

# FACTFILE: GCSE

# Technology and Design

## OPTION C: PRODUCT DESIGN



## 2.40 Ergonomics and anthropometrics

### Learning Outcomes

You should be able to:

- consider ergonomics when designing;
- analyse how product design is affected and influenced by the relationship between product and user.

### Ergonomics

The term ergonomics refers to the relationship between people and the products they use. Anthropometric data is used to help design products to meet ergonomic needs.



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When designing, the designer must always keep in mind the person that the product is designed for. People using the products will differ in age, size, shape and weight. Adults and children come in different shapes and sizes. Ergonomics is the application of a set of average sizes of humans to the design of products. The product must fit the person who will use it. For example, if you are

designing a chair you will need to work out the average comfortable seating height. Designers look at ergonomics in order to make things easier for people to use. The chairs shown below have been designed to offer a comfortable working position for the user and yet they differ from each other. Different designers will interpret the anthropometric data in differing ways ending with differing outcomes.

A great number of people use computers as part of their work and will use these for extended periods of time. Because of this change in working practice, computers, computer desks and chairs are the focus of ergonomic design. If these products are poorly designed or improperly adjusted for human use, the person using them may suffer unnecessary fatigue, stress, and even injury.

### What should the designer consider?

When designing the shape, weight, height and width of the product should be given consideration. How these factors affect the interaction with the user is of vital importance to how the product is utilised. Anthropometric data will provide the designer with the data to do this. In some cases the environment in which the product will be used in should also be given consideration. Then the designer will need to consider factors such as light, moisture and the temperature of the environment that the product will be used in.

Designers will consider a number of principles to ensure their product is ergonomically sound. The anthropometric data will be of considerable use whenever design a product that the user will handle or manipulate.

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**Fig. 1**

**Fig. 1** shows an example of a fairly typical desktop PC mouse. It is evident that some thought has been given to how it is to interact with the user's hand. This would be a standard shape for a mouse.

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**Fig. 2**

**Fig. 2** gives a clear view of how the designer has shaped the mouse to ensure optimum comfort in using the device. This is a vast improvement on the earlier forms of mouse used in schools and offices worldwide.

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**Fig. 3**

**Fig. 3** illustrates the physical interaction between the user and the device showing how the shape of the mouse follows the contours of the human hand.

The evolution of the shape of the mouse has been

needed to reduce the chance of the user suffering from any form of repetitive strain injuries (RSI). RSI describes a painful condition generally linked to doing a particular activity repeatedly or for long periods of time. You can get RSI from a wide range of occupations and activities although you're most likely to be affected if your job involves working mainly with your hands and arms, e.g. computer or assembly line work.

The designer would have made use of anthropometric data available for the user group. Had the design brief stated the mouse was to be used by teenage students then a table similar to the tables below would have been of use to the designer.

Age	Height		Hand Length	
	Girls	Boys	Girls	Boys
11	1440	1430	155	155
12	1500	1490	165	165
13	1550	1550	175	190
14	1590	1630	175	190
15	1610	1690	180	195
16	1620	1730	180	195
17	1620	1750	180	200
18	1620	1760	180	200

Another area of user / device interaction which has benefitted from the application of ergonomic principles can be witnessed in the development of car steering wheels. Not many years ago the steering wheel was simply that, a device used to steer the vehicle in the desired direction. The only other function it had was to activate the car horn when the switch was depressed. Now the steering wheel acts as an interface for most functions of the vehicle. It has become the control pod for the majority of secondary functions of the vehicle.



**Fig. 4**



**Fig. 5**

A driver can now carry out a number of actions using controls mounted on the steering wheel

Fig 4 © dutourdumonde / iStock / Thinkstockphotos  
 Fig 5 © algre / iStock / Thinkstockphotos

without moving hands from the steering wheel;

- Directional indicators can be activated,
- windscreen wipers activated and screen washed (front and rear);
- headlights activated automatically;
- answer phone call / end call (via Bluetooth function);
- access vehicle computer and driving date;
- select desired data;
- operate cruise control settings;
- select audio input;
- change track / station;
- increase / decrease volume or mute sound,
- sound the horn and,
- have a clear view of dashboard instruments.

### Industrial considerations

In the workplace ergonomics is about matching tasks and people. Ergonomics in industry is a relatively new concept. In the early days of industrialisation getting the job done was more important than the welfare of the workers. Around the 1940s people began to realise that work could be done more efficiently if the equipment was easier and safer to use. The science of ergonomics was born.

In many industries efficiency can result in greater profitability. It makes economic sense to create as efficient a workplace as possible. To achieve this, basic principles of ergonomics can be applied.

#### Principle 1. Maintain Neutral Posture

Neutral postures are postures where the body is aligned and balanced while sitting or standing, placing minimal stress on the body and keeping joints aligned. This minimizes the stress applied to muscles, tendons, nerves and bones and allows for maximum control and force production. The opposite of a neutral posture is an “awkward posture” which moves away from the neutral posture putting more stress on the worker’s body and should be avoided.

#### Principle 2. Work in the Comfort Zone

This principle is very similar to maintaining a neutral posture and sometimes referred to as the “hand shake zone”. The principle here is that if you can “shake hands with your work”, you are minimizing excessive reach and maintaining a neutral posture and you are working from proper heights and reach.

#### Principle 3. Allow for Movement and Stretching

Working for long periods of time in a static position will cause your body to become fatigued. Stretching reduces fatigue, improves muscular balance and posture and improves muscle coordination. It is beneficial to take periodic breaks over the course of your work day to get your blood moving and restore your energy.

#### Principle 4. Reduce Excessive Force

Excessive force is one of the primary ergonomic risk factors. Eliminating excessive force requirements will reduce worker fatigue. Adjustable height tables and workstations, powered equipment and ergonomic tools will reduce work effort.

#### Principle 5. Reduce Excessive Motions

Repetitive motion is another one of the primary ergonomic risk factors. Many work tasks involve repetitive movements. Repetition, when combined with other risks factors can contribute to the formation of MSD (Musculoskeletal Disorders).

#### Principle 6. Minimize Contact Stress

Contact stress can be caused by resting wrists on the sharp edge of a desk or workstation while performing tasks and sitting without adequate space for the knees.

#### Principle 7. Reduce Excessive Vibration

Studies have shown that regular and frequent exposure to vibration can lead to permanent adverse health effects, which are most likely to occur when contact with a vibrating tool or work process is a regular and significant part of a person’s job. This can cause a range of conditions as well as specific diseases such tendinitis.

#### Principle 8. Provide Adequate Lighting

Poor lighting is a common problem in the workplace that can affect a worker’s comfort level and performance. Too much or too little light makes work difficult. Dimly lit work areas and glare can cause eye fatigue and headaches and improperly lit areas put workers at greater risk for all types of injuries.

Providing workers with adjustable task lighting is often a simple solution to lighting problems. At a computer workstation take steps to control screen glare.

### Summary

The ergonomic principles listed above primarily address situations within the work environment. Within these environments the workforce will be interacting with equipment and machinery on a regular basis to which the designer will have to apply ergonomic principles to ensure optimal utilisation.

### Revision questions:

Q1. What is meant by the term ergonomics?

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Q2. Give **two** main reasons why the implications of ergonomics are important to the designer.

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Q3. What is meant by the term repetitive strain injury.

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Q4. Look at fig. 3, and select **two** different aspects of the product and briefly explain how the designer has been influenced by ergonomics.

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Q5. Identify and explain three aspects of an office chair which show that the designer has considered ergonomics.

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**Additional information sources:**

[www.ergonomics.org.uk/](http://www.ergonomics.org.uk/)

<http://whatis.techtarget.com/>

[www.technologystudent.com/](http://www.technologystudent.com/)

<http://ergo-plus.com/fundamental-ergonomic-principles/>

<https://www.youtube.com/watch?v=LAKlmdMHpdE>

