Unit 12

Applied Anthropology

Applied anthropology use anthropological methods, theories, concepts, and insights to help public institutions or private enterprises deal with practical, real-world problems. Applied anthropology sometimes is viewed as a fifth subfield, but all applied anthropologists have been trained in one or more of the traditional four fields. In this sense, applied anthropology cuts across the other subfields and individuals in all subfields may also do applied work—that is, work that contributes directly to problem solving in an organization.

We discuss some of the ways applied anthropologists have contributed to the alleviation of human problems in later chapters. For now, a few examples illustrate some of the work they do.

Development anthropology is one area in which anthropologists apply their expertise to the solution of practical human problems, usually in developing countries. Working both as full-time employees and as consultants, development anthropologists provide information about communities that helps agencies adapt projects to local conditions and needs. Examples of agencies and institutions that employ development anthropologists include the U.S. Agency for International Development, the Rockefeller and Ford Foundations, the World Bank, and the United Nations Development Program. One important role of the anthropologist in such institutions is to provide policymakers with knowledge of local-level ecological and cultural conditions, so that projects will avoid unanticipated problems and minimize negative impacts.

Educational anthropology offers jobs in public agencies and private institutions. Some roles of educational anthropologists include advising in bilingual education, conducting detailed observations of classroom interactions, training personnel in multicultural issues, and adapting teaching styles to local customs and needs. Many modern nations, including those of Europe and the Americas, are becoming more culturally diverse due to immigration. As a response to this trend, an increasingly important role for educational anthropologists working in North America is to help professional educators understand the learning styles and behaviour of children from various ethnic and national backgrounds. Persons trained in both linguistic and cultural anthropology are especially likely to work in educational anthropology.

Private companies sometimes employ cultural anthropologists full time or as consultants, creating a professional opportunity often called **corporate anthropology**. As international trade agreements remove tariffs, quotas, and other barriers to international trade, people of different cultural heritages increasingly conduct business and buy and sell one another's products. The dramatic growth of overseas business activities encourages companies to hire professionals who can advise executives and sales staff on what to expect and how to speak and act when they conduct business in other countries. Because of their training as acute observers and listeners, anthropologists also work in the private sector in many other capacities: they watch how employees interact with one another, analyze how workers understand the capabilities of office machines, study how the attitudes and styles of managers affect worker performance, and perform a variety of other information-gathering and analysis tasks.

A rapidly growing field is **medical anthropology**. Medical anthropologists usually are trained both in biological and cultural anthropology. They investigate the complex interactions among human health,

nutrition, social environment, and cultural beliefs and practices. Medical anthropologists with extensive training in human biology and physiology study disease transmission patterns and how particular groups adapt to the presence of diseases like malaria and sleeping sickness. Because the transmission of viruses and bacteria is strongly influenced by people's diets, sanitation, sexual habits, and other behaviours, many medical anthropologists work as a team with epidemiologists to identify cultural practices that affect the spread of disease. Different cultures have different ideas about the causes and symptoms of disease, how best to treat illnesses, the abilities of traditional healers and doctors, and the importance of community involvement in the healing process. By studying how a human community perceives such things, medical anthropologists help hospitals and other agencies deliver health care services more effectively. Language and communication also are important influences on health care delivery, so people trained in linguistic anthropology sometimes work in medical anthropology.

Applied anthropology is an important thread that weaves through all four fields of anthropology:

• Archaeologists are employed in cultural resource management (CRM), assessing the presence of possible archaeological remains before construction projects, such as roads and buildings, can proceed.

• Biological anthropologists are employed as forensic anthropologists, participating in criminal investigations through laboratory work identifying bodily remains. Others work in nonhuman primate conservation, helping to protect their habitats and survival.

• Linguistic anthropologists consult with educational institutions about how to improve standardized tests for bilingual populations and conduct policy research for governments.

• Cultural anthropologists apply their knowledge to improve policies and programs in every domain of life, including education, health care, business, poverty reduction, and conflict prevention and resolution

Speaking broadly, anthropologists are valuable to governments, international agencies, companies, and other organizations because they are trained to do two things very well: first, to observe, record, and analyse human behaviour in diverse settings; and, second, to look for and understand the cultural assumptions, values, and beliefs that underlie that behaviour.

Forensic Anthropology

Physical anthropologists are specialists in the human skeleton. This is derived, in part, from their studies of comparative primate anatomy and fossilized skeletal remains and the analysis of burials and cemeteries. **Forensic anthropology is the applied application of this knowledge. Forensic anthropologists assist medical examiners in the analysis of skeletal remains in investigations of murder, suicide, and accidental death.** The results of these analyses often are used in criminal and civil court cases.

Forensic anthropologists also work for various international organizations and governments to identify people killed in natural disasters or as a result of human rights violations and genocide. In the latter case, forensic anthropologists have played a major role in helping to identify people placed in mass graves because of reigns of terror by military dictators or warfare in such places as Argentina,

Guatemala, Rwanda, and Bosnia. They also have assisted in the identification of remains of servicemen reported as missing in action in Vietnam.

The tasks of a forensic anthropologist are varied. Often the subject of study is a single skeleton, but when several skeletons are intermingled, as would be found in a mass grave or the site of a major disaster, the forensic anthropologist is able to sort out the isolated bones and bone fragments and determine which bones are the remains of which particular individual.

A major task is the **identification of the individual** represented by a skeleton. What descriptive features can be determined from skeletal material? The **sex of an adult** skeleton can be determined with a fair degree of accuracy due to the presence of secondary sexual characteristics and the presence of a degree of sexual dimorphism in human anatomy. **The pelvis** shows the greatest differences and the rate of successful determination of sex is estimated at 96 percent, but the rate of success using only a skull is 80 percent. Sex determination from isolated bones or fragments is much more difficult and less accurate. Because secondary sexual characteristics have yet to develop, sex is very difficult or impossible to determine on skeletal material from children.

On the other hand, estimation of age is more accurate on skeletal material from children than on that from adults. The pattern of tooth formation within the jaw and tooth eruption and the development of centers of ossification and fusion of growth plates are indicative of age. Estimation of age in adults is usually based on degenerative changes and tends to be less precise.

“Racial” identification is extremely problematic. As we saw, “race” is a social concept, not a biological one. While most anthropologists are of the opinion that “races” do not exist as biological categories, the fact that “race” is used in the police and criminal systems means that forensic anthropologists need to make “racial” identifications.

In actuality, the forensic anthropologist is making an estimate of population affinity. There has been so much admixture and variability in the human gene pool that dividing the species into a finite number of “races” makes no sense. Yet different populations of people from different areas of the world do differ statistically in some anatomical and genetic characteristics. The forensic anthropologist often can provide an estimate of the ancestry of a specimen or even the degree of admixture from different ancestries.

Stature is usually reconstructed through the use of formulas. These formulas represent the results of analyses of known features found in collections of skeletons. Greater development of limb skeletons on one side of the body can be used to reconstruct whether the victim was right- or left-handed.

Conditions due to malnutrition often can be determined from skeletal material. For example, many Native American skulls show a spongy hyperostosis—lesions on the surface of the cranial vault—that is associated with iron-deficiency anemia. This condition often is associated with malnutrition that comes from an overemphasis on maize, which is deficient in iron. Several diseases also leave signs on bone.

The human body is often subject to cultural modification. While tattooing and body piercing cannot be determined from skeletal material, head-shape modification and the ling of teeth can. Often such modification is identified with particular social groups. A forensic anthropologist may be able to provide a reconstruction of what the person looked like in life, recognition of habitual activities including occupation, and the determination of the approximate time since death.

The cause of death often can be determined by an examination of the skeleton. Death due to trauma is the easiest to identify. Different types of weapons—guns, knives, blunt instruments—leave different types of wounds.

Personal Identification

Fingerprint:

Fingerprints are the tiny ridges, whorls and valley patterns on the tip of each finger. They form from pressure on a baby's tiny, developing fingers in the womb. No two people have been found to have the same fingerprints -- they are totally unique. There's a one in 64 billion chance that your fingerprint will match up exactly with someone else's.

Fingerprints are even more unique than DNA, the genetic material in each of our cells. Although identical twins can share the same DNA -- or at least most of it -- they can't have the same fingerprints.

All of the ridges of fingerprints form patterns called loops, whorls or arches:

Loops begin on one side of the finger, curve around or upward, and exit the other side. There are two types of loops: Radial loops slope toward the thumb, while ulnar loops slope toward the little finger.

Whorls form a circular or spiral pattern.

Arches slope upward and then down, like very narrow mountains.

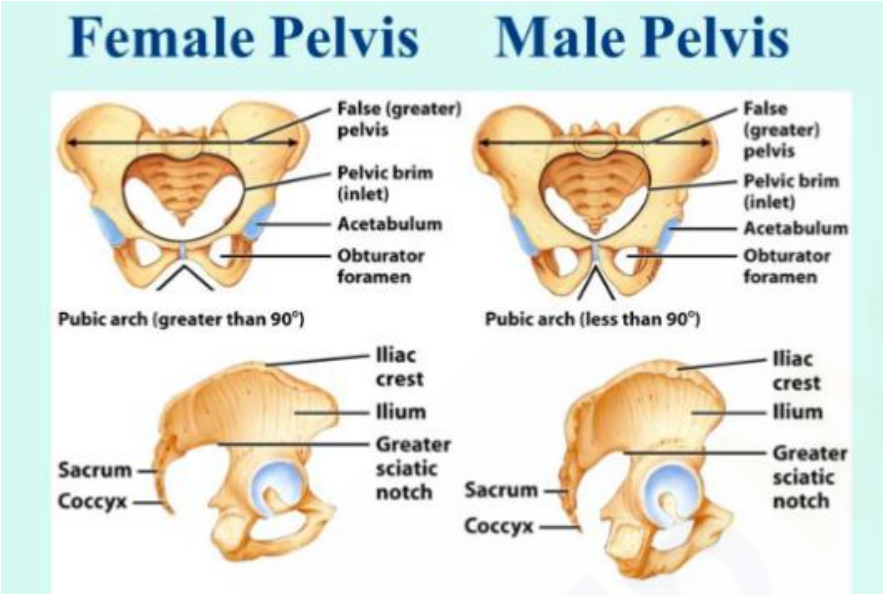
The technique of fingerprinting is known as **dactyloscopy**. Until the advent of digital scanning technologies, fingerprinting was done using ink and a card.

Law enforcement agents can analyze fingerprints they find at the scene of a crime. There are two different types of prints:

Visible prints are made on a type of surface that creates an impression, like blood, dirt or clay.

Latent prints are made when sweat, oil and other substances on the skin reproduce the ridge structure of the fingerprints on a glass, murder weapon or any other surface the perpetrator has touched. These prints **can't be seen with the naked eye**, but they can be made visible using dark powder, lasers or other light sources. Police officers can "lift" these prints with tape or take special photographs of them.

Sex identification



S.N.	Male Pelvis	Female Pelvis
1.	It is smaller and narrower with heavier and thicker bone.	It is bigger and wider with lighter, thinner and denser bone.
2.	It is designed to support a heavy body with a stronger muscle structure.	It serves for the purpose of childbearing and easier delivery.
3.	False (greater) pelvis is deep.	False (greater) pelvis is shallow.
4.	Pubic arch is V shaped and is less than 90^0.	Pubic arch is wider and is greater than 90^0.
5.	Acetabulum is larger and faces laterally.	Acetabulum is smaller and faces anteriorly.
6.	Coccyx is immoveable and less curved anteriorly i.e. projected inwards.	Coccyx is movable or flexible and more curved anteriorly. i.e. straighter
7.	Pelvic brim (pelvic inlet) is smaller and heart shaped.	Pelvic brim (pelvic inlet) is large and oval.
8.	Pelvic outlet is narrower.	Pelvic outlet is wider.
9.	Greater sciatic notch is narrower.	Greater sciatic notch is wider.
10.	Obturator foramen is round.	Obturator foramen is oval.

Skull:

The skull is the next most reliable skeletal indicator of sex. Males tend to have larger and more rugged skulls than do females. Usually, a large supraorbital ridge, long and broad mastoid processes, and a

rugged nuchal region of the occipital bone are indicators of the male sex. In contrast, female skulls are more gracile, meaning they do not present the heavy bony development of male skulls.

The mandible also represents sexual differences. Males tend to have broad, “squarish” chins while females have more “V-shaped” chins. Although the common wisdom is that the skull is the most important feature of the skeleton, using it alone to determine sex is much less accurate than using only the pelvis. Again, the best technique is to use all the available bones.

Female	Male
Smaller and lighter skull	Larger and heavier skull
Rounded forehead (frontal bone)	Sloping, less rounded forehead (frontal bone)
Smooth supraorbital ridge (brow)	Prominent supraorbital ridge (brow)
Round eye sockets (orbits)	Squarer eye sockets (orbits)
Sharp upper eye margins	Blunt upper eye margins
Pointed chin	Square chin
Sloping (obtuse) angle of the jaw	Vertical (acute) angle of the jaw

Age Determination:

On the basis of teeth:

Teeth is the hardest substance in body and resist degradation to the maximum extent. Accidents, however severe, is sure to leave teeth intact. Hence forensic Odontology serves to identify persons where other measures fail.

Dental development is important indicator of age. Particularly in the young, teeth provide some of the best age indicators, but they also can be difficult to identify. Up to the age of about 6, children have only deciduous teeth. From age 6–13, there will be varying combinations of deciduous and permanent teeth. After age 13, only permanent teeth are found, but not all are immediately visible. The third molar usually erupts at about age 17.

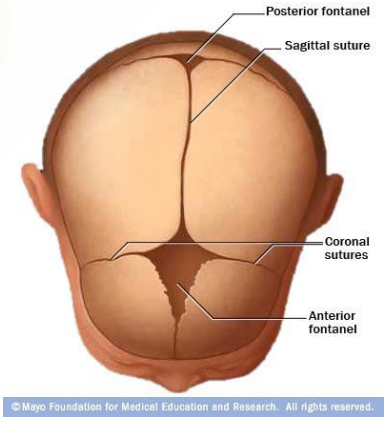
X-rays of the maxilla and mandible in children show the unerupted teeth and can give an accurate age determination. The time of eruption of these teeth, combined with the completion of root formation of the permanent teeth, give a good indication of age up to about 25. Evidence of wear, deterioration, and type and style of dental restoration may be used as gross indicators of age.

Growth Chronology in Human Dentition

Tooth	Eruption	Root Completed
	Deciduous dentition	
Maxillary teeth		
Incisor 1	7.5 months	1.5 years
Incisor 2	9 months	2.0 years
Canine	18 months	3.25 years
Milk 1	14 months	2.5 years
Milk 2	24 months	3.0 years
Mandibular teeth		
Incisor 1	6 months	1.5 years
Incisor 2	7 months	1.5 years
Canine	16 months	3.25 years
Milk 1	12 months	2.25 years
Milk 2	20 months	3.0 years
	Permanent dentition	
Maxillary teeth		
Incisor 1	7–8 years	10 years
Incisor 2	8–9 years	11 years
Canine	11–12 years	13–15 years
Premolar 1	10–11 years	12–13 years
Premolar 2	11–12 years	12–14 years
Molar 1	6–7 years	9–10 years
Molar 2	12–13 years	14–16 years
Molar 3	17–21 years	18–25 years

Age Determination based on suture:

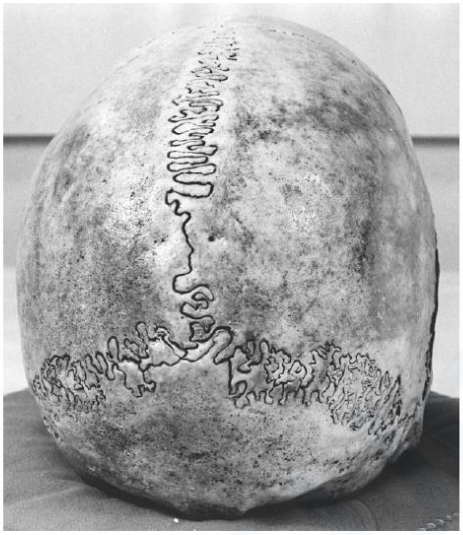
The skull can be helpful in determining age as well. The sutures in the vault of the skull are the edges where the separate bones are joined. In infancy, the sutures are wide open and large fontanels are present on the top of the skull. The posterior fontanel closes by the end of the first year and the anterior fontanel is closed by the end of the second year.



Sagittal Suture: Full obliteration may never occur. The suture closes sometime between the ages of 30 years old and 40 years old.

Coronal Sutures: Suture may begin to fuse by the age of 24. Average Suture closes between the ages of 30 years old and 40 years old.

Lambdoid Sutures: Full obliteration may never occur. Suture closes normally between the ages of 30 and 40 years old.



The ectocranial sutures are easily seen; however, they provide only a broad age estimate. (Photo courtesy of R. B. Pickering.)

Determination of Race:

In any case, throughout the history of humanity there have been genetic patterns that vary in time and place. Even if one accepts the categorization defined by "race," there probably never was any such thing as a "pure" race. Wherever humans have gone, they have managed to successfully interbreed with any other group of humans encountered. Today, the ease of travel means that there are more people moving around the globe, creating greater genetic mixing opportunities than ever before.

From the forensic perspective, using the "three-race" model still has some value in describing broad genetic and morphological characteristics. This model is used by many people to describe themselves and others. Therefore, it falls to the forensic investigator to use the term defined by the model in trying to identify the dead. The model is not perfect, but it does help us understand some of the variation in shape and form on some parts of the skeleton, particularly the skull.

Feature	Negroid	Mongoloid	Caucosoid
Nasal Index	Greater than .53	.48-.53	Less than .48
Nasal Spine	Very small	Slightly prominent	More prominent
Prognathism	Prominent	Variable	Straight
Orbital opening	Rectangular	Rounded	Rounded
Skull Length	Long	Long	Short
Skull Breadth	Narrow	Broad	Broad
Skull height	Low	Middle	High

Facial reconstruction:

Facial reconstruction is a broad term used to describe a number of methods that have a common goal—trying to determine if a skull can be matched to a particular face. The concept sounds reasonable. A face gets much of its form from the underlying support of the skull. If one could somehow show that the form of the skull and the face, not to mention the shape and position of the teeth, were identical to a missing person, then the identity of the skull could be determined.

Facial reconstruction is a mixture of art and science. The science provides the measurements and the understanding of the relationship between the face and underlying skull. Through sculptural art, the scientific data is transformed into a lifelike face that is recognizable as a real human face that has meaning to the viewer. For many years, museums have used facial reconstructions to show visitors how ancient people and our prehuman ancestors looked. The famous fossil skull of Lucy (our 2.2-million-year-old ancestor), the Ice Man, and many other dry bones from the distant past have been brought to life through facial reconstruction.

Direct Facial Reconstruction/ 3d facial reconstruction technique

Perhaps the oldest type of direct facial reconstruction involves the building of a face with clay or wax over the actual skull or a cast of the skull. Many anatomists and physical anthropologists of the nineteenth and early twentieth century have tried to describe and quantify the variability they saw in the human body. They were often interested in differences attributed to sex and race.

During this period, the new science of statistics was being used to systematize and standardize visual observations. These trends toward quantification and statistical interpretation converged in an early attempt to reconstruct faces on skulls. These scientists recognized that they needed to identify important points on the skull that give the face its shape. They also had to determine the thickness of soft tissues including skin, muscle, and fat over various parts of the skull. Recognizing that there were differences in tissue thicknesses between men and women, and theorizing that there might be differences between races, earlier scientists used medical school cadavers to gather data on tissue thicknesses in the various sex and race groups, for example, white males and females and black males and females. New medical imaging techniques also are being used to solve some of the old problems. Every day thousands of people undergo computed tomography (CT) scan, magnetic resonance imaging (MRI), or other sophisticated imaging procedure in hospitals and medical laboratories.

Fake eyes are also added to the reconstruction. Various measurements are also taken to determine eye placement, the width/length of the nose and the length/width of the mouth. The eyes are centered and are also placed at a specific depth.

Once the tissue markers are glued to the skull the sculptor can then begin placing clay on the skull and sculpting it so that a face is formed. Once the basic shape has been constructed the sculptor can begin to make the skull look similar to the victim. The sculptor does this by using all of the information that has been made available to them by the forensic anthropologist. This information can include the geographic location of where the victim lived or the victims life style. To help make a possible identification of the unknown victim sculptors will add hair, either in the form of a wig or clay representing hair. A sculptor can also add various props such as glasses, articles of clothing, or anything that could generate a possible identification.

Now three-dimensional facial reconstructions are created with high resolution three-dimensional computer images.

2-dimensional reconstruction technique

The two dimensional reconstruction techniques like the three dimensional reconstruction techniques involves placing tissue markers on the skull in specific places and specific depths using the generalized measurements that have been determined by age, sex and ancestry.

Once the skull is in the proper position on the stand, the skull is photographed. The skull is photographed at a one to one ratio from both the frontal and the profile views. While photographing a ruler is placed along the skull. After the photographs are taken they are enlarged to life size and then taped on two wooden boards next to each other. Once the photographs are attached transparent natural vellum sheets are taped directly over the printed photographs. Once the setup is completed the artist can start to sketch. The artist sketches the skull by following the contours of the skull and using the tissue makers as guidelines.

Craniofacial Superimposition:

Photographic superimposition in its simplest form includes creating a photographic image of the skull that can be superimposed on an ante mortem photo of the person.

There are cases in which each of these techniques has been used successfully; yet, can be misleading. Virtually all the investigators who have proposed one of these techniques say that it should never be used by itself to establish identity; other evidence is always required. Facial reconstruction or craniofacial superimposition may prove to be useful, but it should not be relied upon by itself to determine identity.

Kinanthropometry:

Kinanthropometry comprises of three Greek words kinein (to move), anthropos (man) and metrein (to measure) referring to the dynamic relationship and quantitative interface between human structure and function. It is defined as the study of human size, shape, proportion, composition, maturation, gross function and cardiorespiratory function, which enables to understand growth, exercise, performance, and nutrition. Ever since that time kinanthropometry has grown to be an all-encompassing scientific interest; with the application in research related to auxology, physical anthropology, human biology, physical education, sports science and medical science.

Ross et al. (1978) defined kinanthropometry as the application of body measurements to the study of human size, shape, proportion, composition, maturation and gross functions so as to help to understand human movement in relation to growth, exercise, performance and nutrition.

International Society for the advancement of Kinanthropometry (IASK) defined kinanthropometry as, “Scientific specialization dealing with the measurement of humans in a variety of morphological perspective, its application to movement and those factors which influence movement including components of body build, body measurements, proportions, composition, shape, maturation, motor abilities and cardio- respiratory capacities, physical activity, including recreational activity as well as highly specialized sports performance.”

Kinanthropometry is a medium for individuals to contribute to basic research and applications and is closely associated to physical education, sports science and medicine, human biology, science of growth, physical anthropology, gerontology, ergonometry, and other several disciplines.

The kinanthropometry of physical characteristics are known to be of fundamental importance for individual development to achieve high level of performance in a specific sport. Knowledge of kinanthropometry equips us with technique of various body measurements like weight, height, diameters, circumferences, skinfolds and sportsmen are selected on the basis of physical characteristics for a particular sport (Singh & Malhotra, 1989). Kinanthropometry provides quantitative interface between human structure and function. For this reason, the application of kinanthropometric knowledge is getting tremendous importance and popularity to identify the potential talents in sports for a particular event.

Kinanthropometric investigations have the basic importance in establishing the prerequisite characteristics of athletes for their maximum performance. Detailed information regarding kinanthropometric characteristics of athletes is certainly important in modern sports. It is a well-known fact that most of the kinanthropometric characteristics are almost exclusively genetically determined therefore length and breadth measurements can not be changed with training (Norton & Olds, 2001). Therefore, the athletes in a particular sport must possess such specific characteristics which are of advantage to them during the game (Sodhi & Sidhu, 1984). Besides the relationship with physical performance, kinanthropometric status is also important for sports trainers in order to direct young athletes into the sports they are best suited at the beginning of their careers.

Kinanthropometry is a useful tool in the hands of sports scientists, human biology, physical anthropologist, sports coaches and physical educationists for the study of athletes in different sport specializations (Singh and Malhotra, 1989). Kinanthropometric measurements are also used to determine body size differences, somatotyping and body composition.

Body composition of athletes is an important tool to evaluate the health of the athlete, to monitor the effects of a training program and to determine optimal competitive body weight and other components of body composition (Prior et. al., 2001). Knowing and understanding the effect of training and competition on body composition can help athletes control weight and alter body composition safely. Seasonal variations in body composition can be studied and used to find optimal body composition levels for health, recovery, training, and competing (Alburquerque et al. 2005).

Following body composition trends in specific sports enable coaches and athletes to accurately prepare athletes for specific events/positions. Because of the importance of body composition in athletic health and performance, a practical, safe, and efficient method of measuring body composition is necessary.

Body composition, specifically body fat percentage is of great interest to athletes and is often negatively associated with athletic performance (Gomez, 2004; Malina, 2007; Sigurbjorn et al., 2000). Athletes represent a unique body composition fat free mass density is altered with changes in proportions of fat free mass components (Prior et al., 2001). Young, elite male athletes have greater lean body mass, strength, and power, lower percentage body fat and earlier maturation compared to their peers, while young, elite female athletes have a less “curvy” physique, lower percentage body fat and later maturation than their peers (Malina, 2007). It is obvious that athletes have different

physiology and health consequences associated with body composition, which emphasizes that body composition is an important field of study.

Percentage body fat, is an important factor in endurance events where the extra fat increases the cost of running, but does not give extra energy (Sigurbjorn et al., 2000). Rowland et al. (1999) demonstrated that there was a significant relationship between body fat percentage and running performance in children. In contrast to running events, lean body mass is a better predictor of performance than fat mass in strength events (Brechue & Takashi, 2002). Body composition is also an important determining factor for performance ability of an athlete. Excess body fat is detrimental to performance in most sports whereas, fat free body mass, especially muscle mass, is generally associated with performance.

Morehouse and Rasch Classification of Physique:

Height Category	Weight Category	Suitable for Events
Tall	Heavy	Wrestling
	Medium	Boxing
	Light	Sprinting-Jumping
Medium	Heavy	Throwing
	Medium	Long Distance Swimming
	Light	Hockey, Football
Short	Heavy	Weight Lifting
	Medium	Gymnastic
	Light	Skating

Each category of the table can be justified

Skaters: Since they perform great balancing act hence they must be short to keep centre of gravity low. They have to be light because they have to show high activity level.

Gymnast: They have to be short because of balancing act. In addition, development of muscle is also required.

Sprinters, Jumpers: they are tall person with greater lengths of their limbs in comparison to their trunk length. Greater the length of trunk more will be frictional force of the wind encountered during the running. Also a larger weight of trunk on the legs is sure to exhaust muscles of the leg sooner.

Weight-lifters: Tanner (1964) has studied the anthropometric characteristics of weight lifters. It has been found that in champion weight lifters the limb height is less than the trunk height. It is natural because taller individuals are at disadvantage because they have to lift the weight to a greater height

and this would require greater strength to overcome gravitational pull. Hence the stature is found to be small in champion weight lifters.

Throwers: On the basis of Indian studies, Sharma and Shukla (1982-1989) and others have shown that throwers have indicated significantly higher values in all anthropometric measurements. They are taller and heavier, have longer upper and lower extremities.

Aerobic and Anaerobic power: For persons who have to apply great force in sudden jerk such as weight-lifter must have high aerobic power whereas those persons who have to play games and sports for long duration such as long-distance runner must have high anaerobic power. In former high lung capacity is required; in latter high level of blood-alkali is required.

Genes and Anthropometry: American Journal of Human Genetics has reported that there are definite genes for short distance running and long distance running. For short distance running, the gene responsible is Alpha-Actin 3 and for long distance running the gene responsible is Alpha Actin 2.

PHYSICAL ANTHROPOLOGY AND DEFENCE DESIGNS

Anthropometry is the branch of Physical anthropology concerned with the measurement of the human body. Anthropometric surveys provide information on the range and variation of body shape. Size and fit are important issues because they can significantly affect the utility of equipment, clothing, or work space. For example, a computer key board may be designed for the Indian market, with the right spacing for the average Indian to rest his or her finger on the keys. Before such computers are marketed in other countries say Nepal, it is important to know whether it is equally comfortable for a typical Nepalese hand. The same may be said for automobile seating or airplane cockpits where reach or filed of version may be critical factors.

There was a time when equipment were designed with little concern for the Physical characteristic of the users. Physical anthropologist as experts of human anatomy were first involved in the designing of defense equipment during world war ll. Since then anthropometric research has played significant role in engineering designing of many technologies, from Jet –fighter ejection seats to analyzing human posture in zero gravity based on Skylab experiences.

The term Anthropometry was first coined by Queflet (1871) it was, however, Martin, a German Scientist, who published in 1928 the famous title Lehrbuch der Anthropologic. The revised edition of this book in three volumes, co-authored by Salter is still a significant work (1957). Knussmann (1990, 1992) has recently edited two volumes based on Martin's work.

Designing of any product or equipment considering human variability is a complex one, and it needs participation of three groups of people, viz, the users, the anthropologists and the manufactures Role of anthropologists is crucial particularity if the efficiency of equipment is dependent on human variability. Anthropologists are supposed to provide basic data on human variability in such a simple manner that it is easy to understand and ready to apply.

Three factors that collectively determine the quality of man-machine relationship are efficiency, safety and comfort (Malik et.al.1995). Design that do not consider human variations lead to Poor job performance, low job-satisfaction, waste of time and increased morbidity.

GUN TURRETS: Anthropometric data has had been very reliably taken and intelligently applied by anthropologists for Air force. It improved flying efficiency of the pilots thus saving much money on procurement of large number of pilots. After 1942, its spread to other fields of human activities has improved work efficiency in other fields by reducing discomfort of people. It is not that anthropometric data has not been used in military services, but it was primarily used for physical or medical description.

A gun-turret is a movable enclosure containing the gunner, wearing protective clothing and equipment, a pair of machine guns and sighting mechanism. The gun turret is so designed that the gunner has all the free movement of hid body needed. It has to be scientifically designed because any extrusion form an aircraft adds air-resistance. Hence, such areas as offering resistance must be reduced to minimum without compromising efficiency of the gunner.

Such improvements in US gun-turrets greatly increased efficiency of crewmen, reduced their discomfort of long occupancy in a cramped enclosure and insured effective means of escape from an aircraft in emergency, or in removal of a casualty. With the increased efficiency of crewmen, the losses to the air force were effectively curtailed.

COCKPIT SIZE AND SEAT CONFIGURATION: Scientists have made study of cockpit space and established parameters for cockpit size in different types of air-craft. They were also instrumental in designing various seat configuration for both fighters and bombers. Such improvisation largely aided inn reducing cockpit fatigue and discomfort by proper body support.

USE OF MOCK UP: Engineering design of defense equipment's is necessarily a three- dimensional problem which cannot be solved by two dimensional studies alone. Hence, full-scale mock up is manufactured with everything that a crewman will bear clothing, inner-line gloves, helmets, masks and goggles, boots and parachute. This has vastly improved gun-turret and cockpit size designing. This increases initial costs but is more than compensated by improved operator acceptance and saves from a possible error that might lead to rejection of the design.

FIGHT CLOTHING: Application of anthropometric data in the fight clothing has been vital. Individual designers have their own schedule of size so that clothing's sometimes fit no one. Flying Helmets is one such problem. To provide correct size-control. Anthropologists have sculptor-carved wooden head forms in four statistically derived sizes-extra-large, large medium and small. Sets of these head forms are supplied to helmet follow the ratio of 10:40:40:10. This is a great and immediate to purchase departments.

Physical anthropologists are also concerned with designing of oxygen masks and makes its correct fit with the help of a set of seven statistical sizes and shapes of sculptured face-forms. Similar is the case

with the garments. Body-sizes of females are also taken to procure flight clothing and other garments for service women.

Such anthropological efforts bring about two-sided advantage operational efficiency and economic benefits the latter to agencies such as government manufacturer. Such studies indicate the least number of sizes in which a garment would have to be fabricated the values of dimensions necessary for each size and the number of garments required in each size.

JET ENGINES: Anthropometric engineering is applied in the Jet engines and it is perhaps the most important engineering programme. The Jets fly over altitudes above 50000ft. At such altitudes, human body can swell up due to reduced atmospheric pressure. Dr. JP Henry, a medicate physiologist, invented a concept called the "partial-pressure suit" – a one piece perfectly fitting non-stretch garment with air tubes connected to it so that when air-pressure dropped, air could be introduced in the spaces within the clothing that could prevent muscles from expanding. The unit served the purpose but there were severe sizing dilemmas. Each suit has to fit like skin from neck to wrists and ankles, but there were no anthropological data.

Once the garments are available there is conducted fit test, they are checked for conformity to the specified dimensions by trying them on a sample of 50 or more subjects, selected to show the full range of body-size in the target population. The subject, after he dons it, goes through all the motions required to show whether that size actually is comfortable fit.
It was found that stature and weight generally yield the highest correlations with other bodily dimensions and could become the diagnostic for complex, ratting garments.

Numerous "height-weight" sizing programmes have been tested in the force of all the countries the world over.

The Ejection Seat and Car Passenger Safety: Originally, this used to be a simple metal bucket seat mounted in the aircraft in type of gun, so that in an emergency, the pilot could fire the seat and himself out of the aircraft and after freeing himself from the seat take to his parachute. The Germans invented this seat during world war ll.

Any such device must take into account center of gravity to avoid excessive rotation of the seat as it enters the airstream at high speed. The center of gravity is determined by the man-equipment-seat combination. Since limbs are flayed in the air it is important to know center of gravity of the limbs. For such purposes hence center of gravity of limbs are known from large sample of population Later on many studies were conducted for knowing moments of inertia of living subjects in a variety of fixed position on a Compound pendulum, nude and with full-pressure suit. Such dates have helped refine crew accommodation in the space capsules as well as cockpits and seats of advance fighter aircraft and automobiles. This has reduced the severity of damage during accidents.

Anthropomorphic Dummy: Physical anthropologist started studying the Gravitational Forces generated when living subjects, strapped to a seat on moving sled stopped suddenly against a barrier. The experiments were hazardous and dummies displayed little mobility of the body and center of gravity A Sophisticated dummy was drown up after considerable research of anthropological,

engineering and orthopaedic literature Such dummies are now regularly manufactured for variety of tests situation, such dummies enable engineering to approximate the trajectories of human bodies in crashes and to obtain some idea of the force involved.

Design Requirements: Design requirements may be classified into three groups:

a) Work space design
b) clothing and personal equipment design
c) Component and device.

Workspace design includes designing of any space for human occupancy during work recreation rest education, travel treatment etc. The design aims to ensure that operator has adequate workspace and proper location of control, display and device (Malik et.al. 1991). Designing of automobile interior, aircraft cockpits, seating apparatus, doors, tunnels etc. are some of the example where workspace designing is needed. The measurements required in designing workspace includes research limits body clearance aye location etc.

Clothing and personal equipment design include designing of garments press suite helmets etc. The designing of such things assure proper fit, minimize restriction of movements. The body measurements that are generally required for designing clothing and personal equipment includes circumferences body contours, limb movement etc.

Designing of components and devices includes designing of small appliance such as knobs levers, switches handholds etc.

There is No Average Man in Designing: Clearance and research are the important aspects of anthropological designing. A door whose size is designed on the basis of average height would obstruct the one half of population above the average value, Similarity a control set up at an average height will hardly be approachable by shorter half of the population. These are the examples of clearance and reaches separately. If an equipment were designed taking averages of the two, the equipment would be practically suitable to none.

Hence, in the design anthropometry there in no average person, it is percentiles of the normal distribution curve. While designing for clearance, it is to base on 95 or 99 percentiles, and for reaches it is to base on 1^{st} to 5^{th} percentiles.

The front of a car with its steering wheel, windlass clutch, breaks, door, several accessories cannot be designed keeping in view an average person.

As already started where reach is crucial, it is always the lowest percentiles, and where clearance is crucial it is always the highest percentiles. The thinking that large female can be repressed by average male and the children are miniature adults has equally proved wrong so far, anthropometric designing is concerned.