget**

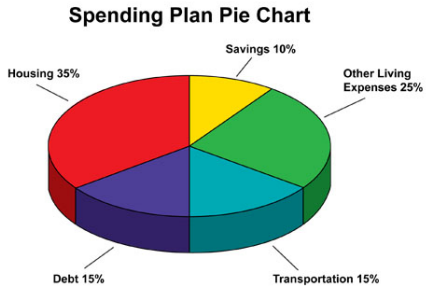
    a. Don't go over your budget
    b. Keep a budget journal
    c. Don't count on potential sources of revenue
    d. Take your money out for the week at the beginning
    e. Don't freak out if you violate your budget, rarely, in a small way– you are human.

9.2 Personal Finance

1. Set a Budget – Write down the plan for your earnings and expenses balance out how much you are spending with how much you are making.

goodcents.pocketsmith.com

2. Track Spending – Record all the expenses you have and show how much of your money is being spent on each category of expenses such as dining out, groceries, clothes, etc.



maillardvillemanor.com

3. Live Within Your Means – Don't try to buy random things that waste your money, try to spend it only on the essentials.

cheeseslave.com

4. List Goals – Make a plan to reach goals for things such as saving money, paying off debts, big expenses, etc.

5. Reduce Debt – Don't take out unnecessary loans, earn the money to pay for things before you buy them.

cowanglobal.com

6. Respect Credit Cards – Make sure you understand all the terms and rates of your credit card company. Don't use it to pay for large purchases that will take you months to pay off.

money.howstuffworks.com

7. Never be Late on a Payment – Make sure to pay off loans or credit cards on time so that you don't have to pay late fees and your credit score isn't ruined.

leavedebtbehind.com

8. Start an Emergency Fund – Set aside an account to save money just in case a big expense comes up such as car repairs or medical bills.

eversyncbackup.com

Having good personal finance is important because without smart personal finance you can end up bankrupt quickly and can get yourself into a hole that you can't get out of. As engineers we typically make more than the average person which is good and bad. It is good because you have more money to use and can live easier but if you are stupid with money, it can be gone just as fast as it comes in. This brings me to the first of three topics to know about personal finance.

1. Have self-control – since as engineers we earn more money starting out, we have extra spending money. This can get us into trouble because we can lose sight of what we really need and just see what we want which can lose money fast.

2. Make a future financial plan – it is important to make a future financial plan because then you can really see what you need and how much it can cost so you can start saving money beforehand instead of just blowing it all on something stupid.

3. Create an Emergency Fund – "Life is what happens to you when you are busy making other plans" (John Lennon), so it is important to maintain an emergency monetary fund so when things go wrong, you are prepared, and have enough money to get yourself out of it. Once you are back afloat, you must make another emergency fund because life seems to kick you when you're down and you must be ready for it.

- Personal finance is the application of the principles of finance to the monetary decisions of an individual or family.

- A key component of personal finance is planning. First you need to assess your situation by compiling documents for your situation such as balance sheets and income statements.

- It is also good to set manageable goals with your own personal finance. To maintain these goals, it is good to set a plan, and limit expenses. To limit expenses there are exercises you can follow like budgeting. Budgeting is limiting the amount of money per area of your life. It could be anything you spend money on. For example you can limit per month how much you want to spend on entertainment, food, bills, or whatever else you spend money on.

- Personal finance also involves investing in stocks, bonds, and other financial vehicles. You can buy a stock at a given amount, and track its progress, and eventually sell it to earn a profit hopefully. Also with some stocks, you can earn dividends, which are sums of money paid quarterly by a company to its shareholders out of its profits.

- Contribute to a retirement plan. If your employer has a 401k plan and you don't contribute to it, you are ignoring one of the best tax-deferred deals available. Ask your employer if they have a 401k or similar plan, and sign up when you start your job. If you're already contributing, try to increase your monthly contribution. If your employer doesn't offer a retirement plan, consider an Individual Retirement Account (IRA). Stick to your investment plan regardless of what the market is doing.

- If your bank adds new fees attempt to negotiate instead of just switching banks. Keep a close eye on monthly statements, banks like to add new fees and they are required to send a fee disclosure which many people just throw out.

- Turn in all paperwork and check with your lender to avoid home purchase failure, keep copies of all paperwork

- Invest with money left over in budget

- Maximize Employment Benefits

- Review Insurance

- Keep Good Records

9.3 Managing Student Loans After Graduation

- Most federal loans have a 6 month grace period between the time that you graduate and the time you need to begin repaying back your loan.
- Set up a payment plan and follow it to ensure you are more likely to stay on top of the debt.
- Many lenders will offer you discounts for borrowers who sign up for auto debit and electronic billing.
- You could consolidate to a fixed-loan rate.
- Update all your information.
- Consider special consolidation, an example is the new proposal by President Obama.
- Check out places like National Student Loan Data System to help you keep on track for repaying your debt.
- Manage your future budget to include repaying your student loan debt on time.

9.4 Mortgage Example

This example is intended to teach you the shocking amount of interest paid over the life of a loan (home mortgage) in order to buy a house. Do not buy a house (keep renting) unless you know you will be in the same place for a few years minimum.

An old rule-of-thumb indicates that you can afford a house twice the cost of your annual gross salary. Assuming an ME starts out at $60,000 per year, you can afford a house for $120,000. A substantial down payment is required, say $20,000. Therefore, this example focuses on a loan of $100,000, for two time periods (30 and 15 years to pay back) and two annual fixed interest rates (8% and 4%). DO NOT agree to a variable interest rate!

Monthly payment ($)

	8%	4%
30 year	734	477
15 year	956	740

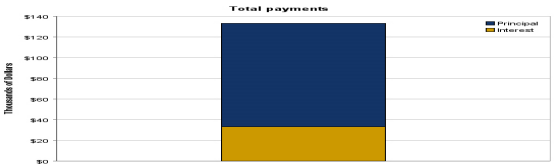
Total interest ($)

	8%	4%
30 year	164,155	71,870
15 year	72,017	33,145

Percentage of interest paid (%)

	8%	4%
30 year	164.2	71.9
15 year	72.0	33.1

30 years @ 8%



15 years @ 4%

So the obvious conclusion is that one should arrange the shortest term and lowest interest rate home mortgage loan possible. Credit card debt is similar but even more of a rip-off because the interest rates are HUGE and credit companies allow a minimum payment that is interest only, i.e. not reducing the principal owed a bit.

Other possible savings:

- Buy as cheap a house as possible that does not require a big maintenance investment. Buy as small a house as possible – no McMansions!
- Lay down as large a down payment as possible (an alternate theory says to minimize that down payment and then invest the rest in the stock market – but if years of negative stock market gains occur, you will be kicking yourself).
- Accelerate the principal, i.e. make additional payments each year as you are able – these go straight to directly pay down the principal without extra interest. See below.

Mortgage Principal Acceleration Example

For the same example above, now assume that the homebuyer is able to make one extra payment per year, identical to the monthly payment in each case, applied directly to principal. In this case, the monthly payments do not change, but the term of the loan can reduce considerably, saving a lot of money on interest.

Reduced term (years)

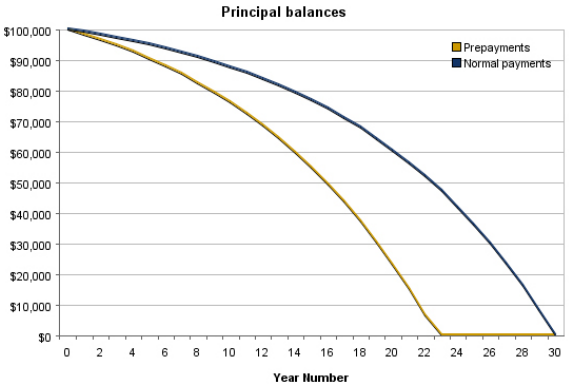
	8%	4%
30 year	23	26
15 year	13	14

Interest saved ($)

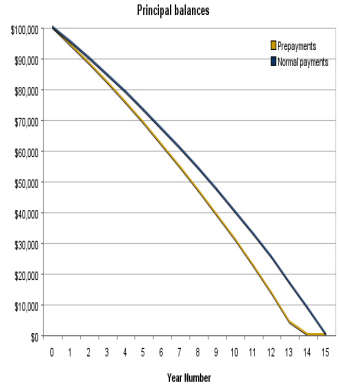
	8%	4%
30 year	47,676	11,523
15 year	11,921	3,885

Percentage of interest paid (%)

	8%	4%
30 year	116.5	60.3
15 year	60.1	29.3



30 years @ 8%, accelerated



15 years @ 4%, accelerated

We see that if you already had the best deal (15 years @ 4%), this principal acceleration has less effect than the 30 years @ 8% case. Whatever mortgage deal you have, since this is non-linear, the greatest effect of principal acceleration occurs near the beginning of the life of the loan.

9.5 References

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wikihow.com/Budget-Your-Money

10. Ethics

Ethics is a set of moral principles or rules of conduct for a group or culture.

Ethics is formally defined as:

1. A system of moral principles (*the ethics of a culture*).

2. The rules of conduct recognized in respect to a particular class of human actions or a particular group, culture, etc. (*medical ethics; engineering ethics*).

3. Moral principles, as of an individual.

4. That branch of philosophy dealing with values relating to human conduct, with respect to the rightness and wrongness of certain actions and to the goodness and badness of the motives and ends of such actions.

dictionary.reference.com/browse/ethics

Ethics is a system of moral values and principles the affect how we make our decisions. The Greek word *Ethos* means custom, habit, character, or disposition. Ethics are generally derived from religion, philosophy, and culture. Ethics influences not only personal decisions but also politics and how everybody lives.

Ethics is always doing the right thing, no matter what, even if nobody is watching.

shbailbonds.com

asme.org/getmedia

10.1 Ethics in Engineering School

Don't EVER CHEAT, in any form, for anything, regardless of how significant or insignificant you think it is!

Never EVER take materials in whole or in part from the Internet or any other resource and pass them off as your own work. This is PLAGIARISM and is totally unacceptable in school and in the profession. My advice is to NEVER make direct quotes from another author. Instead, always put

everything in your own words and then credit the idea to the original author with proper referencing. If you must use direct quotes, do so sparingly only as needed, include the "quotation" marks around the verbatim text, and obviously use proper referencing of the source, both in the text and in the bibliography list.

When you borrow graphics from the Internet, YOU must reference the source in your document. For school work this is enough; for more formal publications you must seek the original author's permission to use their figure(s). They will most likely agree if you are not profiting from their work.

As engineering students, you are expected to work and study together (ask your professor to be sure). However, never EVER COPY homework from another student to turn in. Also, group sessions should all be equal give-and-take; if someone is only taking and never giving, explicitly and overtly drop that person from your group.

In Dr. Bob's classes you are expected and encouraged to work together in homework, project, and study groups. It is acceptable to share ideas and help each other with problems and technology such as software. However, when it comes to turning in any assignment, the written submission must be 100% your own work. With MATLAB and other computer programs, never EVER copy someone else's program and pretend it is your own. Feel free to help each other but do your own programming 100%. The same is true of drawings, calculations, and everything associated with your engineering education.

I believe that ethics in school is common sense – if something doesn't seem legit, refuse to do it! Always do the right thing and never cheat, even when no one is watching – you will learn much more and sleep better at night. If you encounter cheating by others, please quietly inform your professor.

If you cheat in engineering school you will kill people later.

Ethics is the way we deal with issues that challenge our own personal sense of what is honest and true.

From student perspective:

- No cheating on homeworks/tests/quizzes
- Cite sources in papers or whenever a direct quote is used
- Do the best work you possibly can every day

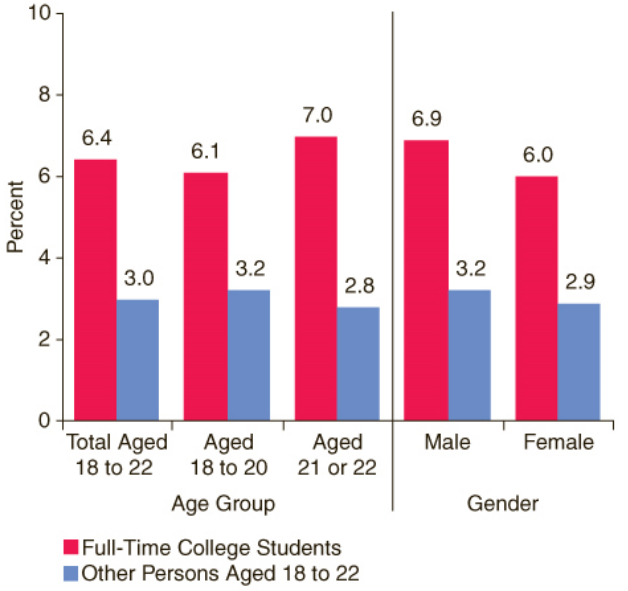
From professor perspective:

- No favoritism among the class
- Grade everything fairly
- No inappropriate student/teacher personal relationships

One interesting problem: Since personal ethics dictates how the person handles a situation, what if they were raised incorrectly? e.g. brought up by parents saying cheating isn't a bad thing?

Academic Honesty Although we are encouraged to work in groups and study together, any type of cheating is prohibited. This includes plagiarism, copying, not citing sources, cheating on tests. All of these actions are punishable up to being kicked out of the school.

Taking non-prescribed drugs Due to a large workload in college and poor time management skills in students, some may be tempted to take non-prescribed drugs such as aderol to give them the extra boost to complete the coursework. This action is hard to catch so it is easy to get away with. Do not start this cycle of behavior, in order to avoid adverse health benefits.



Source: 2006 and 2007 SAMHSA National Surveys on Drug Use and Health (NSDUHs).

Treating Staff/ fellow students with respect Always attend class, show up on time, and treat your professors and fellow students with respect. Do not use laptops and other portable electronic devices in class for non-class purposes. Do not engage in any behavior that and distracts the professor and other students.

Both Ohio University and The Russ College of Engineering & Technology have developed formal Honor Codes, given next.

The Ohio University Honor Code

"As members of the Ohio University community, we take great pride in our institution. This sense of pride and our five core values of character, community, citizenship, civility and commitment define who we are and what it means to be a member of Ohio University. These characteristics form the foundation of personal integrity, which includes academic integrity and social and civic responsibility. Together, these guide the pursuit of learning and community involvement.

Academic integrity refers to the honest and fair pursuit of knowledge and entails, but is not limited to, refraining from plagiarism, cheating, and other unethical acts that undermine the values of Ohio University. As members of the community we strive for a bright future; a future that is best achieved through honesty, fairness, and ethical behavior.

Social and civic responsibility is an extension of academic integrity and involves upholding the community values inherent in being a member of Ohio University. Social responsibility encompasses the fair and equitable treatment of all people, while civic responsibility recognizes the expectation that students of Ohio University contribute to the improvement of our community. This dedication to integrity ensures the progress and protection of Ohio University as an institution of higher learning. Therefore, as a student of Ohio University:

- I understand the importance of the Honor Code for myself, the university, and my community.
- I will hold myself to the highest standards of personal honesty and ethical behavior in my academic work.
- If I see an instance of academic dishonesty, I will take the appropriate steps that are consistent with the Honor Code.
- I will respect myself, fellow Ohio University students, faculty and staff, and members of our community and I will do my best to apply the standards set forth by the Honor Code to my daily life.

As a member of the Ohio University community, I am committed to this Honor Code and maintaining the highest level of academic integrity and social and civic responsibility at our institution."

Direct quote from:
ohio.edu/students/honor_code

Adopted by a vote of OU students on May 20, 2010.

The OU Russ College of Engineering Honor Code

"We members of the Russ College pledge to act with integrity and expect the same from each other."

Adopted in February 2008, and signed each year by Russ College students, faculty, and administrators.

Statement of Student Responsibility

"1. Students: As a student you should be dedicated to the process of learning and be willing to explore and research novel ideas and concepts. You should be willing and able to evaluate your own performance as a student and take the necessary effort to better it in the future. You should inform the instructor of any discomfort you experience with the course structure, make suggestions for its improvement, and make an effort to go beyond the course material to learn the subject.

2. Advisee: As an advisee, you should value the role of your advisor, develop an educational/ research plan parallel to your expectations from the degree, optimize the use of campus resources, and ensure that lines of communication between you and your advisor are always open.

3. Aspiring professionals: As individuals who intend to work as professionals in an environment governed by ethics, you must educate yourself on the expectations of you from the organization you are affiliated with. You are encouraged to avail yourself of an appropriate number of professional development opportunities. Your work and conduct in the professional world is a reflection of your preparation in the academic world. Ethical standards expected of a program apply to each student who is a part of that program.

4. Researchers: As a researcher or as a person conducting laboratory experiments you are solely (or jointly with your co-researchers) responsible for all aspects of your research. You must accord credit where it is due and refrain from misreporting, falsifying, forging, and/or fabricating experimental data.

5. Tutors: As teaching assistants, teachers, or peer mentors you should provide equal opportunity to all students under your instruction. You should maintain objectivity in all performance evaluation activities. You should be approachable and available to students and be willing to extend help to them on matters related to the course. You should strive to uphold integrity and honesty in all activities related to the course."

Statement of Faculty Responsibility

"The faculty of the Russ College of Engineering and Technology acknowledge and accept the Statement on Professional Ethics in section I.A.1. of the Ohio University Faculty Handbook. With this Statement of Faculty Responsibility, the faculty of the Russ College of Engineering and Technology reaffirm their dedication to teaching and learning, to academic and professional integrity. They actively promote dedication to these values, and expect the same from all members of the Russ College community. Faculty are teachers and mentors, and continuously learning to increase their effectiveness in both roles.

1. As instructors, faculty identify the crucial outcomes for an education in engineering and technology, implement learning experiences that encourage and challenge students to achieve those outcomes, and assess students' progress based on the merits of their work. They regularly improve and update courses and programs.

2. As advisors, faculty familiarize their students with the requirements of the program and the expectations of the profession, and help students develop strategies to meet them. Recognizing that the quality of graduate education in particular depends on the quality of advising, faculty regularly assess their graduate students' professional achievements based on the merits of their work, and invite others to advise and instruct when needed.

3. As researchers in a university environment, faculty pursue research to educate their students and themselves, as well as to reveal the truth. They require that research under their direction be conducted and reported honestly, and that credit be given where it is due. They mentor their research students towards becoming competent, independent researchers themselves.

4. As colleagues, faculty search for examples of best practices and advocate for their wider adoption. Faculty offer and accept advice with respect. They offer and accept help willingly. They offer and accept praise gracefully. They give credit where it is due.

5. As professionals, faculty follow the Code of Ethics established by a professional society in their discipline, and the policies and procedures of Ohio University and the Russ College. Their performance in professional work outside the university reflects positively on the Russ College and Ohio University, and does not interfere with their university responsibilities.

Faculty have a responsibility to act when they discover academic or professional misconduct. Examples of action to take include conversation with the individual, a group discussion of appropriate conduct, a report to a higher authority, or referral to an adjudication process, in accordance with personal judgment and university policy. Inaction is not acceptable."

Direct quotes from:
ohio.edu/engineering/integrity

10.2 Ethics in the Engineering Profession

National Society of Professional Engineers Code of Ethics

communicators.com/images/nspe_logo

- Engineers shall hold paramount the safety, health, and welfare of the public.
- Engineers shall perform services only in the areas of their competence.
- Engineers shall issue public statements only in an objective and truthful manner.
- Engineers shall act for each employer or client as faithful agents or trustees.
- Engineers shall avoid deceptive acts.
- Engineers shall be guided in all their relations by the highest standards of honesty and integrity.
- Engineers shall at all times strive to serve the public interest.
- Engineers shall avoid all conduct or practice that deceives the public.
- Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve.
- Engineers shall not be influenced in their professional duties by conflicting interests.
- Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods.

- Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action.

- Engineers shall accept personal responsibility for their professional activities, provided, however, that engineers may seek indemnification for services arising out of their practice for other than gross negligence, where the engineer's interests cannot otherwise be protected.

- Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.

- Engineers shall conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession."

nspe.org/Ethics/CodeofEthics

According to ASME the ethics of engineering are important to uphold and advance the integrity, honor and dignity of the engineering profession. This can be done by:

- Using knowledge and skill for the enhancement of human welfare.

- Being honest and impartial, and serving with fidelity with clients.

- Striving to increase the competence and prestige of the engineering profession.

Also according to ASME:

1. "Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.

2. Engineers shall perform services only in the areas of their competence; they shall build their professional reputation on the merit of their services and shall not compete unfairly with others.

3. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional and ethical development of those engineers under their supervision."

files.asme.org/ASMEORG

Responsibility for Engineers Any engineer must realize that their biggest merit is their work, to serve society, and attend to the welfare of the majority. They must reject ideas with intent to harm the general interest. They should focus on building/designing products that are meant to last, not be destroyed easily so there is a need to buy for a new product soon. Engineers should give society the best they can.

Engineers should provide a contribution to discussions on the moral responsibilities of engineers in engineering design processes. With regard to active responsibility, the problem of many hands can be seen when no one feels or thinks that he or she is responsible for certain issues.

10.3 Work Ethic

Work ethic is not the same as the other ethics discussed in this chapter. It is possible to have acceptable engineering ethics without a clear work ethic. It is also possible to have great work ethic without any engineering ethics. Therefore, the successful engineer should have both strong engineering ethics and a strong work ethic.

Engineers should have ambition to get through rigorous course work, and to stay competitive in the field. They must also be cooperative because there is a lot of communication and working together that must be done in the field. Craftiness is also a key part because they need to be able to be quick in order to find the best way to make or improve something. They also need to be precise because one wrong move can set an entire project off the wrong track.

Engineers should strive for full and perfect attendance in all duties. Engineers should always strive for loyalty, honesty, responsibility, and reliability to gain trust and be known as full of integrity. Engineers should have the ability to work as a team member, neat and professional appearance, high productivity, good communication in all forms, continual cooperation, and the ability to improve oneself.

Engineers should always be courteous. Engineers should always work hard and want to be there. Engineers should be devoted to work and study, have a passion for their work, and always accept challenges.

Accept this fact: you will fail. Failure is a learning experience and an opportunity to try again better. Never readily give up and accept failure, keep trying to the end. You are the only person that can say “you can’t”, and you don’t have to listen.

10.4 References

bbc.co.uk/ethics

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11. Learning and Personality

This chapter presents some famous, interesting, and important studies on learning styles and personality types. Included are Bloom's Taxonomy, Howard Gardner's Theory of Multiple Intelligences, the VARK Learning Preferences, the Myers-Briggs Personality Test, and the True Colors Personality Typology. You should learn and know as much as you can about your own learning style preferences and personality type and exploit all of your strengths, and prevent weaknesses from limiting you, in learning. Professors should also try to determine their students' learning types and allow for, encourage, and facilitate different learning styles in each class.

11.1 Bloom's Taxonomy

In **1956** Benjamin Bloom and a group of educational psychologists developed a classification on how people learn, called Bloom's Taxonomy. Bloom's original scale started with Knowledge then Comprehension, Application, Analysis, Synthesis, and Evaluation. In the **1990s** one of Bloom's former students updated this scale to a more modern version. This scale started at Remembering, then Understanding, Applying, Analyzing, Evaluating, and Creating. One major change to the taxonomy was converting the terms from nouns to verbs. Also, synthesis was promoted to Creating and Evaluating was moved down one slot.

Descriptions of terms in the updated Bloom's Taxonomy are given below.

- **Remembering.** Ability to recall or remember information by defining, duplicating, memorizing and/or recalling.

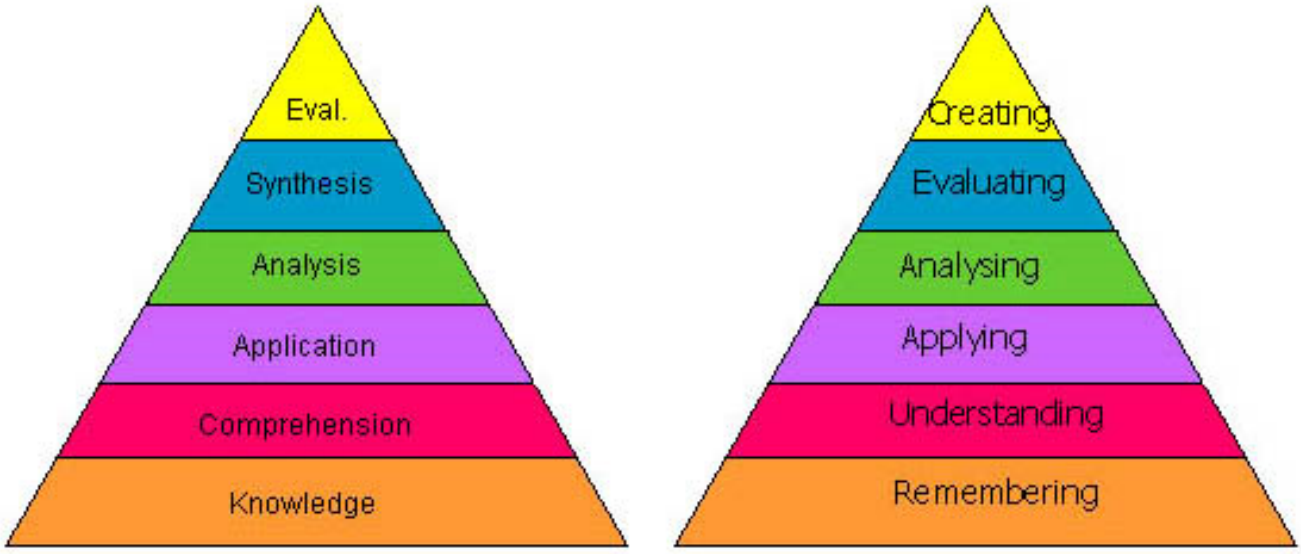
- **Understanding.** Ability to explain ideas or concepts by classifying, discussing and/or explaining. Demonstrative understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.

- **Applying.** Ability to use new information in a new way by choosing, demonstrating, illustrating and/or solving. Solve problems in new situations by applying acquired knowledge, facts, techniques and rules in a different way.

- **Analyzing.** Ability to distinguish between different parts of a whole, by appraising, comparing, and/or examining. Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.

- **Evaluating.** Ability to justify a stance or conclusion by arguing, defending, selecting and/or supporting. Present and defend opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria.

- **Creating.** Ability to create a new product or point of view by synthesizing, assembling, creating and/or developing.



Original Version **Modernized Version**

Bloom's Taxonomy

Bloom's Taxonomy works by following three classifications of learning:

- Cognitive or mental skills
- Affective or growth in feeling or emotion areas
- Psychomotor or growth in physical skills

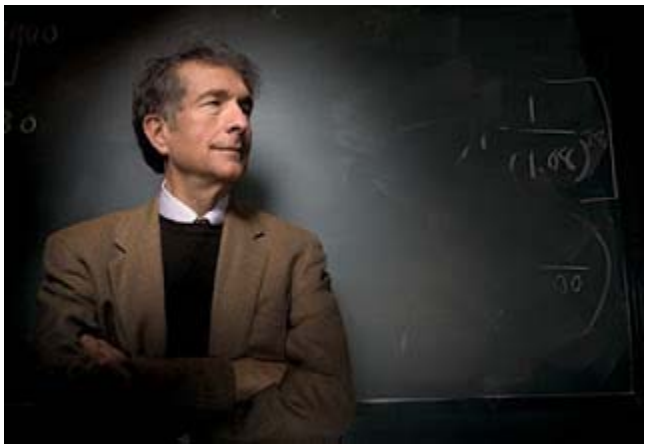
This method of learning focuses on different areas of the brain and how they are best stimulated in a learning process. Basically, you start at the bottom of the pyramid and work your way up in order to learn most effectively, Each step on the chart has a different function that helps one to learn more efficiently.

Creating: can the student create new product or point of view?	Assemble, construct, create, design, develop, formulate, write.
Evaluating: can the student justify a stand or decision?	Appraise, argue, defend, judge, select, support, value, evaluate
Analyzing: can the student distinguish between the different parts?	Appraise, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.
Applying: can the student use the information in a new way?	Choose, demonstrate, dramatize, employ, illustrate, interpret, operate, schedule, sketch, solve, use, write.
Understanding: can the student explain ideas or concepts?	Classify, describe, discuss, explain, identify, locate, recognize, report, select, translate, paraphrase
Remembering: can the student recall or remember the information?	Define, duplicate, list, memorize, recall, repeat, reproduce, state

Bloom's Taxonomy, Modernized Version

11.2 Howard Gardner's Theory of Multiple Intelligences

Howard Gardner was born in Scranton PA in 1943. He attended Harvard with the intent to study law, but changed his mind and started studying human nature and how humans think. His Theory of Multiple Intelligences differentiates intelligence into various specific modalities, rather than seeing it as dominated by a general ability.



Howard Gardner

Traditional IQ tests only focus on Verbal, Visual-Spatial, and Logical Mathematical Skills to measure human intelligence. The way Gardner viewed human intelligence is by the way they solve the problems or the way they fashion products. According to his theory:

"We are all able to know the world through language, logical-mathematical analysis, spatial representation, musical thinking, the use of the body to solve problems or to make things, an understanding of other individuals, and an understanding of ourselves. Where individuals differ is in the strength of these intelligences – the so-called profile of intelligences – and in the ways in which such intelligences are invoked and combined to carry out different tasks, solve diverse problems, and progress in various domains."

Gardner studied human intelligence using eight criteria (Gardner 1983, pp. 62-69):

1. Potential isolation by brain damage
2. The existence of idiots savants, prodigies and other exceptional individuals
3. An identifiable core operation or set of operations
4. A distinctive development history, along with a definable set of 'end-state' performances
5. An evolutionary history and evolutionary plausibility
6. Support from experimental psychological tasks
7. Support from psychometric findings
8. Susceptibility to encoding in a symbol system

Gardner originally identified seven distinct intelligences:

- **Verbal/Linguistic** – use words effectively, highly developed auditory skills and often think in words. The capacity to use language to express your thoughts and to understand others.

- **Logical/Mathematical** – reasoning calculating, think conceptually, abstractly, and are able to see and explore patterns and relationships. The ability to understand underlying principles of causal systems.

- **Musical** – Show sensitivity to rhythm and sound, love music, these people study better with music in the background. The capacity to think in music, hear, recognize, and manipulate patterns.

- **Intrapersonal** – understand one's own interests and goals. Shy away from others, in tune with their inner feelings, they have wisdom, intuition, and motivation, strong will, confidence and opinions. Having an understanding of yourself, who you are, and what you can do.

- **Visual/Spatial** – aware of the environment, like to draw, do puzzles, read maps and daydream. The ability to represent the 3D spatial world in your mind.

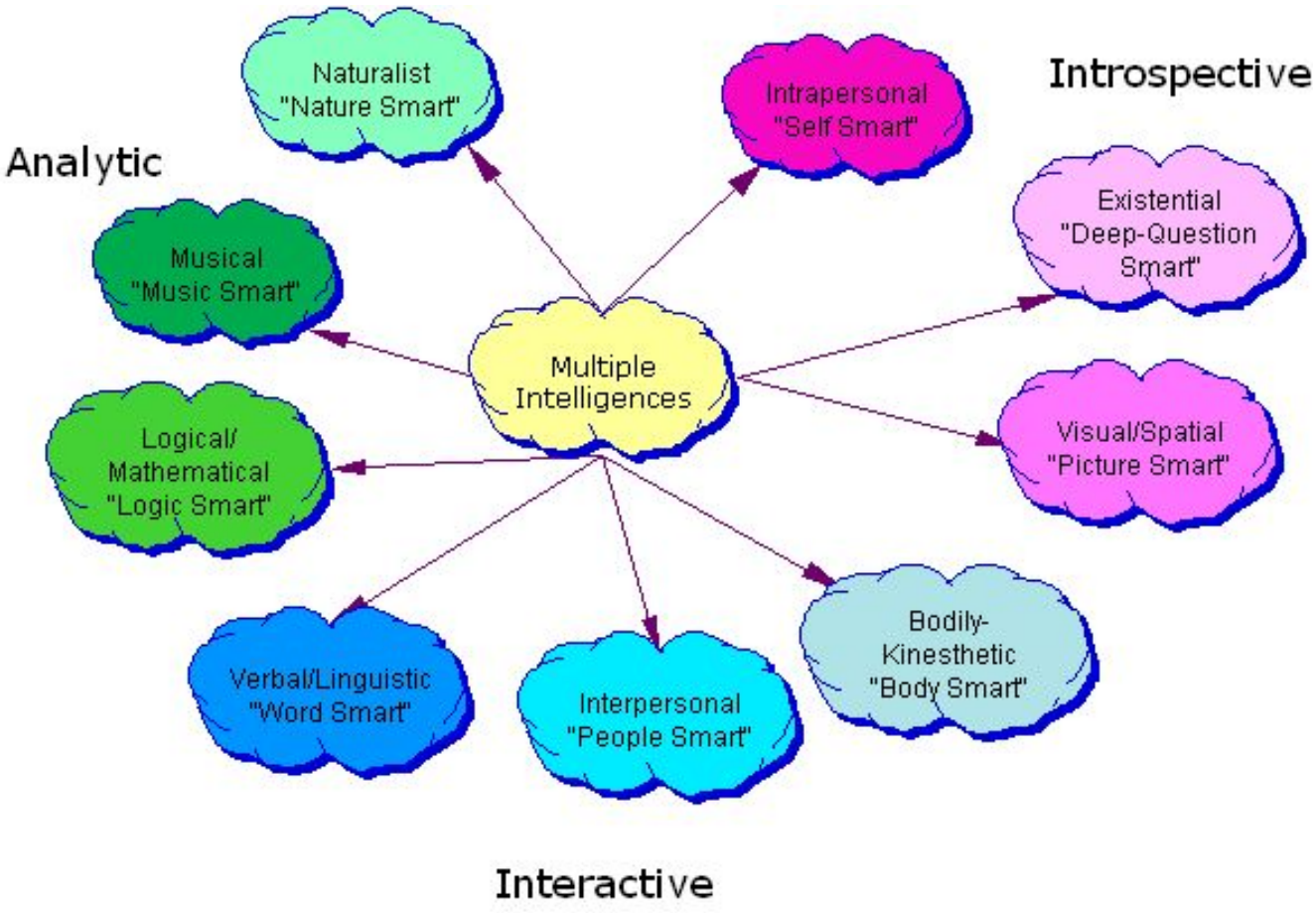
- **Bodily-Kinesthetic** – those who use their body effectively (like a dancer or surgeon). They like movement, making things and touching, and communicate well through body language. The capacity to use your body to solve problems, make something, and/or perform.

- **Interpersonal** – Understanding of and interaction with others. Learn through interaction. Have many friends, empathy for others, street smarts. The ability to understand other humans.

Gardner later added two more distinct intelligences:

- **Naturalist** – The ability to discriminate among living things plus sensitivity to features of the natural world. Ability to identify and classify patterns in nature. Certainly important in pre-history hunter-gatherer tribes. Today Naturalist Intelligence relates to how we relate to our environment and what role each part of the environment plays.

- **Existentialist** – exhibit the tendency to pose and ponder the big questions about life, death, and ultimate realities. Why am I here? What is my role in the world. Interest in discovering the roots and purpose of human nature, belief in a supreme being, and the structure and essence of human morality.



Gardner's Multiple Intelligences

In summary, human intelligence is quite complicated and individuals each have their own forms of intelligence, generally no one entity, but with combinations of some of the nine identified Intelligences.

11.3 VARK Learning Preferences

The **VARK** Learning Preferences Questionnaire helps to determine the learning styles of individuals to help them improve their learning and communication skills. The VARK learning preferences questionnaire is designed to find out how you learn most efficiently through asking basic questions about how you perceive actions in daily life. A student may want to use the questionnaire in order to find out what learning style is best for them, or a teacher could give it to their students to find out how they learn the best and change their lessons accordingly. The questionnaire has four different results of learning styles: **V**isual, **A**ural, **R**ead/Write and **K**inesthetic.

- **Visual** – Learns best through seeing diagrams and charts. Strategies to learn are: make charts and diagrams in notes, connect key words to visual representation, underline and highlight things, draw pictures and use white space in notes. People who learn best visually find it easiest to retain information when it is presented to them in a way that they can easily see it, such as using graphs or charts.

studygs.net

- **Aural** – Learns best through listening. Strategies to learn are: go to class and discussions, discuss the material with teachers and other students, use a tape recorder, remember examples or references, describe the overheads or visuals to people who were not there. Those who learn best aurally find it easiest to comprehend new information when they hear it from someone.

oocities.org

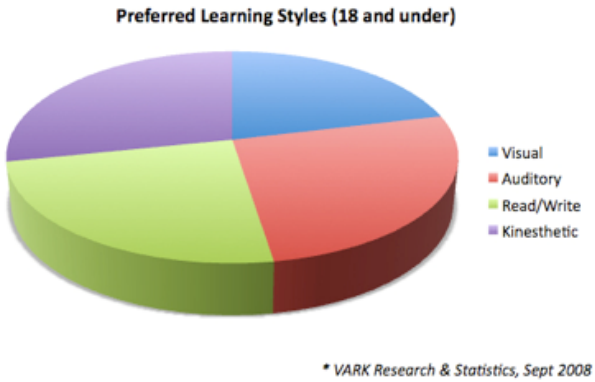
- **Read/Write** – Learns best through reading the material and writing it out. Strategies to learn are: read textbooks and handouts, use dictionaries and encyclopedias, read/write essays, keep lots of notes, arrange information into lists. People who learn best through reading and writing find it easiest to learn new information when they read it on paper or are able to write it down.

secondarycontent.pbworks.com

- **Kinesthetic** – Learns best through working hands-on – Go on field trips and to exhibits, work in laboratories if possible, find real life examples of material, take a hands-on approach to material, discuss material with another kinesthetic person. The kinesthetic learning style refers to a way of acquiring knowledge in which the learner uses sense of movement to gain information about the world. Kinesthetic learners work best in activities that incorporate physical activity. Learning kinesthetically means to learn through actions and practicing new things, as opposed to listening to a lecture or watching a demonstration.

Read/Write vs. Kinesthetic

autism-essentials.com



Please note that the VARK Learning Styles indicate individual learning preferences, not necessarily individual strengths or weaknesses.

11.4 Myers-Briggs Type Indicator

The theory of personality type was developed by Carl Jung in the **1920s** to explain how personality affects our judgment and decisions. The Myers-Briggs Type Indicator is a personality assessment developed during **WWII** by Katherine Briggs and her daughter Isabel Briggs-Myers, based on the work of Jung. Developed for determining how women could best fill job openings during **WWII**, the Myers-Briggs Type Indicator was not published until **1962**.

- The Briggs found that there are 16 different personality types, based on your attraction to the words Extraversion vs. Introversion, Sensing vs. Intuition, Thinking vs. Feeling, and Judging vs. Perceiving.

- They realized that if there are different personalities and that they show similar characteristics in people, then the decision making process should be equally similar. This applies to the topic in that people who have the same personalities probably learn the best in similar ways.

- They found that there is a correlation in decision making between those who have the same personality type.

- It is important to note that one personality type isn't better than any other, it's just how you are. The Myers-Briggs test has been repeatedly proven to be an accurate way of measuring one's personality and a way to gauge one's decisions.

- Some can learn to act outside their personality. For example, you may think that Bill Gates is extroverted due to his leadership and ability to address large crowds. In fact he is an introvert based on the test (taken before he became famous).

The Myers-Briggs Type Indicator (personality test) is a 72 question test that determines what type of personality you have. It is a psychometric questionnaire composed of questions designed to measure psychological preferences on how people perceive the world. There are a multitude of questions asked ranging from how one performs at work to how one goes about their average day. There are only two options for this test to choose from for each question, so answering it right is a must if the test is to be accurate. This test can also be used to determine for which careers a person would be best suited, based on their personality. The results can also be applied in a personal relationship to see the long term compatibility results with a person's significant other.

The Theory of Personality Types contends that:

1. An individual is either primarily **E**xtraverted or **I**ntroverted (How do you direct your energy?)

2. An individual is either primarily **S**ensing or i**N**tuitive (How do you prefer to process information?)

3. An individual is either primarily **T**hinking or **F**eeling (How do you prefer to make decisions?)

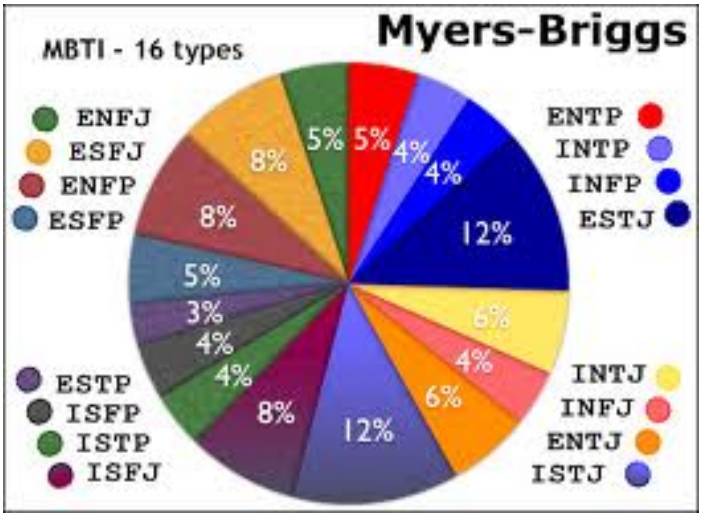
4. An individual is either primarily **J**udging or **P**erceiving (How do you structure your dealings with the outside world?)

These are the four dichotomies. From these possibilities there are 16 possible combinations of personality types (4 traits with 2 choices each, 4^2=16). This does not mean that someone is always strictly only one or the other of these choices in each category. We all function in all of these realms on a daily basis. When we study ourselves and see what works for us, we can identify our natural preferences and learn our strengths and weaknesses.

The following table shows the 16 Myers-Briggs Personality Types, by Capital letters designation, name, and example famous persons with each personality type.

ESTJ – SUPERVISOR Colin Powell Joseph Stalin Queen Elizabeth I	ISTJ – INSPECTOR Queen Elizabeth II Harry S. Truman Woodrow Wilson	ESFJ – PROVIDER Leonid Brezhnev George Washington	ISFJ – PROTECTOR George Bush Mother Teresa
ESTP – PROMOTER Winston Churchill Hug Hefner Ernest Hemingway	ISTP – OPERATOR Amelia Earhart Clint Eastwood Charles Lindbergh	ESFP – PERFORMER "Magic" Johnson Elvis Presley Elizabeth Taylor	ISFP – COMPOSER Paul Gaugin Wolfgang Mozart Barbra Streisand
ENFJ – TEACHER Mikhail Gorbachev Vladimir Lenin Margaret Mead	INFJ – COUNSELOR Emily Dickenson Eleanor Roosevelt	ENFP – CHAMPION Charlotte Bronte Thomas Paine	INFP – HEALER Emily Bronte Albert Schweitzer
ENTJ – MOBILIZER Napoleon Bonaparte Bill Gates Margaret Thatcher	INTJ – MASTER MIND Peter the Great Thomas Jefferson Fredrich Nietzsche	ENTP – INVENTOR Walt Disney Steve Jobs	INTP – ARCHITECT Marie Curie Albert Einstein

The Sixteen Myers-Briggs Personality Types with Examples



The Personality Types are fairly evenly distributed in the population

The Sixteen Myers-Briggs Personality Types with Descriptions

(caution – different organization than the previous table)

11.5 True Colors Typology

Around **400 BCE Hippocrates** incorporated the Four Temperaments concept (derived from the ancient Four Humors concept) into medical theory:

- Sanguine – pleasure-seeking and sociable
- Choleric – ambitious and leader-like
- Melancholic – introverted and thoughtful
- Phlegmatic – relaxed and quiet

Diana Vandel (UT Austin Music Education) created the "Hue-man Traits" test in **1982**, to maximize personality and psychology in the workplace.

In **1984 David Keirsey** and **Marilyn Bates** presented four character and temperament types in Please Understand Me:

- Dionysian or Artisan Temperament (Sanguine)
- Apollonian or Idealist Temperament (Choleric)
- Epimethean or Guardian Temperament (Melancholic)
- Promethean or Rational Temperament (Phlegmatic)

In 1978 **Don Lowry** developed the True Colors character and temperament types, along with a simple test to rate individuals (true-colors.com).

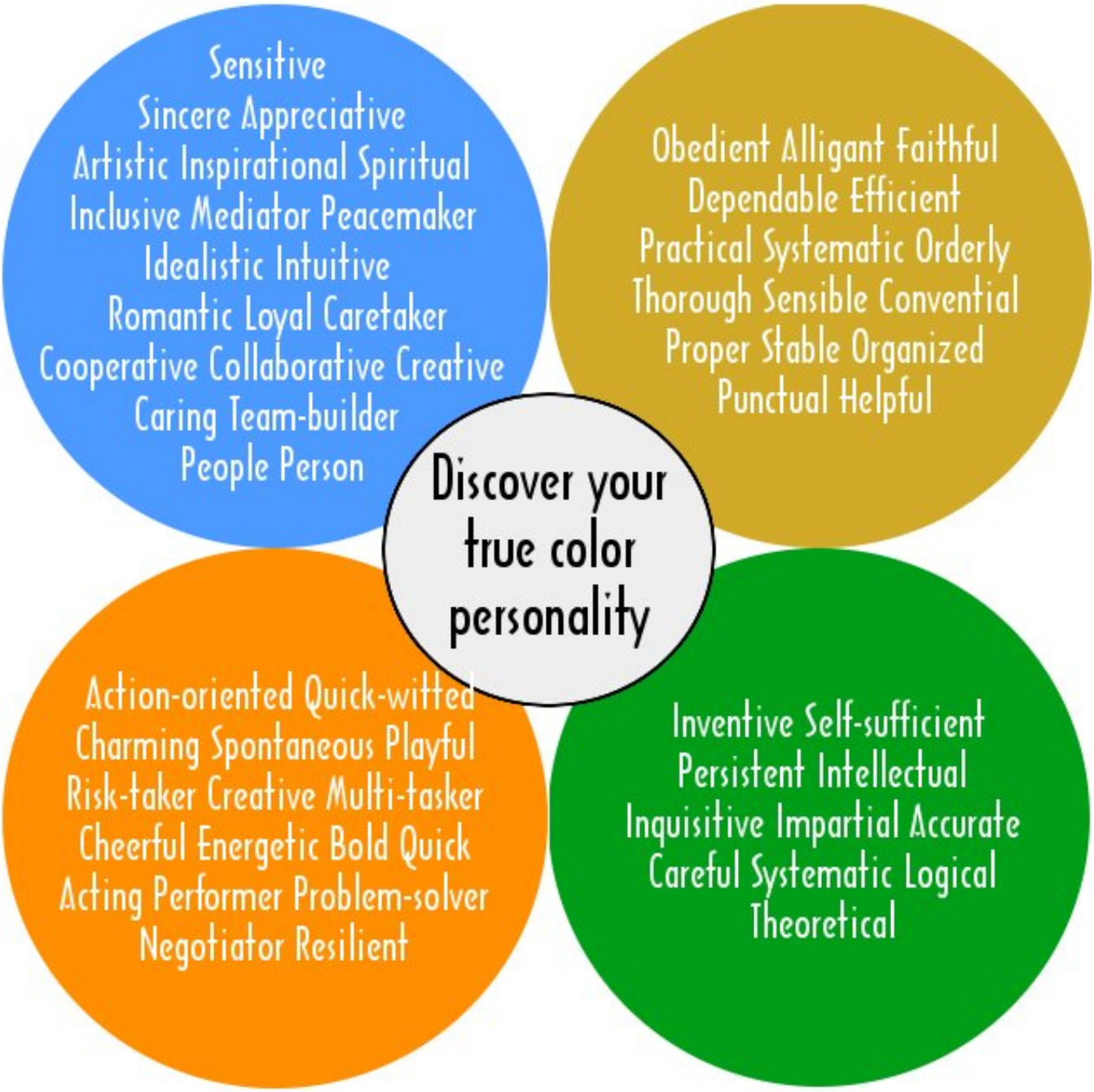
The four possible personality colors are Blue, Orange, Green, and Gold. This test can stand alone or serve as part of team building, leadership, communication, interpersonal skills, conflict management, and collaboration programs. It is a metaphor for characteristics and how to create success and attain self-esteem.

All individuals have characteristics of each of the four colors to some degree. Most individuals have a dominant or even strongly dominant color. Your dominant color can change with time and maturing. Most individuals can operate outside their color comfort zone. This does not necessarily come easily, but must be actively worked on.

Core Needs and Values by Color

Color	Core Needs and Values
Blue	relationships and authenticity
Orange	skillfulness and freedom
Green	intellectual competence and knowledge
Gold	duty and responsibility

At OU, 3500 students, faculty and staff have learned their True Colors since 2008. The test is offered by the Amanda J. Cunningham Leadership Center at a cost of $10 per person, scheduled at least two weeks in advance. It is intended for businesses and organizations. It helps improve communication, team-building, leadership, morale, and conflict resolution skills both at work and at home. The class is taught by a certified True Colors trainer and lasts about 2 hours.



True Colors with Characteristics

Characteristics by Color

	Blue	Orange	Green	Gold
Esteemed by	helping people	recognition of skill	insights, intellectual competence	being of service
Appreciated for	unique contributions	creativity	ideas	accuracy and thoroughness
Validated by	personal acceptance	visible results	affirming insights and wisdom	appreciation of service
At work	catalyst	flexible	pragmatic	procedural
Specialty	relationships	energy	strategy	results
Overall mood	committed	enthusiastic	cool, calm, collected	concerned
Character trait	authenticity	skillfulness	ingenuity	responsibility

Example Famous People by their True Color, projected from history (not from the test):

Blue

- Mozart
- Thomas Jefferson
- Mahatma Gandhi
- Jimmy Carter

Orange

- St. Francis of Assisi
- Amelia Earhart
- Sir Winston Churchill
- John F. Kennedy

Green

- Socrates
- Benjamin Franklin
- Thomas Edison
- Eleanor Roosevelt

Gold

- George Washington
- Florence Nightingale
- Henry Ford
- Mother Teresa

11.6 References

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Appendix - Maps

OU Athens Campus and Athens Ohio Maps:

Main Campus Map
ohio.edu/athens/campus.pdf

North, College, and East Greens Map
ohio.edu/athens/ada_access/north_green.pdf

South Green Map
ohio.edu/athens/ada_access/south_green.pdf

West Green and Campus Services Map
ohio.edu/athens/ada_access/west_green.pdf

Sports Complex Map
ohio.edu/athens/ada_access/sports_complex.pdf

The Ridges Map
ohio.edu/athens/ada_access/the_ridges.pdf

The Ridges Nature Trails Map
athensohio.com/upload_files/files/RidgesTrailMap

Athens Ohio Map
mapas.owje.com/maps

The Athens Trail Network
athensohio.com/upload_files/files/Athens_Trail_08

Hockhocking Adena Bike Path Map
seorf.ohiou.edu