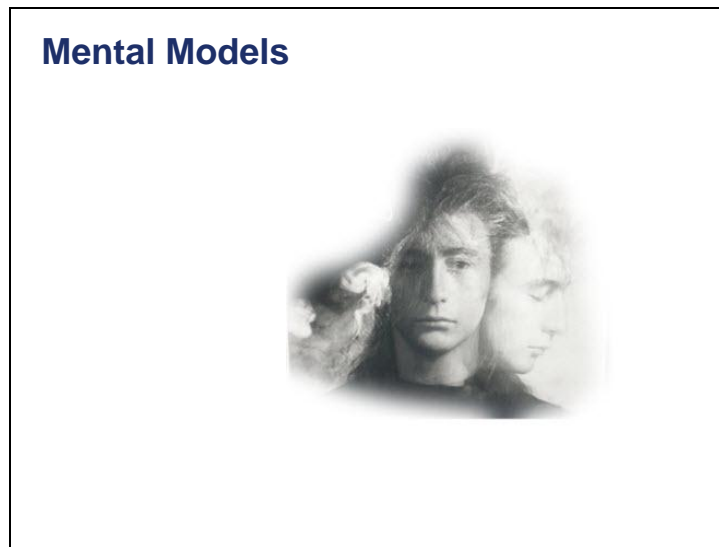


The FAA has developed a memory aid called 'PEAR' and it makes recognition and mitigation of Human Factors even easier. 'PEAR' has been used as a memory device for over a decade to characterize Human Factors in aviation maintenance. It prompts recall of the four important considerations for Human Factors programs:

- People who do the job;**
- Environment in which they work;**
- Actions they perform;**
- Resources necessary to complete the job.**



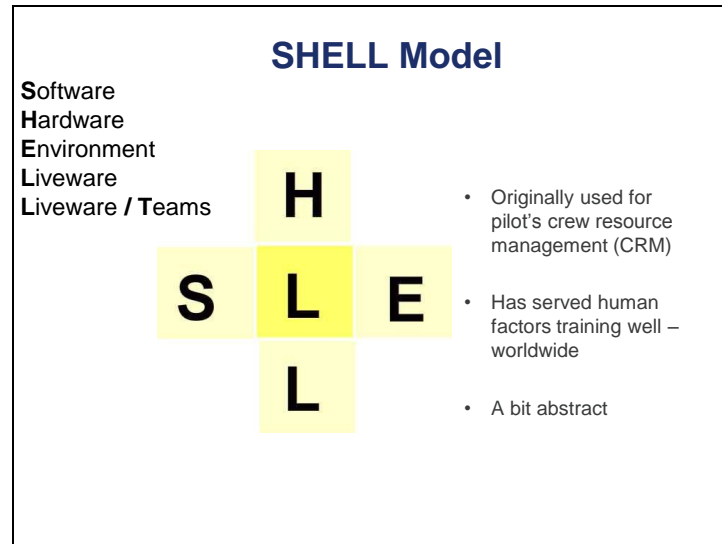
To understand PEAR, we need to understand mental models.

A mental model is an explanation in someone's thought process for how something works in the real world. A mental model is a visual explanation of a thought, a means to better explain and understand complex concepts and systems.

Mental models are like schematics, or road maps that leads us to understanding - that can be shared.

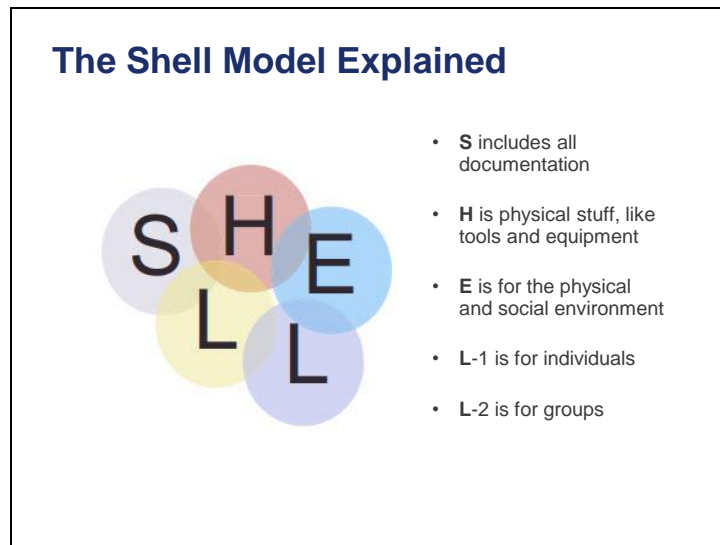
You have seen three-dimensional scale models of buildings, cities, aircraft or components. Models do not have to be in three dimensions to be helpful. A clear sketch or photograph is another type of model. A model can also be more abstract - for example, a simple block diagram. A figure of speech is another model. For example, a co worker may say to you, “the storm is just north of the airport.”

In that case, you merely imagine the model in your head. The models most often used in defining the dynamics at work in an aircraft maintenance system are the SHELL and the PEAR.



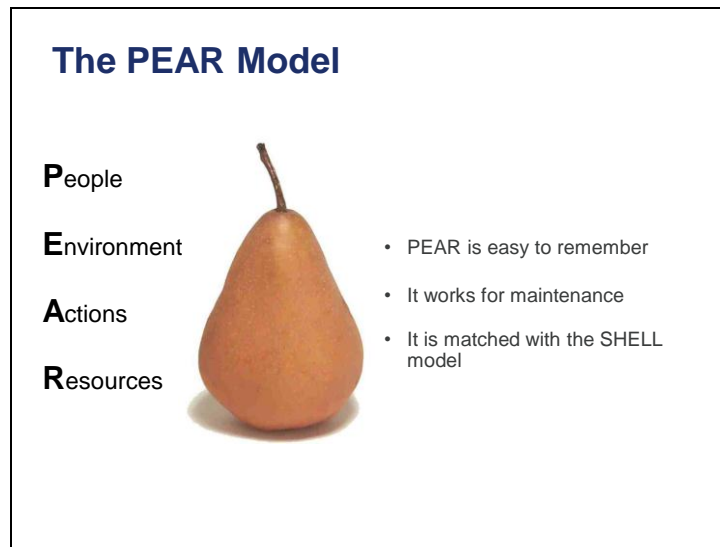
FAA is promoting the PEAR model. However, the SHELL model has also been widely used, and therefore, is offered here. The SHELL model was created by Professor Edwards in the early 1970's. The original purpose was to teach flight crews about Crew Resource Management. However, the model also helps us to understand maintenance environments. The SHELL model is comprised of the following parts:

S for Software;
H for hardware;
E for Environment;
and there are two Ls for Liveware.



Here is a quick review of the SHELL Model.

S, the first letter in the SHELL model, applies to **Software**. Software with regard to SHELL is not necessarily computer software. It refers to such things as the rules and procedures of operation, technical manuals, and information to support system operation. The **H** is the **Hardware**, which are quite clearly the tools, hangars, aircraft, buildings and other such physical things. **E** represents the **Environment**, which is actually two distinctly different environments: the physical work environment, including factors like temperature, lighting or humidity, and the political and social environment. That includes abstract factors like corporate communications or company profitability. The **L** in Shell stands for **Liveware**, and uses 2 **Ls**. The first **L** represents the individual human characteristics like knowledge, skills, experience, attitude and culture. The second **L** refers to the human in groups, including such factors as teamwork, communication, group norms and leadership. In summary, if you can remember the word **SHELL**, like the oil company, you can remember key considerations for human factors.



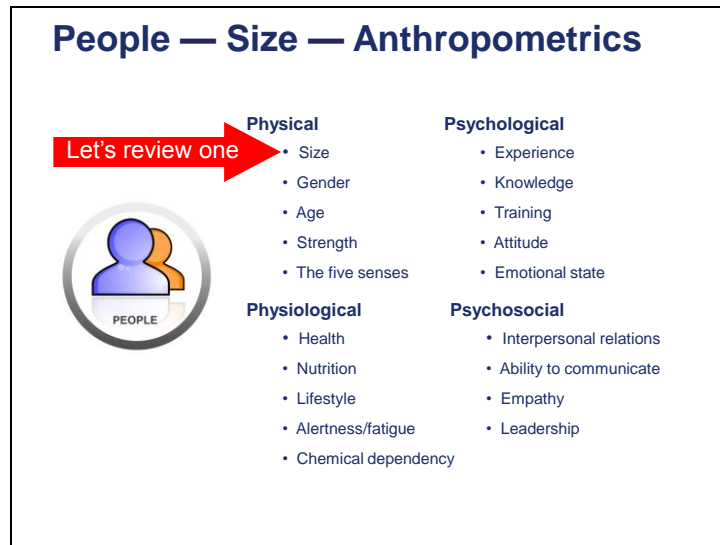
The PEAR Model is easy to remember. People, Environment, Actions, Resources. It is very similar to the SHELL Model.



The PEAR model covers the same content as the SHELL model, but the terms are a bit less abstract. Dr. Michael Maddox and Dr. Bill Johnson developed the PEAR model as an easy way for aviation maintenance personnel to remember human factors. Remember the fruit, the PEAR: P is for People; E is for the Environment in which they work; A is for the Actions they perform, and R is for the Resources necessary to perform the work. If you remember the words for these four letters, then you will always maintain the basic "know how" to consider the human factors within any work environment.



People come in all shapes, sizes, other variables include age, gender, health, experiences and capabilities. Even though we experience variability one from to another in physical attributes, for the most part these characteristics are the most concrete. Our physicality directly impacts the task at hand. Physiology is a bit more abstract. But this attribute is tied directly to our physical world. Physiology is a dynamic state that changes based upon health, habits and the way we live. Psychological differences are not as easy to identify, our psychological self takes into consideration our experiences, knowledge, training, attitude and emotional state these all inform our attitudes, awareness and cognitive capabilities. The psychosocial self is defined by how we relate to others and this directly impacts teamwork.



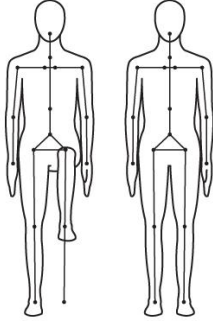
Physical size deals with issues of anthropometrics, matching the people to the job. At times various tasks may take into consideration the variable of size.

For example, a taller person may not need a ladder to perform a task. On the other hand a smaller person may work in a more restricted/confined space like cockpits, access panels, or inside aircraft infrastructures.



Attitude is derived from several factors including our physical attributes, the way we live, our training, experience and knowledge basis. Attitude is something we can see and sense. However truly understanding this aspect of another person may be very difficult. Often we misunderstand or misread others. One reason is the complexity of our design. We can't always know or understand what is going on inside another person.

Anthropometry



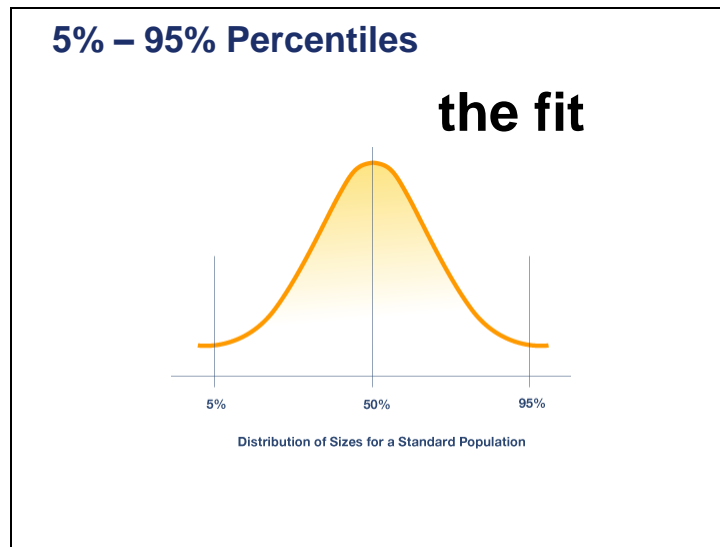
The diagram shows two human figures, one male and one female, with various measurement points indicated by dots and lines. The male figure is on the left and the female figure is on the right. The measurement points include the head, neck, shoulders, elbows, wrists, hips, knees, and ankles. The female figure is shown with a wider pelvis and a different leg structure compared to the male figure.

The Study of Body Measurement

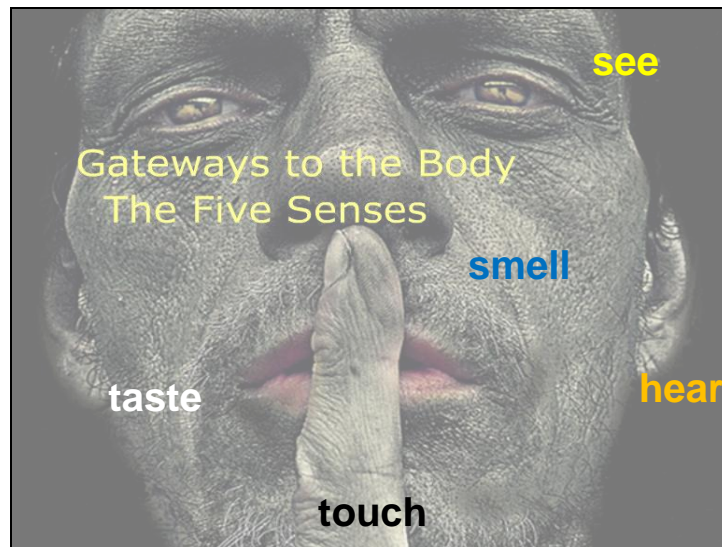
- User populations
- Why it's important
- Male/female split
- Individual variation
- Use of "percentiles"
- The myth of the 50th percentile person
- 5th through 95th percentile

Lets come back to the physicality side of a person. Mechanics, technicians and inspectors span a wide range of body sizes. Body measurement data can be used to ensure workplaces, tools, requirements for lifting parts, accessing confined spaces and so on are appropriate to the size and strength of the people who will be doing the jobs.

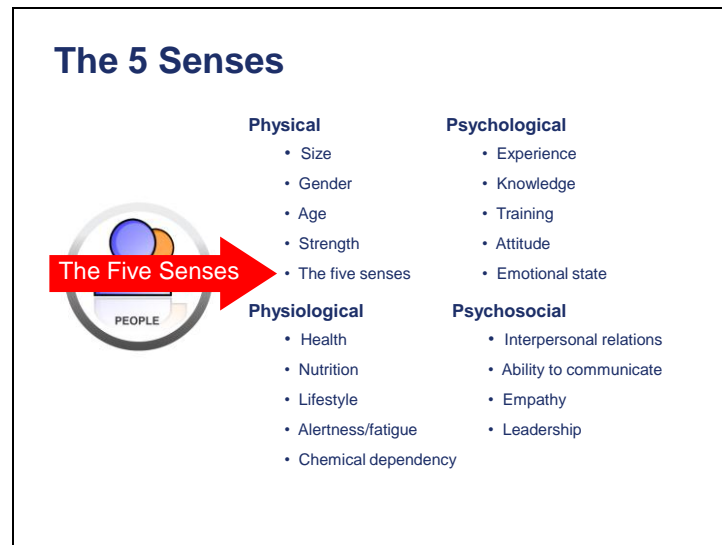
This will lead us to consider the principal of the 5th through 95th percentile.



Groups of people do not have the same body dimensions. For each body dimension, there is an approximate “normal” distribution, sometimes called a bell-shaped curve. Typically we do not design things for the 50th percentile of the population. If we do that, then we ensure that it won’t fit most of the people who do the job. For example, designing doorway heights for the 50th percentile would result in doors that are about 5’6” high. We need to design for the extremes - 5th percentile female to 95th percentile male.

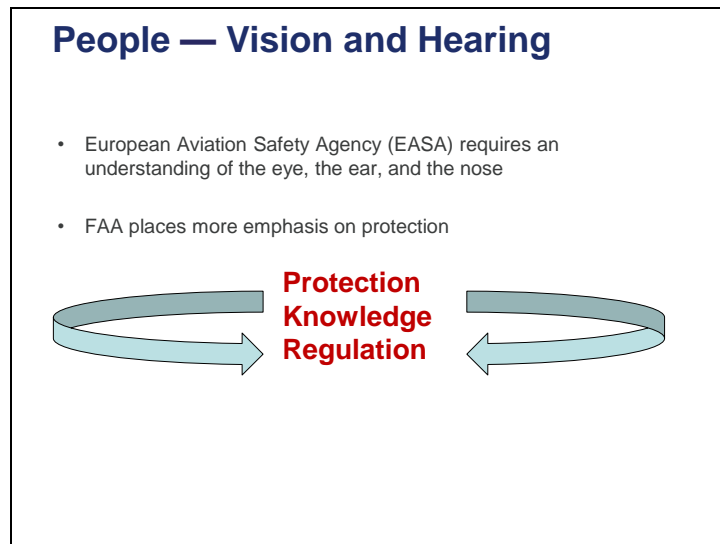


Lets consider the fives senses of taste, touch, smell, hearing and seeing as gateways to the body.



The five senses of smell, touch, hear, see and taste are gateways to our perceptions. Whether or not we realize it we are continually receiving information concerning our tasks and actions via our five senses. For example as we move through a hangar or move through a task our senses are continually updating and changing our situational awareness.

The senses are subject to degradation as we age or as a result of damage to one of our sensors. Sometimes we compensate for senses that have been dulled, or damaged often this compensation is done sub consciously. Therefore it is important to be proactive with your health and the testing of your senses. An example would be compensation in our vision. As we grow older our eyes begin to have a harder time with focus, as a result we may compensate, when we really need to have an eye examination.



There are few FAA regulations to force you to address sensing and perception in your human factors program. However, the European Aviation Safety Agency (EASA) rules do require that you understand the working of the eye, ear and nose and how to this relate this knowledge the overall function of the maintenance environment. Increasing your knowledge of the senses will result in a greater degree of protection. Regulatory guidelines are in place to ensure companies and individual workers address the senses within the context of human performance and the workplace.

People — Vision

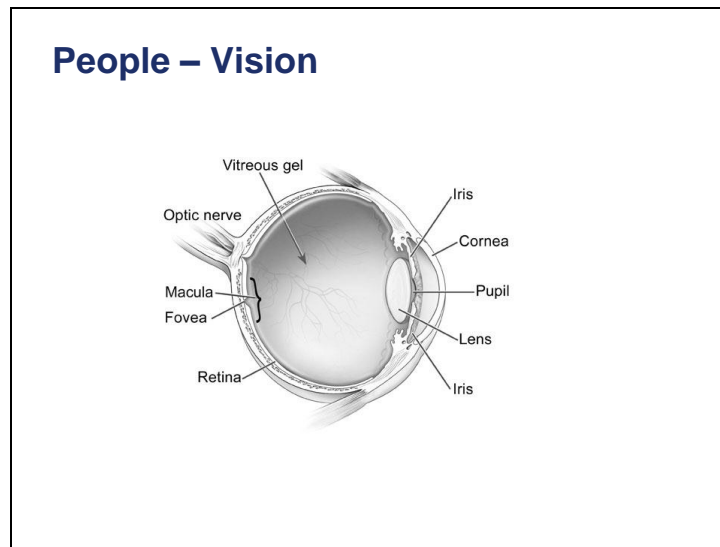


- The eyes and how they function
- Wear your safety glasses
- Have a regular eye exam

Eyes are the parts of our body that perceive light. They allow us to see the world and to understand how objects relate to each other. We can distinguish far away objects from close ones and determine their color and shape.

The brain processes the raw data from the eyes to make sense of what you see compared to your knowledge of the world around you. The brain interprets what it receives from the eyes.

The function of the eye is critical and care must be taken to protect your eyes in the workplace . One way to do this is to obey safety warning signs in the shop and wear the proper safety rated eye protection. Fostering a proactive attitude concerning your vision is important. Proper prescriptive aids will help to reduce eye strain and blurred vision.

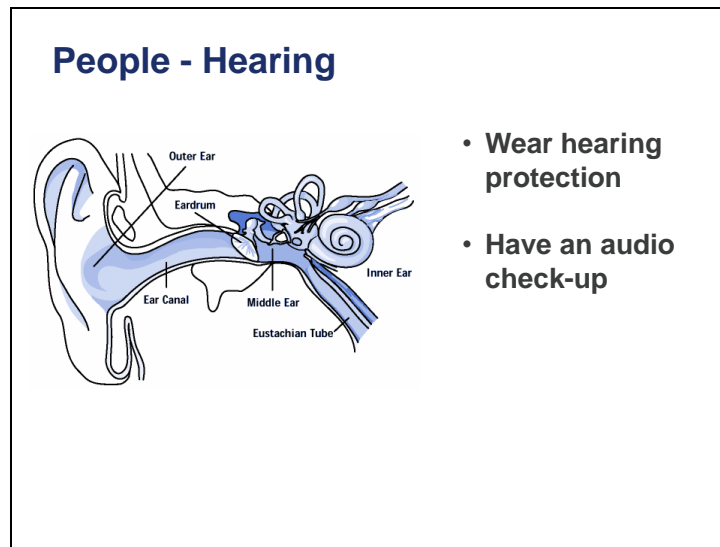


It is important to explain the function of the eyes so that we can better understand sight and possible visual impairments. The eye has four main tasks:

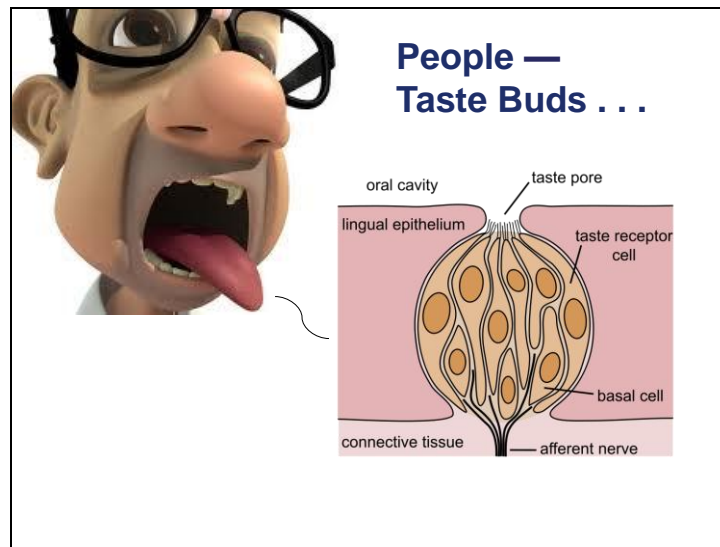
The perception of brightness, color, space and form and movement.

The eye is similar to a simple camera with a shutter, a lens, and a light-sensitive background. In the case of the eye these are called: - IRIS, - LENS and - RETINA. Light passes through the cornea, the pupil, and the lens onto the retina, stimulating light-sensitive cells.

This stimulation produces small electrical impulses that are transmitted to the brain via the optic nerve. The eye adapts constantly to changing visual tasks. These include ADAPTATION - controlling the incidence of light; ACCOMMODATION - focusing; and FIXATION - locating direction. All three activities are physiologically dependent on each other and are controlled by six muscles.



The ear has two main tasks - to provide hearing and balance. Both are important for our occupation. Here we will deal mainly with hearing. The ear is made up of the outer, middle and inner ear. The three sections transform sound waves into nerve impulses, which the brain recognizes as sounds. The sound waves are directed to the eardrum through the auditory canal. The vibrations are "mechanically" transferred to the membrane of the cochlea, which is filled with liquid, by small bones in the ear. The liquid oscillates, stimulating millions of tiny hairs, which in turn stimulate the nerves. The hearing range of a healthy, young individual is from 20 Hz (Hertz) to 20,000 Hz. It is most sensitive at about 3,000 Hz. Care must be taken with the ears, the ear does not adapt to high pitches well and over time may suffer damage. This is an accumulated effect. This is of special importance in the aviation industry where maintenance personnel may be exposed to loud and pitched noises from the everyday operation of aircraft. Damage to our hearing is an accumulated effect. Rules concerning ear protection should be carefully followed.



Humans receive tastes through sensory organs called taste buds, concentrated on the upper surface of the tongue. To taste something, you need the "sensors" in the mouth and the nose. That is why food tastes different when you have a cold. However, tasting should play NO part in maintenance! While a person may perceive hundreds of different tastes these are all combinations of four primary taste sensations, sour, salty, sweet and bitter.

People — Taste / Touch / Smell

Sensors in the skin perceive temperature, pressure, and other tactile information.

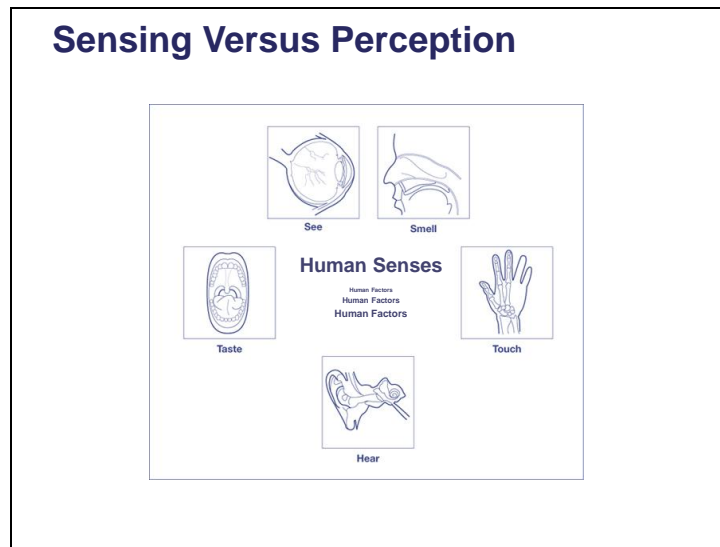
Cells in the nose enables us to smell.

A photograph showing a person's hand holding a silver pen, with the tip of the pen touching the screen of a black smartphone. The phone is lying flat on a white surface. The background is plain white.

Touch is when the sensors in the skin perceive temperature and pressure and transfer the information to the brain. Sense of touch can, for example, enable us to work with our hands and warn us of injuries.

Cells in the nose enables us to smell. Some maintenance tasks require a "sniff check" in order to determine a system error.

To taste something, you need the "sensors" in the mouth and the nose. That is why food tastes different when you have a cold. However, tasting should play NO part in maintenance!



The next couple of examples show how sensing and perception can be tricked.

Sensing and Perception

desk

rock

cat

spoon

book

Tell them to name the color of the word. Move them along if they go slow.

Sensing and Perception

dog

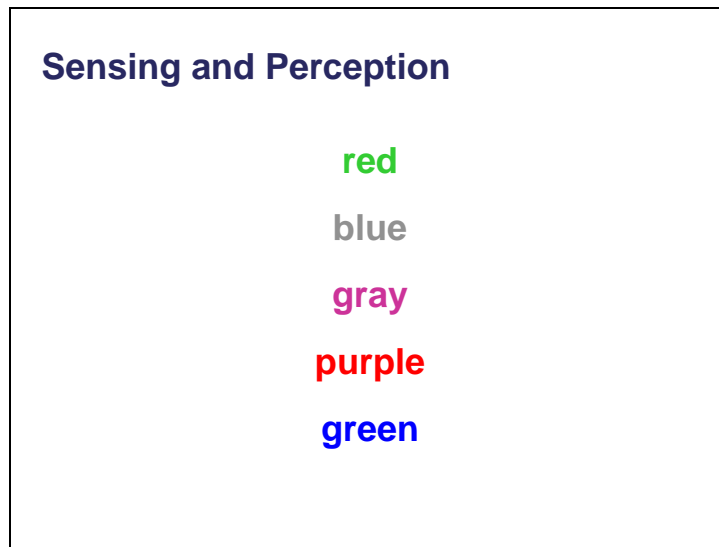
house

table

car

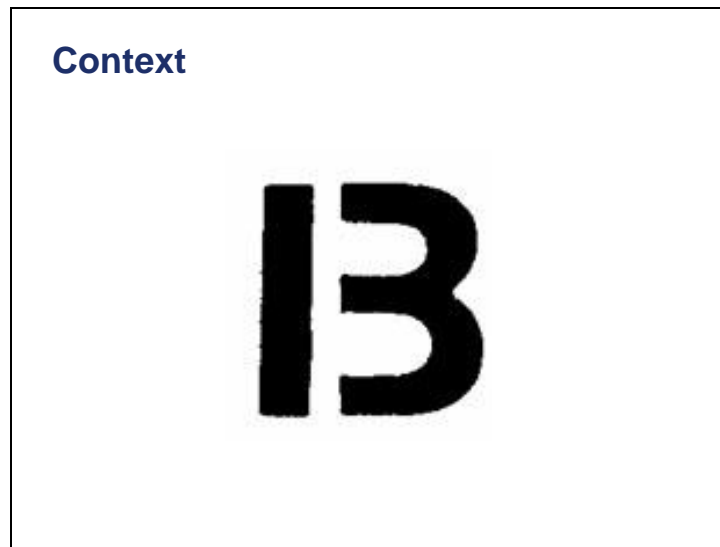
tree

Rush them along. Tell them to go faster.



In most cases they will get this wrong, especially if you rushed them.

This is called the “Stroop” test and it demonstrates that there is some mental processing that takes place between when the eyes see things and the brain understands what we see.



What do you see? Some will see “the letter B” some will see the “number 13.” Without more information we can only guess.

Now?

A, B, C, D, E, F
10, 11, 12, 13, 14

Both the letter “B” and the number “13” are the same figure. However, the context determines how you perceive it.

(Coren, et al, (1994), Sensation and Perception, Harcourt Brace College Publishers)

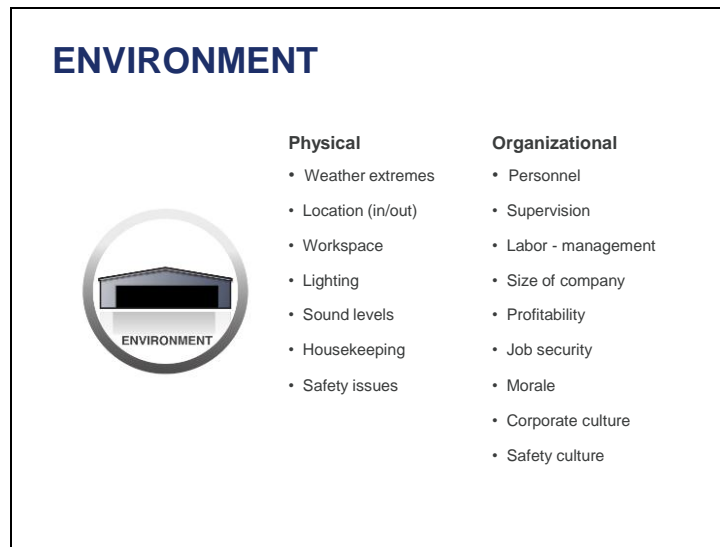
Humans tend to process written information, such as instructions, signs, etc., in the context in which they are used. A single item in a series of numbers will likely be perceived as a number, whereas the same item in a series of letters will likely be seen as a letter.

Many times context is key to understanding.

PEAR — People — Summary: It Takes a Human to Adapt to this Kind of Work



Look at the complexity of the rewiring tasks, the environment, the tools. This is an example of how humans can adapt to work.



Now lets consider the E of the PEAR which stands for environment, the physical environment includes weather extremes, lighting, clutter in the shop. A different example of environment is organizational environment, the shop culture, company cultrure, safety culture and includes how we feel about where we work.

NOISE



- Exposure to noise is cumulative
- People cannot adapt to high noise levels
- Noise interferes with communication
- OSHA requires hearing protection above 85 dbA (TWA)
- Ear protection devices can also interfere with communication
- Noise increases the rate of errors

This is not ideal hearing protection. Important things to remember about noise, it has an cumulative effect over time, it is hard for the human ear to adapt to high pitches.

Organizational Factors — Safety Culture



- Safety is everyone's responsibility
- Management rewards safe actions
- Everyone is empowered to stop work for safety concerns
- Employees will enforce safety practices
- Reporting unsafe acts or conditions will be rewarded
- Employees work as a team
- Formal safety management systems are now being included in shops

Take a moment to review Safety Culture as an example of environment. Safety is everyone's responsibility. Not only are we required to practice safe work habits, reporting unsafe acts should be encouraged and rewarded. In order for reporting to be encouraged the company must adopt a just culture environment.

Actions



- What do you need to know?
- What skills are necessary?
- Steps to perform a task
- Sequence of actions
- Communication requirements
- Information requirements
- Inspection requirements
- Certification requirements

The A of the PEAR model stands for Action. This includes your actions in a maintenance task, what skills, procedures and resources are required in order for you to perform your maintenance duties.

Actions — What Can You Do Today?



- How do you communicate error events?
- Are there enough people to do the job?
- Do personnel understand the cost of aircraft damage?
- How can you motivate one another to care more?
- Are you responsible for the things that others do?

Review these questions.

- How do you communicate error events?
- Are there enough people to do the job?
- Do personnel understand the cost of aircraft damage?
- How can you motivate one another to care more?
- Are you responsible for the things that others do?

Task Analysis — It's How We Do It



- Identify the steps required to complete a task
- For each step, identify the information, tools, communication links, procedures, and so forth, necessary to complete the step

Task analysis is an organized way to decompose a job. You look at each task and then analyze the necessary knowledge, skills, and attitude to accomplish the task.

COMMUNICATION



- Lack of communication is a major cause of errors
- Verbal and non-verbal
- Positive listening
- Communication protocols
- Affirm reception of information (readback)
- Never assume the information you transmitted is the same information received

Verbal Communication: the reason that we have two ears and one mouth," said the Greek philosopher, Zeno, "is that we may listen the more and talk the less." Of the top five areas employees feel management needs to improve, listening skills consistently ranks near the top. than our mouths can possibly work.

a.) Verbal Communication

there are three considerations: (1 One of the reasons that all of us tend to struggle in this area (according to other's assessment; rarely do we see the need) is that our mind works five to seven times faster) you must

make your message understood; (2) you must receive/understand the intended message sent to you; (3) you should exert some control over the flow of the communication.

(b.) Thus you must learn to listen as well as to speak.

NON-VERBAL COMMUNICATION includes facial expressions, tones of voice, gestures, eye contact, spatial arrangements, patterns of touch, expressive movement, cultural differences, and other "non-verbal" acts. Research suggests that non-verbal communication is more important in understanding human behavior than words alone--the non-verbal "channels" seem to be more powerful than what people say.

Research suggests that the majority (as much as 76%) of the message we give to another person during conversations is carried by non-verbal communication. So, we must be very careful and strategic in our use of non-verbal communication. The tone, volume, rhythm or cadence of our voice is critical. Blending and pacing are also important aspects of this skill.

Never assume the information you transmitted is the same information received.

Lack of communication is a major cause of errors.

RESOURCES



- Technical documentation systems
- Test equipment
- Enough time
- Enough people
- Lifts, ladders, stands, seats
- Materials
- Portable lighting, heating, cooling
- Training

The R of the PEAR model is Resources. Resources includes documentation, procedures, tools equipment, time, people, materials to name a few. A LACK of resources is very difficult to work around. Without the proper equipment, tools, documents, people and environment - accomplishing maintenance tasks are almost impossible. A lack of parts or a lack of inventory is also a source of frustration that may result in improper workarounds.

EXAMPLES



- Are resources ever a problem?
- What are the solutions?
- Can you give an example?
- What advice can you offer?

Use these questions for discussion.


TEST EQUIPMENT



- It's how we get objective information
- A "must have" for proper diagnosis
- Can have a good or bad user interface
- Can be misused
- Might require significant training to use properly

Test equipment provides the user with objective information, and is vital for proper diagnosis. Following procedures is important here. Test equipment can be miss used. If the equipment is on the calibrated equipment list it should be up to date on its calibration.

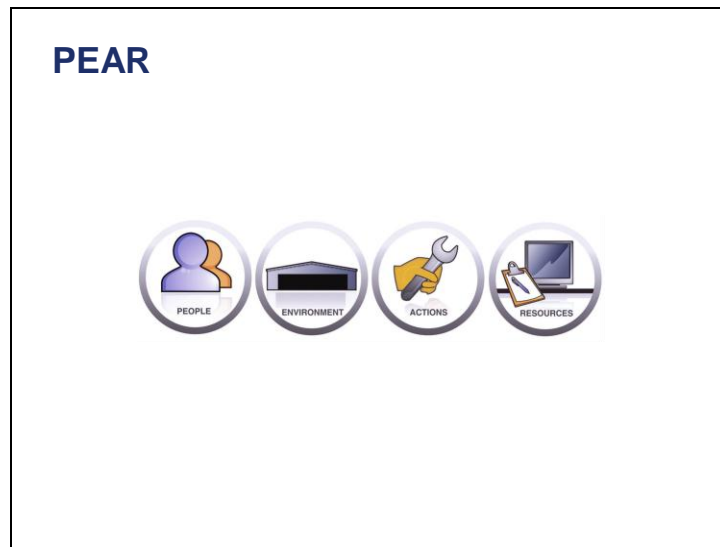
PROCEDURES



- Everything in aviation maintenance is proceduralized
- FAA regulations (part 43) require aviation maintenance technicians to follow approved procedures
- Some procedures don't work as written
- Most common violation is "failure to follow procedures"

Not long ago, Blue Tuna took a poll of FAA Inspectors . . . At the top of the problem list for many FAA Inspectors are technicians, mechanics and inspectors who don't follow the written procedures, don't follow their shop manuals and repair station documentation.

PART 43 of the FAA Regulations requires maintenance personnel to follow approved procedures and documentation. It is extremely important to follow the rules, procedures and documentation in our work.



**In conclusion remember,
PEAR stands for
People who do
the job;
Environment in which they work;
Actions they perform;
Resources necessary to complete
the job.**

CONCLUSION

It is time to take the quiz.

Once you start a quiz make sure you finish it!

A passing grade is 70%. Retake the quiz if necessary to reach a 70% or higher.

Now it is time to take the quiz. Exit this course and take the quiz.

Once you start a quiz make sure and finish it.

A passing grade of 70% is required.

Retake the quiz if necessary to reach 70% or higher.