At the end of this section you should be able to ….

Describe the principle of experimentation to include

* Careful planning and design
* **Safety** of procedure
* Necessity and selection of an experimental **control**
* Explaining why **sample size** is important
* Explaining why **random selection** is important
* Explaining why **replicates** are important
* Explaining why **double - blind testing** is important

**Planning and design:**

 What is the purpose of the investigation? How can you make sure it is a fair test? What controls are needed? What equipment is required? How many times is the procedure to be repeated? How are results going to be recorded and presented? Be careful not to cause suffering to animals. In most hypotheses there are a number of factors which may influence the result. These are called variables.

**Variables**

 In most experiments, only a single factor or variable is tested. All other variables should be kept constant.

**Independent Variable** - the factor you change, what you do to your exp. group.
**Dependent Variable** - what happens as a result of that treatment, what you are measuring

**Safety:**

All safety procedures pertaining to lab work / field work should be adhered to.

**Control**: A control experiment should be used to provide a comparison against which the actual experiment can be judged. In carrying out experiments, all conditions should be kept constant except the one being tested. This is known as the experimental variable. To be absolutely sure that the results are due to the experimental variable and not to some unknown factor, it is necessary to set up a separate sample known as a control group. A control group goes through all the steps of the experiment except the one being tested.

**Sample size**: When carrying out an experiment it is important that more than sample is tested. Normally as large a sample as possible is tested. This reduces the risk that the results are due to individual differences, rather than being caused by the factor being investigated.

**Random Selection**: The organisms for the experiment must be selected at random and not selected as the best ones to get the expected results.

**Replicates**: Repeating an experiment many times helps to verify results and prevents jumping to conclusions based on a single set of results. Refers to the number of times you repeat your entire experimental design including controls.

**Double blind testing:** In a properly designed experiment neither the researcher nor the person being tested should know who is receiving the real treatment and who is receiving the placebo. This ensures avoiding bias in an experiment.

WAKEFIELD EXPERIMENT as an example of poor research – scientific method not followed

In 1998 Dr Andrew Wakefield conducted research which suggested a link between the MMR vaccine and developing autism- bowel syndrome. The results of his research was published in a reputable scientific journal The Lancet and has been one of the biggest health controversies resulting in large groups of parents opting not to vaccinate their children against measles, mumps and rubella.

Medical and scientific experts and recent research suggests that the research carried out by Wakefield were significantly flawed.

* There was no research hypothesis clearly stated.
* Sample was highly selective – 12 children who had been selected because they had both bowel symptoms and autism like syndrome.
* Sample extremely small – sample size should be 100’s if not 1000’s
* No control group – a group of individuals who had never been exposed to the vaccine
* Parental recall – the alleged link with MMR vaccine was based on parental recall, parents were asked to consider how closely in time the vaccine was with the on set of autism like symptoms. The study took no steps to prevent recall bias i.e. remembering a closer association between two events than actually occurred. The notion that children were normal one day and showed clear signs of autism the next day is scientifically implausible.
* No double blind testing – the researchers who examined the children and analysed the samples all knew that the children had received MMR and that a link had been raised about its link with with autism bowel syndrome.
* Conflict of interest- As well as carrying out research on whether there was a link between the MMR vaccine and autism he was also being paid to acrry out a study for the Legal Aid Board representing parents who believed the vaccine caused autism in their children and intended suing if as soon as such proof was found.

