THE DUSTON SCHOOL
Knowledge itself is power
TDS 4-19

Year 10 Science Knowledge Booklet

Term 1

Name:	**Class:**
Homework 1 Due: 17th September	**Homework 2 Due: 1st October**
Homework 3 Due: 15th October	

Science Homework 1

Read all of this knowledge organiser.

Big questions: What do we mean by bioenergetics?
What is Photosynthesis?
What do plants do with the glucose they have made?
What limits photosynthesis?
How do limiting factors interact?
Required Practical: How does light intensity effect photosynthesis?
What is aerobic respiration?
What is anaerobic respiration?
How does your body react to exercise?
How do we investigate the effects of exercise on the body?
What do we mean by metabolism?

Key vocabulary

Aerobic Respiration	Releasing energy from a molecule such as glucose, using oxygen.
Anaerobic Respiration	Releasing energy from a molecule of glucose without using oxygen.
Breathing Rate	The number of breaths taken in one minute.
Cellulose	Cellulose
Chloroplast	Small disc in the cytoplasm of plants containing chlorophyll.
Endothermic	A reaction which takes in more energy (to break bonds) than it gives out (when bonds form).
Ethanol	The alcohol found in beer, wine and spirits. Waste product in anaerobic respiration in fungi.
Exothermic	A reaction which takes in less energy (to break bonds) than it gives out (when bonds are formed).
Fermentation	Another word for anaerobic respiration by microorganisms such as yeast which produces alcohol and carbon dioxide.
Heart Rate	The number of times the heart beats (contracts) per minute.
Inverse Square Law (HT)	If a distance to a light halves, the light intensity increases by a factor of four.
Lactic acid	Waste product from anaerobic respiration in animals. It causes muscle fatigue.
Light Intensity	How strong the light is (how many photons per square metre). Measured in lux.
Limiting Factor	A factor which is running out and stopping a process or chemical reaction (e.g. photosynthesis).
Metabolism	All of the chemical reactions in an organism or cell.
Mitochondria	The site of aerobic respiration in plant and animal cells.
Oxygen Debt	The amount of oxygen required to remove lactic acid from the body.
Photosynthesis	An endothermic reaction in plants and algae. Water and carbon dioxide combine to from oxygen and glucose using energy from sunlight.
Respiration	Exothermic reaction which releases energy from molecules such as glucose.
Yeast	Single celled fungus used in baking and brewing.

What is Photosynthesis?

- Plants are **autotrophs** – this means that they can make their own food using light, water and carbon dioxide
- This is why they are called **producers** in food chains
- Photosynthesis is an **endothermic** reaction in which energy is transferred from the environment to the chloroplasts by light

The word equation for this is:

water + carbon dioxide --> glucose + oxygen

The symbol equation for this is:

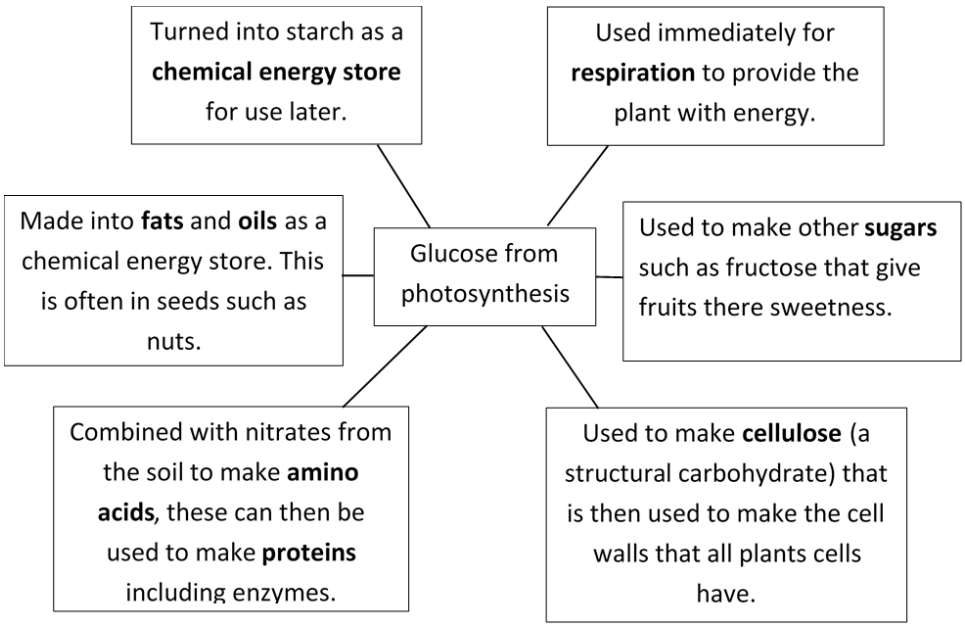
$$H_2O + CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$$

What do plants do with the glucose they have made?

Glucose produced in photosynthesis may be:

- Used for respiration.
- Converted into starch for storage.
- Used to produce fats and oils for storage or cellulose to strengthen cell walls.
- Used to produce amino acids for protein synthesis, to produce proteins plants also use nitrate ions from the soil.

The glucose and the products made from it also go into food chains and are used in the organisms within that food chain.



What limits photosynthesis?

If plants have the correct temperature, unlimited carbon dioxide and enough light energy the only thing that limits photosynthesis is the plant itself – can it absorb what it needs at a fast enough rate? Does it have enough chlorophyll?
Most plants are not in this situation, usually an external factor is preventing photosynthesis from happening faster.
We call these limiting factors

The four main limiting factors are:

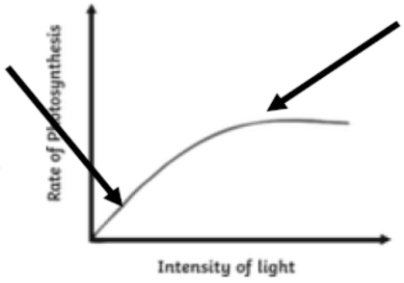
1. **Light intensity**
2. **Temperature**
3. **The concentration of carbon dioxide**
4. **The amount of chlorophyll/chloroplasts/leaves**

Water is not classed as a limiting factor in photosynthesis as other processes in the plant would already have stopped, and the plant died, before it became a limiting factor.

How do limiting factors interact?

A limiting factor is something that is limiting the rate of photosynthesis e.g. if there isn't enough light for the reaction to occur, light is the limiting factor.

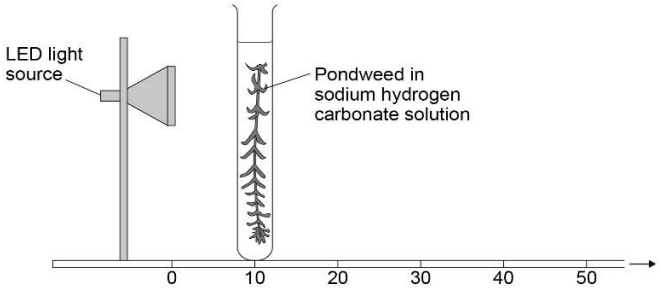
As the intensity of light increases, so does the rate of photosynthesis. This means light is the limiting factor



The graph levels out when increasing the light intensity no longer increases the rate of photosynthesis.
This means light is no longer the limiting factor. Something else is limiting the reaction such as temperature of carbon dioxide concentration.

Required Practical: How does light intensity effect photosynthesis?

- A cut piece of an aquatic plant is placed under the water.
- An inverted funnel is submerged over it and the oxygen produced collected and measured **OR** the number of bubbles produced over a set period of time is counted.
- A light source (usually a lamp) is shone on the pondweed from a distance and the rate of bubble production is measured or the total volume of gas produced over a set time.
- The distance is then varied (e.g. 100cm, 80cm, 60cm, 40cm, 20cm) and the experiment repeated.



Science Homework 2

Try to answer all of these key knowledge questions. Then check your answers using the answer page.

Questions in *italics* are from older work.

Key knowledge question	**Answer**
Write the word equation for photosynthesis	
Where in the cell does photosynthesis occur?	
Name factors that affect the rate of photosynthesis	
How can the rate of photosynthesis be determined?	
Write the symbol equation for photosynthesis?	
Define respiration.	
Write the word equation for aerobic respiration	
Why is yeast used in the baking and brewing industries?	
Write the word equation for anaerobic respiration in animals	
What is oxygen debt?	

What is aerobic respiration?

This is a process that goes on continually in cells. Without it the cells would not be able to live.

The word aerobic in aerobic respiration refers to the fact that oxygen is used in this form of respiration.

By reacting glucose with oxygen the chemical energy store in the glucose molecules can be transferred into other energy stores that the organism can then use to carry out the processes that are essential for life.

The word equation for this is:

glucose + oxygen --> water + carbon dioxide

The symbol equation for this is:

$$C_6H_{12}O_6 + 6O_2 \rightarrow H_2O + CO_2$$

What is anaerobic respiration?

Anaerobic respiration means respiration without oxygen.

In animals this form of respiration is used when the cells cannot be supplied with oxygen at a fast enough rate to supply energy needs through aerobic respiration.

In anaerobic respiration glucose is incompletely broken down to form lactic acid.

The word equation for anaerobic respiration in animals is:

glucose → lactic acid

Anaerobic respiration in yeast is important in bread making, it is the carbon dioxide formed by yeast in the bread dough that makes it rise and become full of bubbles.

Anaerobic respiration in yeast is also used to produce alcohol, both in making drinks and as a biofuel and other industrial applications.

The equations for anaerobic respiration in plants and yeast are:

glucose → ethanol + carbon dioxide

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

How does your body react to exercise?

In humans this results in a number of things:

- **The heart rate increases** – this means the blood which is delivering the oxygen travels around the body faster.
- **Breathing rate and volume increase** – this increases the rate of absorption of oxygen in the lungs and the removal of carbon dioxide from the blood.

Anaerobic respiration and exercise

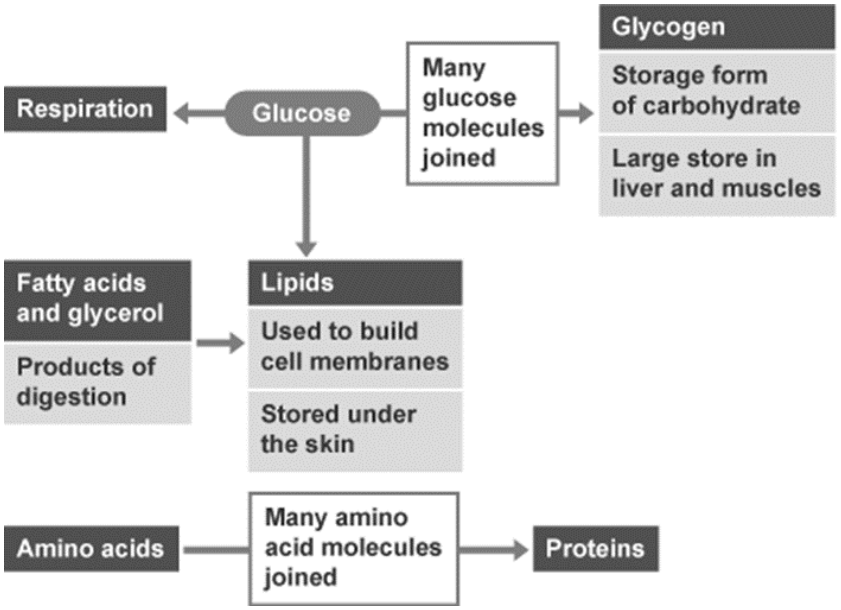
- During strenuous exercise the body cannot supply the muscles with enough oxygen for them to meet the demand for energy by aerobic respiration.
- In this situation muscles will respire anaerobically, this incompletely breaks glucose down into lactic acid.
- This releases far less energy from each glucose molecule than aerobic respiration.
- This creates an **oxygen debt** in the tissue, the extra oxygen that is needed to break the lactic acid down.
- This is why a person continues to breathe heavily after they have stopped exercising.

What do we mean by metabolism?

Metabolism means all the chemical reactions happening in a living organism.

Metabolism includes:

- The conversion of glucose to starch, glycogen and cellulose.
- The formation of lipids.
- The formation of amino-acids and proteins.
- Respiration.
- The breakdown of excess proteins to form urea for excretion.



Key knowledge question	**Answer**
Write the word equation for photosynthesis	water + carbon dioxide --> glucose + oxygen
Where in the cell does photosynthesis occur?	In chloroplasts
Name factors that affect the rate of photosynthesis	CO_2 concentration, temperature, light intensity
How can the rate of photosynthesis be determined?	Counting bubbles in a given time/volume of gas collected in a given time
Write the symbol equation for photosynthesis?	$H_2O + CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$
Define respiration.	Release of energy from the breakdown of glucose
Write the word equation for aerobic respiration	Glucose + Oxygen --> Carbon Dioxide + Water
Why is yeast used in the baking and brewing industries?	In baking to make bread rise in brewing to form ethanol
Write the word equation for anaerobic respiration in animals	Glucose --> lactic acid
What is oxygen debt?	A temporary oxygen shortage in the body tissues arising from exercise.

Big questions: The Particle Model of Matter

How does the particle model explain the properties of solids, liquids and gases?
How can we measure the density of materials?
What happens to the particles of a substance when it is heated and changes state?
What is latent heat and how do we measure it?
What do we mean by internal energy?
How can we measure the specific heat capacity of a solid?
What causes gas pressure?

Key vocabulary

States of matter	Substances (matter) can exist in three states: the solid state, the liquid state and the gas state.
Density	The mass per unit volume of a substance.
Displacement can	The volume of irregular objects can be found by immersing them in water in a Eureka can. Its sometimes called a displacement can.
Change of state	Melting, freezing, boiling, condensing, evaporating and sublimation are the names given to changes of state. Eg. Melting is the change of the state of a substance from solid to liquid.
Kinetic theory	The idea that all matter is made of particles that are in **constant motion**. **Heat energy** can increase the motion of the particles and raise the **temperature** or break the bonds between them and **change the state**
Internal energy	The total **thermal energy** stored in the particles of a substance. Particles have **kinetic energy** because of their motion and **potential energy** stored in their bonds.
Specific heat capacity	The energy needed to raise the temperature of 1kg of a substance by 1^{o}C.
Specific latent heat of fusion	The energy required to melt 1kg of a substance from solid to liquid with no temperature rise.
Specific latent heat of vaporisation	The energy needed to boil 1kg of substance from liquid to gas without temperature rise.
Temperature	How hot or cold something is. Temperature increases if the average speed of the particles increases.
Liquid pressure	The pressure exerted by the particles of a liquid on objects immersed in them. Liquid pressure increases as you go deeper.
Gas pressure	The pressure exerted when the particles of a gas collide with its surroundings. Gas pressure increases as the gas gets hotter.

How does the particle model explain the properties of solids, liquids and gases?

- **Solids** have **fixed shape** because their particles don't move much so are close together. The forces between particles are very strong.
- **Liquids** have the **shape of their container** because their particles move more so are a bit further apart. The forces between particles are weaker.

- **Gases fill their container completely** because their particles move fast so are far apart. The forces between particles are very weak.

How can we measure the density of materials?

The density of an object is its **mass per unit volume**. This is the mass of one metre cubed of the material.

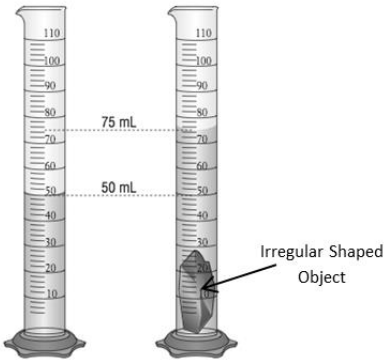
- **Denser** materials have particles which are **packed more closely together**.
- **Solids** are generally denser than **liquids** and **gases** are least dense.

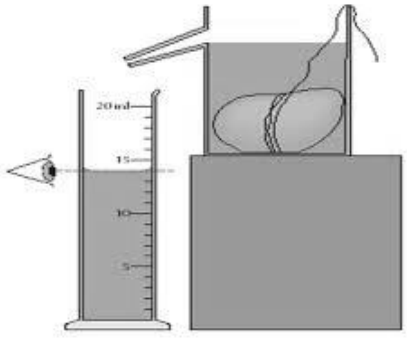
Objects **float** if they are less dense than the liquid they are in and **sink** if they are more dense.

Required practical – measuring density

The density of a material can be found if its mass and its volume can be measured.

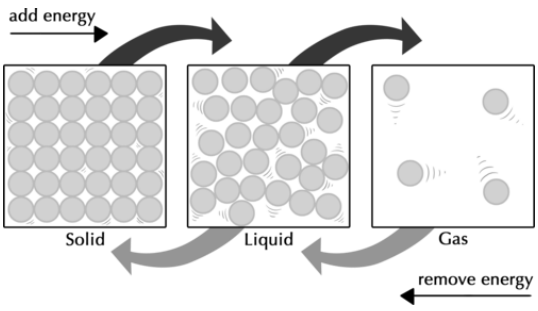
- **Mass** is measured using a top-pan balance.
- **The volume of regular solids** can be found by measuring the sides with a **ruler** and multiplying the **length x height x width**.
- **The volume of liquids** can be found by using a **measuring cylinder**.
- **The volume of irregular solids** can be found using a large **measuring cylinder** or a **displacement can (**sometimes called a **eureka can)**





What happens to the particles of a substance when it is heated and changes state?

Heating transfers energy to the particles so **melting** and **boiling** can happen. **Cooling** removes energy from the particles so condensing and freezing can happen.



What is latent heat and how do we measure it?

When a substance **changes state** (melting/freezing or boiling/condensing) the temperature stays constant.
The **energy** is used to **break bonds** not raise temperature.

The specific latent heat is the **energy needed** to change the state of 1kg of substance at constant temperature.

- For **melting** use the **specific latent heat of fusion.**
- For **boiling** use the **specific latent heat of vaporization.**

What do we mean by internal energy?

The particles of solids, liquids and gases have:

- **Kinetic energy** because they are moving.
- **Potential energy** because of the forces of attraction between them.

The **internal energy** of a substance = kinetic energy + potential energy of its particles.
Heating a substance always **increases** its internal energy.

How can we measure the specific heat capacity of a solid?

When a substance is heated its particles **gain kinetic energy** and its **temperature rises**.

The **specific heat capacity** of a substance is the energy needed to change the temperature of 1kg of it by 1^{o}C.

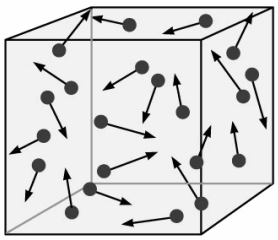
- Substances with a low specific heat capacity heat up quickly and store little energy
- Substances with a high specific heat capacity heat up slowly and store much energy

What causes gas pressure?

Gases contain particles that are fast moving and fill the container.

Particles collide with the walls of the container.
Collisions exert a force
Force over the area of the walls is **pressure**.
Pressure is increased if **temperature** is higher:

- particles move faster,
- collisions with walls are more frequent so exert more force
- and create higher pressure.



Science Homework 3

Try to answer all of these key knowledge questions. Then check your answers using the answer page.

Questions in *italics* are from older work.

Key knowledge question	**Answer**
State the equation for density	Density = Mass ÷ Volume
Define internal energy	Internal energy is the total kinetic energy and potential energy of all the particles in a system
Define specific heat capacity	The energy needed to raise the temperature of 1kg of a substance by 1oC
State the units of specific heat capacity	J/kg°C
Define latent heat of fusion	The energy needed to change the state of 1kg of a substance from solid to liquid
Define latent heat of vaporisation	The energy needed to change the state of 1kg of a substance from liquid to gas
What happens to the kinetic energy of particles when a gas is heated?	The kinetic energy of the particles increases.
List the six possible changes of state	Melting, freezing, boiling, condensing, evaporating, sublimating
Name the change of state when a liquid becomes a gas	Boiling or evaporating
Name the change of state when a liquid becomes a solid	Freezing
State the melting point and boiling point of pure water.	0°C, 100°C
Describe the motion of particles in a gas	Random speeds in random directions

Wider reading

How to get the most out of your knowledge organiser:

- To get the most use out of the knowledge organisers you should be learning sections and then self-testing.

- There are several different things you can do
  - Look, cover, write, check, correct
  - Read through the organisers
  - Mind maps
  - Key spellings
  - Make a glossary
  - Missing out key words
  - Questions/answers answers/questions
  - Flash cards
  - Revision clock learning
  - Mnemonics

Science Learning Tools and wider study:

The Oak Academy – Online Science lessons
BBC Bitesize science
<u>You tube channels:</u>
Fuse school
Ted talks
Free science lessons
Primrose Kitten
<u>Shows on Netfilx</u>
Our planet
Tiny creatures
A life on our planet

Key knowledge question	**Answer**
State the equation for density	Density = Mass ÷ Volume
Define internal energy	Internal energy is the total kinetic energy and potential energy of all the particles in a system
Define specific heat capacity	The energy needed to raise the temperature of 1kg of a substance by 1oC
State the units of specific heat capacity	J/kg°C
Define latent heat of fusion	The energy needed to change the state of 1kg of a substance from solid to liquid
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List the six possible changes of state	Melting, freezing, boiling, condensing, evaporating, sublimating
Name the change of state when a liquid becomes a gas	Boiling or evaporating
Name the change of state when a liquid becomes a solid	Freezing
State the melting point and boiling point of pure water.	0°C, 100°C
Describe the motion of particles in a gas	Random speeds in random directions