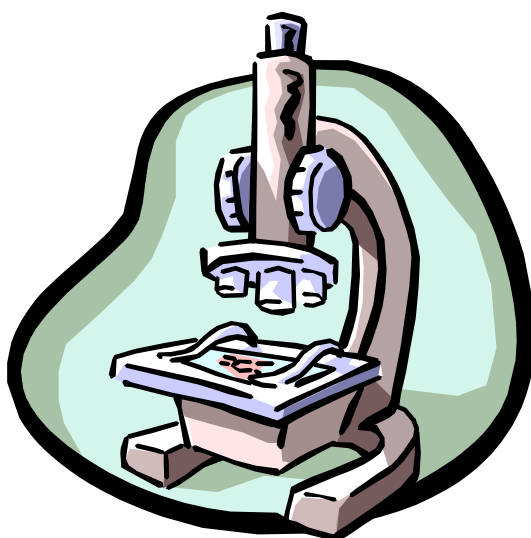




# Melbourne High School Science Year 10 Semester 2 2009



## Practical Booklet

Name: .....

Class: .....

Teacher: .....

All course information can be obtained from the Science web site:

**<http://resources.mhs.vic.edu.au/science/>**

Version: 12 June 2009

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## Safety in the Science Rooms (Laboratory rules)



1. You must not enter the laboratory unless a teacher is present, and you must not enter any preparation room, store room or the roof top nursery except under the direct instruction of a science teacher.
2. Chemicals must not be removed from the laboratory. Theft will be dealt with severely.
3. Never attempt unauthorised experiments. You must follow instructions exactly.
4. If you see another student using an incorrect procedure, point out the error.
5. All apparatus should be examined carefully before use; it should be clean and in working order. Any damaged or dangerous apparatus must be reported immediately. Check all apparatus before putting it away. It should be undamaged and clean. Keep your work area clean and tidy.
6. Avoid waste. Use only small quantities of chemicals and make sure all gas and water taps are turned off before leaving the laboratory.
7. Most waste liquids can be poured down the sink, flush with water if this is the instructed method of disposal. Most waste solids can be disposed of in the bin. Alternative instructions will be given if required. All clean waste paper must be placed flat in the Visy recycle box.
8. If there is an accident, inform your teacher immediately.
9. Whenever you are not sure of how to handle a situation consult with your teacher.
10. Do not handle hot objects, allow sufficient time for the apparatus to cool.
11. Use matches to light a Bunsen, not pieces of flaming paper.
12. Be very careful with flammable liquids. Do not open or pour flammable liquids near a flame.
13. Handle glass with respect. Broken glass should be swept up immediately, wrapped and placed in the bin. All accidents must be reported to your teacher.
14. Treat ALL chemicals as poisonous. NEVER taste chemicals. Smell with care and only after being instructed to do so. Avoid skin contact or inhaling any chemicals.
15. Wash your hands thoroughly after using chemicals.
16. Do not eat or drink in the science laboratory.
17. Handle electrical equipment with great care.
18. Always leave the Science rooms looking better than you found them.

### What to do in case of accidents or injuries:

1. Inform your teacher immediately.
2. Treat splashes in the eye by irrigating the eye with water continuously for several minutes.
3. Flood spills on the skin or clothes with large amounts of water. This also applies to benches. Clean up.
4. Shower burning paper and other burning solids with water. Use the liquid carbon dioxide fire extinguisher on electrical fires.
5. If a person is on fire, shower with water or cover with a fire blanket. Do not use a fire extinguisher.

### Safety is always our first concern!

- Irresponsible and dangerous behaviour will result in your parents being informed and may result in the withdrawal of hands-on practical work.
- Careless handling of equipment causing damage or deliberate breakage will result in the student(s) responsible paying for damaged or broken equipment.
- Serious accidents can occur especially through irresponsibility, disobedience and inattention.
- Class behaviour is also important. Unruly classes will not do practical work.

**We expect you to work well, safely & enjoy this excellent subject.**

Name: \_\_\_\_\_

Form: \_\_\_\_\_

Partner(s): \_\_\_\_\_

## Chemical reactions

**Aim:** To observe chemical reactions and explain these observations.

**Materials:**

Test tubes and test tube rack	Test tube holder	Bunsen burner
spatulas	Straws	Chemicals as listed below

**Safety:**



**Wear safety goggles and safety apron. Compounds of lead and barium are poisonous. Handle them with care and wash hands thoroughly after using them.**  
**Read the general safety in the science room document at the front of this booklet.**

**Method:** Follow the instructions for each of the experiments below.

For each of the six experiments you must write;

- A description of the reactants
- Any observations when the reactants are added together
- An explanation of the reaction that occurred using Science Dimensions 4 page 54
- A balanced chemical equation for the reaction, including the states.

**1.  $\text{Na}_2\text{CO}_3 + \text{HCl}$**

**Method:** place a small amount of sodium carbonate in a test tube and add 2 ml. of HCl (one pump of the pump pack is about 2ml.)

Description:

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Observations:

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Explanation:

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Equation:

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**2.  $\text{Ca(OH)}_2 + \text{CO}_2$**

**Method:** place 2 ml. of limewater in a test tube and gently blow through a straw into the test tube until you observe a change.

Description:

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Observations:

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Explanation:

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Equation:

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**3.  $\text{CuCO}_3 + \text{Heat}$**

**Method:** place a small amount (to a depth of approximately 1 cm.) of copper carbonate in a test tube and heat it strongly.

Description:

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Observations:

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Explanation:

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Equation:

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**4.  $\text{BaCl}_2 + \text{H}_2\text{SO}_4$**

**Method:** place 2 ml. of each of chemical in a test tube.

Description:

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Observations:

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Explanation:

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Equation:

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**5. CuSO<sub>4</sub> + Zn**

**Method:** Place a piece of zinc in a test tube and add 2 ml. of copper sulfate. Observe over time.

Description:

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Observations:

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Explanation:

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Equation:

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**6. Pb(NO<sub>3</sub>)<sub>2</sub> + KI**

**Method:** place 2 ml. of each of chemical in a test tube.

Description:

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Observations:

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Explanation:

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Equation:

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**Discussion:**

1. List 5 observations that could indicate a chemical reaction has occurred.

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2. List some of the chemical hazards related to this experiment.

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3. What safety precautions did you use during experimentation?

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4. Each of the reactants and products can be classified according to their bonding type. Complete the table below by listing the name and formula for each of the reactants and products in the correct column.

Metallic bonding	Ionic bonding	Covalent bonding



Name: \_\_\_\_\_

Form: \_\_\_\_\_

Partner(s): \_\_\_\_\_

## Fractional Distillation of Crude Oil

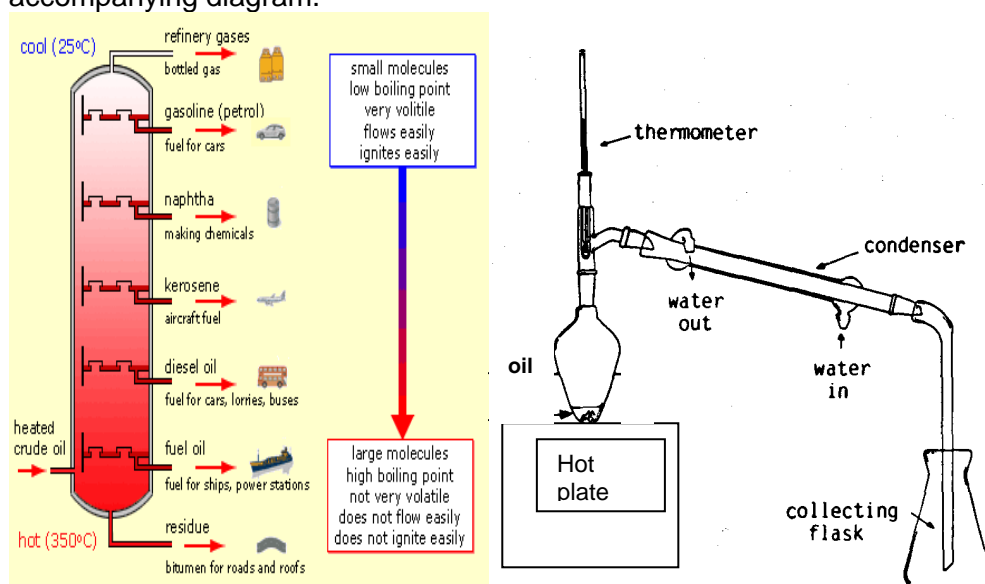
Until it has been processed, crude oil is not much use. This is because it is a mixture of many thousands of different compounds with different properties. They are called **hydrocarbons**, because they contain the elements **hydrogen** and **carbon** only.

To make crude oil useful, these compounds need to be sorted into batches with similar properties. These batches are called **fractions** and they are separated by **fractional distillation**. The idea behind this technique is that some of the compounds in crude oil are easily vaporised. They are volatile, with low boiling points. Others are less volatile and have higher boiling points.

In fractional distillation, the crude oil is heated to make it vaporise. The vapour is then cooled, and the most volatile compounds condense to liquids most easily. Different fractions of the oil are collected at different temperatures. The main fractions are summarised below.

Fraction	Colour	Boiling point range/°C .	Uses
refinery gas	colourless	below room temperature	gaseous fuel (e.g. bottled gas), making chemicals
gasoline - (petrol) ;	colourless or pale yellow	30-160	motor car fuel, making chemicals
kerosine (paraffin)	colourless or yellow	160-250	heating fuel, jet fuel
diesel oil	brown	220-350	diesel fuel for lorries, trains etc., heating fuel
residue	dark brown	above 350	fuel for power stations, ships etc. Some is distilled further to give lubricating oil, waxes etc.

We can carry out a simple version of fractional distillation of crude oil in the laboratory, using the method summarised below. On an industrial scale the distillation is carried out in a huge tower. The most volatile fraction comes out at the top and the least volatile at the bottom. See the accompanying diagram.



**Aim:** To fractionally distil a sample of crude oil and examine the fractions collected.

**Materials:**

- Crude oil
- Fractionating apparatus
- Small collection flasks
- watch glasses
- Thermometer
- Hot plate
- matches
- pipettes



- **Safety glasses and safety aprons** must be worn for this prac!
- A fire blanket must be readily available
- The fractional distillation must occur behind a safety screen
- Care must be taken when igniting the collected fractions

**Procedure: To be performed by your teacher.**

- Set up the apparatus as shown in the diagram above ensuring that the water enters at the lower end of the condenser.
- Place 50 ml of the crude oil in the flask with a few boiling chips.
- Begin heating the crude oil using the hot plate.
- As the crude oil begins to boil and the various fractions begin to distil over, note the maximum temperature for each fraction.
- Change the collection flask as each new fraction begins to distil over.
- Switch off the hot plate as the temperature reaches about 210°C
- Test the flammability of each fraction by placing three drops on a watch glass and igniting the sample with a match.

**Questions:**

1. List the similarities and differences between the lab distillation apparatus and the fractionating tower shown above?

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2. Describe the appearance, viscosity and odour (careful!) of the crude oil

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3. Observe each of the fractions collected and the residue left in the distillation flask and complete the table below.

Fraction number	Boiling Temp range °C	Description of fraction/residue	Ease of flammability	Description of flame and any smoke.
Residue	---			

4. The fractions collected are a mixture of hydrocarbon compounds, mostly alkanes. Complete the table below and predict the possible alkanes in each fraction collected.

Number of C atoms	Name of alkane	Boiling Temp. °C	Physical state at 20°C	Found in fraction No./residue
1	methane	- 162		-----
2	Ethane	-89		-----
3	Propane	-43		-----
4	Butane	-0.5		-----
5	Pentane	36		
6	Hexane	69		
7	Heptane	98		
8	Octane	126		
9	Nonane	151		
10	decane	174		
11	undecane	196		
12	dodecane	213		
17	heptadecane	303	liquid	
20	eicosane	343		

5. Explain in detail the reasons for the increase in boiling temperature as the number of carbon atoms in the alkane molecules increases.

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6. LPG and bottled barbeque gas contain a mixture of hydrocarbons. List two possible alkane components of these bottled gases and draw their structure.

Name:	Name:
Structure:	Structure:

7. Petrol is a mixture of a range of hydrocarbons, but consists mainly of one particular hydrocarbon. Petrol is pink in colour.

a) Name the main hydrocarbon in petrol:

b) Explain why the fractions collected in this prac are not pink but petrol is.

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8. When hydrocarbons burn in excess oxygen from air, the products are carbon dioxide and water. If there is less oxygen present, the products are carbon,  $C_{(s)}$  and water.

Write balanced equations for:

Pentane ( $C_5H_{12}$ ) burning in excess oxygen

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Pentane burning in a limited amount of oxygen to produce carbon

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Name: \_\_\_\_\_

Form: \_\_\_\_\_

Partner(s): \_\_\_\_\_

### Using Ticker Timers to measure motion

**Aim:** To use a ticker timer to measure and analyse motion.

**Materials and Method:** a) As described on page 225 of Pearson Science dimensions 4

**Results:** Follow the instructions on page 226 of the textbook and complete the table below. All graphs (see steps 6 and 9 of the textbook) must be completed on separate sheets and these sheets must be attached to this prac document.

Section	Elapsed time (s)	Distance of each section (mm)	Total distance (mm)	Average speed (mm/s)

b) Repeat the above activity to produce a ticker tape for the acceleration of a trolley rolling downhill.

**Results:** Construct a ticker tape graph as in the previous activity and attach it to this document. Complete the following table:

Section	Elapsed time (s)	Distance of each section (mm)	Average speed (mm/s)	Change in speed (mm/s <sup>2</sup> )
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**Discussion:**

To be completed on a separate sheet of paper

1. Complete questions 1 – 3 on page 226 of the textbook.
2. Generally, how would you describe the motion of the trolley down a ramp?
3. Explain in detail how ticker timers could be used to determine acceleration due to gravity
4. What are some of the problems that could be encountered in determining acceleration due to gravity using this method?



Name: \_\_\_\_\_

Form: \_\_\_\_\_

Partner(s): \_\_\_\_\_

## Describing motion

**Aim:** To use a motion probe to record and describe the motion of a person.

**Method:** Set up the Go-Motion probe in a space with at least five metres clear in front. Record the motion of a person walking in front of the probe over a period of twenty seconds. **Try to walk in a reasonable manner, at a constant speed where possible.**

**Results:** You are to produce a **clear graph** showing the position and velocity **on the same axes**, against time. The graph should be appropriately labelled, with no bad data points showing. (These occur when the person moves outside of the ultrasound beam.)

**Discussion:** Answer the following questions, showing workings and explanations.

1. What was the **displacement** of the person after 20 seconds?
2. What was the **distance** travelled during the 20 seconds?
3. What was the **average velocity** over the 20 seconds?
4. At what time was the person travelling **fastest**?
5. What was the **highest speed** reached?
6. Why is the velocity time graph not smooth? What do the small variations indicate?
7. Identify a point on the position time graph that shows the person **changing direction**. What happens on the velocity graph at that time?
8. Identify a section of your position time graph (and describe what happens) where: a) the graph is **flat**, b) the **gradient is increasing** in magnitude c) the **gradient is decreasing** in magnitude d) the **gradient is negative**.
9. How does the velocity time graph relate to the position time graph?

10. If you were only given the position time information, how could you calculate the velocity? For the table given below, calculate the average velocity for each interval and describe how this object is moving.

Time (s)	Height (m)	Velocity (m/s)
0.00	1.000	-
0.02	0.998	
0.04	0.992	
0.06	0.982	
0.08	0.968	
0.10	0.950	
0.12	0.928	
0.14	0.902	
0.16	0.872	
0.18	0.838	



**Links:**

[http://resources.mhs.vic.edu.au/science/learning\\_technologies/cbl\\_datalogging/using\\_cbr\\_ranger.htm](http://resources.mhs.vic.edu.au/science/learning_technologies/cbl_datalogging/using_cbr_ranger.htm)  
[http://resources.mhs.vic.edu.au/science/learning\\_technologies/cbl\\_datalogging/downloadsfromcbl.htm](http://resources.mhs.vic.edu.au/science/learning_technologies/cbl_datalogging/downloadsfromcbl.htm)  
[http://resources.mhs.vic.edu.au/science/learning\\_technologies/graphing\\_information/graphing.htm](http://resources.mhs.vic.edu.au/science/learning_technologies/graphing_information/graphing.htm)

Name: \_\_\_\_\_

Form: \_\_\_\_\_

Partner(s): \_\_\_\_\_

## Falling objects

**Aim:** To predict, observe and explain the motion of falling objects and the effects of air resistance.

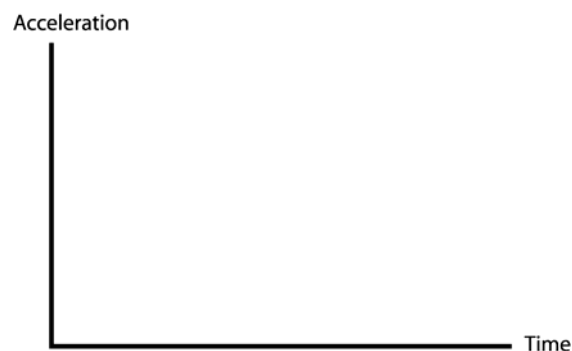
**Materials:**

- Go-Motion probe & computer
- Basketball
- Cupcake patties

### Part one: Predictions

Before conducting the experiment you are to **predict** what you think the relationships are between the **distance travelled, the speed of the object, the acceleration** and **time**. For both the basketball and the cupcake patty you will need to draw what shape you think the graphs of the motion will have. Draw both on the same axes, to the same time scale. Think carefully about the graphs and shapes:

- Which object will hit the ground in the least time?
- Will the speeds be constant?
- Will the accelerations be constant?



## Part two: Observations

Set up the computer and motion probe. Attach the probe firmly to a door-frame or hold it steady at roof height. Hold the ball in front of you at arms length and head high, with the ball directly below the sensor.

**When ready, start the probe recording and then drop the ball.** Observe the shape of the displacement graph shown on the screen of the calculator.

If you are satisfied with the data, then save the data file and copy the columns of data into a spreadsheet.

**Repeat the measurements, this time dropping a cupcake patty.**

To analyse the data, you will need to copy the information into a spreadsheet, with the time in the first column and distance in the second. **Delete any of the points that are not relevant to the fall.**

**Use the spreadsheet to draw xy scatter graphs of the distance vs time, speed vs time and acceleration vs time. Be sure to graph both position time graphs on the one set of axes, speed on another set and the acceleration on a third.**

Comment on the shape of the graphs. Can you explain in words what each graph means?

## Part three: Explanations

The acceleration of a falling object can be explained in terms of Newton's second law of motion:

$$\Sigma F = ma.$$

"The acceleration of an object is proportional to the overall force and inversely proportional to the mass."

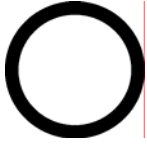
**You can represent the forces as vectors (arrows) on a diagram. The length of the arrow represents the size of the force acting and the direction of the arrow head indicates the direction of the force.**

These vectors can be added: opposing vectors cancel.

What two forces will be acting on an object as it falls?

**Draw on a diagram (such as the one on the next page) showing the two forces (to scale) acting on a cupcake patty as it falls:**

- at the acceleration of gravity.
- at an acceleration less than gravity.
- at a constant speed.



Also draw next to the object an arrow indicating the size and direction of the overall force.

**Now draw (to the same scale as used above) what you think the forces diagram would look like if you dropped two cupcake patties (one inside the other).** Which force would be the same? Which would be larger?





Name: \_\_\_\_\_

Form: \_\_\_\_\_

Partner(s): \_\_\_\_\_

## Natural Selection Modelled

Natural selection can be observed only under particularly favourable circumstances, and usually over a long period of time. The process can, however, be simulated by means of a model. It is then possible to show in a simplified way what in nature is often a complex situation.

### Purpose

To simulate the natural selection by means of a model and observe some of its consequences.

### Materials (per team of 2/3)

- Set of "beetle" cards
- A six-sided die, numbered 1–6; designate three numbers to be red, two to be orange and the other to be yellow.

### Assumptions

- There are 30 beetles in the original population, 10 of each colour
- Each year the beetles mate at random and each pair produces one offspring
- The colour of the offspring is determined genetically, as shown by these rules (using the die as explained below):

red X red gives red  
 yellow X yellow gives yellow  
 red X yellow gives orange  
 orange X yellow gives 50% orange, 50% yellow  
 orange X red gives 50% orange, 50% red  
 orange X orange gives 25% red, 50% orange, 25% yellow

- After the beetles mate, a predator kills one third of the total population each year (15 beetles), and its prey is eaten in the ratio of 3 red : 2 orange : 1 yellow. (That means that orange beetles are twice as likely to get eaten as yellow and red beetles are three times more likely to be eaten than yellow. Thus, the population remains at 30 at the beginning of each breeding season.
- There is no migration or causes of death, other than the predator, operating on the population.

## Procedure

### Breeding

1. Set up the original beetle population by selecting 30 cards, 10 of each colour. Place the remaining cards to one side and use them only if you need additional animals.
2. To represent random mating, shuffle the cards thoroughly and deal them in 15 pairs. For this simple model sex of beetle does not matter.
3. Add an appropriate additional card to each pair to represent offspring. Refer to assumption C to decide the colour of the offspring. In every case where the colour is not certain, you will need to use the numbers designated on the die to decide the colour e.g. if the offspring may be either of two colours, let odd numbers be one colour, and even numbers be the other. If the offspring could be any of three colours, use number 1 for one colour, 2 and 3 for the second, and 4 for the third. If a 5 or 6 is rolled, then roll again until a number from 1 to 4 is rolled.

### Predation

1. To simulate predation, roll the die 15 times. At each roll remove a beetle corresponding to the colour of the top face of the die. If the population does not contain a beetle of the same colour as that designated for the uppermost face, roll again until you can remove a beetle. *15 beetles must be eaten each year.*
2. After one year of mating and predation, collect all the beetles and record the population in the table. Make sure there are 30 total beetles.
3. Repeat the mating and predation procedures for the new population and again record outcomes.
4. Continue mating and predation for seven cycles.

## Results

YEAR	RED	ORANGE	YELLOW	TOTAL
1	10	10	10	30
2				30
3				30
4				30
5				30
6				30
7				30

**Questions**

1. What changes in the beetle population were observed during successive years?

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2. Explain why these changes occurred.

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3. Under what circumstances in nature might a predator feed on red beetles more often than on orange or yellow beetles?

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4. Does the chance of survival of any individual beetle vary from year to year? Explain.

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5. Does the chance survival of the species vary over successive years? Explain.

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