DIXONS SIXTH FORM ACADEMY

SUMMER WORK:

APPLIED SCIENCE DIPLOMA

2023

Contents

About the Summer Work

Getting a good head start into what BTEC Level 3 National Extended Certificate in Applied Science is about will be the key to your success. This bridging work is designed to help you bridge the gap between your GCSE Science studies and BTEC Level 3 National Extended Certificate course.

This booklet contains a number of tasks that students are expected to complete to a good standard in order to be able to be enrolled in this subject.

It is important that you complete all your assigned work in preparation to your new course. The work will help you develop necessary skills for post 16 studies such as resilience and time management that will be essential during years 1 & 2. In September, your bridging work needs to be handed at the first lesson and it will be assessed. This way we can diagnose your strengths and weaknesses and begin to support you in a more targeted way.

The work handed in should be:

- written in black or blue ink on A4 lined paper
- written in full sentences with no copying and pasting from external sources
- have all compulsory tasks completed
- have you full name on each sheet
- multiple sheet should be connected together

All sections need to be completed.

Resources:

1. Free Science Lessons (You Tube) https://www.youtube.com/channel/UCqbOeHaAUXw9Il7sBVG3_bw
2. BBC Bitesize https://www.bbc.com/bitesize/levels/z98jmp3

Welcome to Applied Science

Subject outline

Congratulations on choosing a course through which you will develop a set of knowledge and skills which will allow you to successfully move on to your next step in your journey, whether that is to university, an apprenticeship, or into employment.

BTEC Applied Science is, at its heart, all about giving you as a learner the best opportunity to show off your skills through a combination of examination and coursework units, across a range of scientific topics which are applicable to science as it is used and applied in industry. Through your hard work and determination not only will you come out of the next two years with a fantastic qualification which will allow you to access a range of opportunities, you will also have developed skills which will allow you to quickly adapt to the demands of further education/apprenticeship/employment. These skills include: organisation, research, communication – both verbal and written, time management, practical investigation, and taking initiative and independent working.

By the end of this course you will have built up a portfolio of work which you can feel proud of, knowing that it shows your journey and development as a learner and a scientist.

Good luck, and we hope you enjoy your course.

Careers & Higher Education

One of the main career paths for applied science students is the healthcare sector. The study of applied science helps develop skills which are valuable for this sector – written communication skills, practical lab-based skills, teamwork as part of lab-based work, organisation and time management through the coursework report writing, and problem solving. There is a shortage of skilled workers for the healthcare sector in Bradford and Yorkshire, so a background in science is a real advantage to help you get into this field.

As well as the healthcare sector, double applied science can be used as a means to apply for foundation courses such as foundation engineering, and foundation science which can lead to degrees in areas such as pharmacy and optometry.

If there is a particular career that you are interested in pursuing the best thing you can do to support your application is to look for work experience; that in conjunction with an applied science qualification helps boost applications to science-based university courses.

Links to key information:

Specification: https://qualifications.pearson.com/en/qualifications/btec-nationals/applied-science-2016.html

Summer work tasks

Useful information

SI units

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	m	kilogram	kg
length	l or x	metre	m
time	t	second	s
electric current	I	ampere	A
temperature	T	kelvin	K
amount of substance	N	mole	mol

Prefixes

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Task 1: Practical Key Words

Join the boxes to link the word to its definition.

Accurate	A statement suggesting what may happen in the future.
Data	An experiment that gives the same results when a different person carries it out, or a different set of equipment or technique is used.
Precise	A measurement that is close to the true value.
Prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment.
Range	Physical, chemical or biological quantities or characteristics.
Repeatable	A variable that is kept constant during an experiment.
Reproducible	A variable that is measured as the outcome of an experiment.
Resolution	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.
Uncertainty	The interval within the true value can be expected to lie.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Measurements where repeated measurements show very little spread.
Dependent variable	Information, in any form, that has been collected.

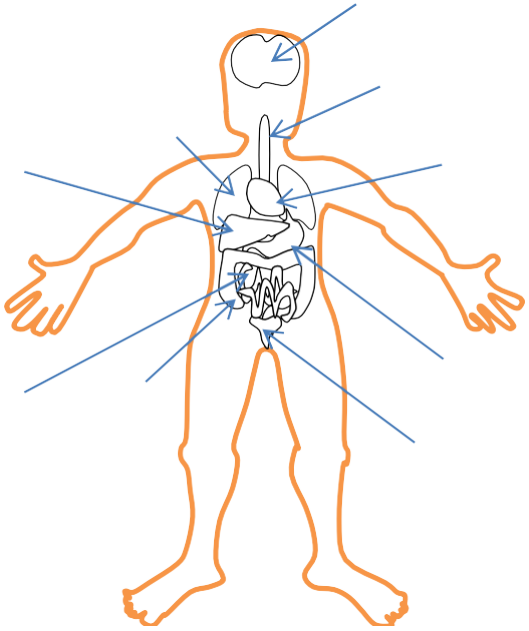
Biology Section

Complete the table.

Structure	Function
Cell-surface membrane	
Chloroplast	
Cell vacuole	
Mitochondria	
Nucleus	
Cell wall	
Chromosomes	
Ribosomes	

Draw the structure of a plant cell and an animal cell. On each cell, add labels showing each of the structures in the table, if they exist.

Label the organs in the body.



Complete the table to show which down the organ that carries out each function.

Organ	Function
	takes oxygen into the bloodstream
	breaks down (digests) food
	make sperm cells
	make egg cells
	controls the body's functions
	absorbs nutrients from food
	produce urine
	sense light

Draw a line to match each organ system with the organs it contains.

Reproductive	ears, eyes, nerves
Digestive	stomach, intestines, pancreas

Circulatory	kidneys, liver, skin
Excretory	ovaries, uterus, oviduct
Sensory	heart, arteries, veins
Nervous	trachea, lungs, diaphragm
Respiratory	brain, spinal cord nerves

Complete the table.

Structure	**Description**	**Adaptation for function**
Rib		
Alveoli		
Bronchus		
Trachea		
Larynx		
Diaphragm		
Bronchiole		

State the three types of blood vessels that make up the circulatory system.

State the name of the space which blood flows in a blood vessel.

.....

.....

Complete the table to compare the relative sizes and structures of the three types of blood vessels. Choose from the options in brackets.

Blood Vessel	Size of lumen (very narrow/narrow/wide)	Thickness of wall (thin/ thick/ very thin)	Do they contain valves? (yes / no)
Arteries			
Veins			
Capillaries			

Compare the function of arteries and veins.

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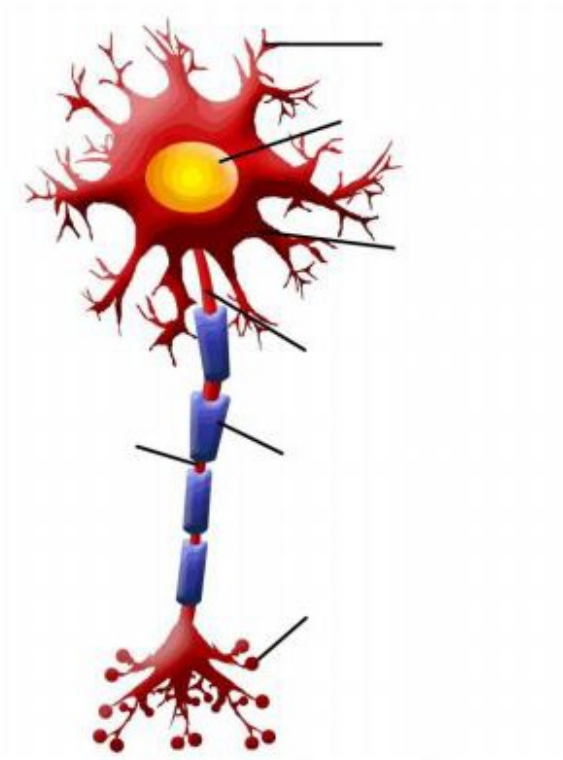
There are three different kinds of neurons or nerve cells. Match each kind with its function.

A. Motor neuron **B. Sensory neuron** **C. Relay neuron;**

Kind of neuron	Function
.....	The nerve cell that carries impulses from a sense receptor to the brain or spinal cord.
.....	The nerve cell that connects sensory and motor neurons
.....	The nerve cell that transmits impulses from the brain or spinal cord to a muscle or gland

Identify the parts of the neuron below:



Summarise the structure and function of the heart.

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Chemistry

Use the periodic table to find the following:

1. The atomic number of: osmium, sodium, lead, chlorine.

2. The relative atomic mass of: helium, barium, europium, oxygen.

3. The number of protons in: mercury, iodine, calcium.

4. The symbol for: gold, lead, copper, iron.

5. The name of: Sr, Na, Ag, Hg.

Relative atomic mass (A_r)

If there are several isotopes of an element, the relative atomic mass will take into account the proportion of atoms in a sample of each isotope. For example, chlorine gas is made up of 75% of chlorine-35 and 25% of chlorine-37. The relative atomic mass of chlorine is therefore the mean

atomic mass of the atoms in a sample, and is calculated by:

Ar = (75.0/100 × 35) + (25.0/100 × 37) = 26.25 + 9.25 = 35.5

1. What is the relative atomic mass of Bromine, if the two isotopes, ^{79}Br and ^{81}Br, exist in equal amounts?

2. Neon has three isotopes. ^{20}Ne accounts for 90.9%, ^{21}Ne accounts for 0.3% and the last 8.8% of a sample is ^{22}Ne. What is the relative atomic mass of neon?

3. Magnesium has the following isotope abundances: ^{24}Mg: 79.0%; ^{25}Mg: 10.0% and ^{26}Mg: 11.0%. What is the relative atomic mass of magnesium?

Harder:

4. Boron has two isotopes, ^{10}B and ^{11}B. The relative atomic mass of boron is 10.8. What are the percentage abundances of the two isotopes?

5. Copper's isotopes are ^{63}Cu and ^{65}Cu. If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes?

Relative formula mass (M_r)

Carbon dioxide, CO_2 has 1 carbon atom (A_r = 12.0) and two oxygen atoms (A_r = 16.0). The relative formula mass is therefore

$M_r = (12.0 \times 1) + (16.0 \times 2) = 44.0$

Magnesium hydroxide $Mg(OH)_2$ has one magnesium ion (A_r = 24.3) and two hydroxide ions, each with one oxygen (A_r = 16.0) and one hydrogen (A_r = 1.0).

The relative formula mass is therefore:

$(24.3 \times 1) + (2 \times (16.0 + 1.0)) = 58.3$

Calculate the relative formula mass of the following compounds:

1. Magnesium oxide MgO

2. Sodium hydroxide NaOH

3. Copper sulfate $CuSO_4$

4. Ammonium chloride NH_4Cl

5. Ammonium sulfate $(NH_4)_2SO_4$

Work out what the formulas for the following ionic compounds should be:

1. Magnesium bromide

2. Barium oxide

3. Zinc chloride

4. Ammonium chloride

5. Ammonium carbonate

6. Aluminium bromide

7. Iron(II) sulfate

8. Iron(III) sulfate

What are the formulas of the following compounds?

1. Methane

2. Ammonia

3. Hydrochloric acid

4. Sulfuric acid

5. Sodium hydroxide

6. Potassium manganate(VII)

7. Hydrogen peroxide

All metals form a positive ion, all non-metals form negative ions. The magnitude of the charge depends on the group number.

Draw the ionic bonding for each compound.

lithium fluoride	sodium fluoride	otassium fluoride	lithium chloride	sodium chloride

Draw a dot and cross diagram to show how the electrons are arranged in the following small molecules.

A. Hydrogen gas	**B.** Water
C. Carbon dioxide	**D.** Hydrogen chloride

Balance the equations below by adding numbers in front of the formulae – however, you must not change the formulae themselves!
Be careful as some may already be balanced.

e.g. $\mathbf{2}\ H_2 + O_2 \rightarrow \mathbf{2}\ H_2O$

1 $HCl + Mg \rightarrow MgCl_2 + H_2$

2 $Na + O_2 \rightarrow Na_2O$

3 $Si + HCl \rightarrow SiCl_4 + H_2$

4 $TiCl_4 + Mg \rightarrow Ti + MgCl_2$

5 $Al + O_2 \rightarrow Al_2O_3$

6 $HCl + Na_2S_2O_3 \rightarrow S + SO_2 + NaCl + H_2O$

7 $C_6H_{12}O_6 + O_2 \rightarrow H_2O + CO_2$

8 $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

9 $K + H_2O \rightarrow KOH + H_2$

10 $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$

11 $NaOH + H_3PO_4 \rightarrow Na_3PO_4 + H_2O$

12 $Pb(NO_3)_2 + AlCl_3 \rightarrow PbCl_2 + Al(NO_3)_3$

Physics

1. Go to this BBC bitesize link for standard form
https://www.bbc.co.uk/bitesize/guides/zxsv97h/revision/1
- revise the entire unit – all seven pages and complete the test to prepare for the task below. Record your score for the test on paper.
2. Complete the standard form questions below on paper.

Convert the following numbers into standard form:

1. 32 000
2. 0.0006
3. 104 000
4. 18 200 000
5. 9 230 000
6. 0.000 040 5
7. 0.002 019
8. 30 200

Convert the following numbers from standard form into decimal notation:

9. 3.26×10^{4}
10. 8.4×10^{-3}
11. 7.29×10^{7}
12. 1.26×10^{2}
13. 8×10^{-6}
14. 1.3×10^{8}
15. 2.3×10^{-4}
16. 5.001×10^{6}

3. Go to this BBC bitesize link for [units of measure](https://www.bbc.co.uk/bitesize/guides/z8bk2nb/revision/1)
https://www.bbc.co.uk/bitesize/guides/z8bk2nb/revision/1
- revise the entire unit – all ten pages and complete the test to prepare for the task below. Record your score for the test on paper.4. Complete the questions below on paper.

Convert the following numbers into metres:

1. 3 km
2. 20 cm
3. 2.3 mm
4. 550 nm
5. 5.1 μm
6. 13.7 Gm
7. 0.0025 km
8. 1.001 km

Waves and the EM Spectrum

1. Draw a wave and label the following features:
- Amplitude
- Wavelength

2. Define the time period of a wave:

_____

_____

3. Define the frequency of a wave and state the unit of frequency:

_____

_____

4. Explain the difference between a transverse and a longitudinal wave, and give an example of each:

_____

_____

_____

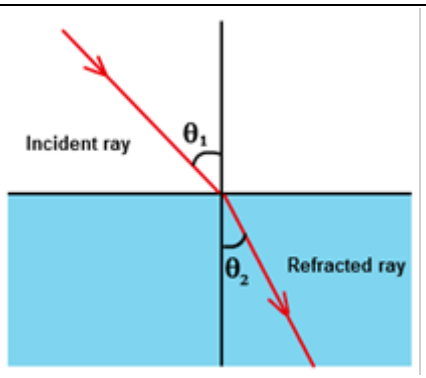
_____

_____

_____

5. EM Spectrum: fill in the table below.

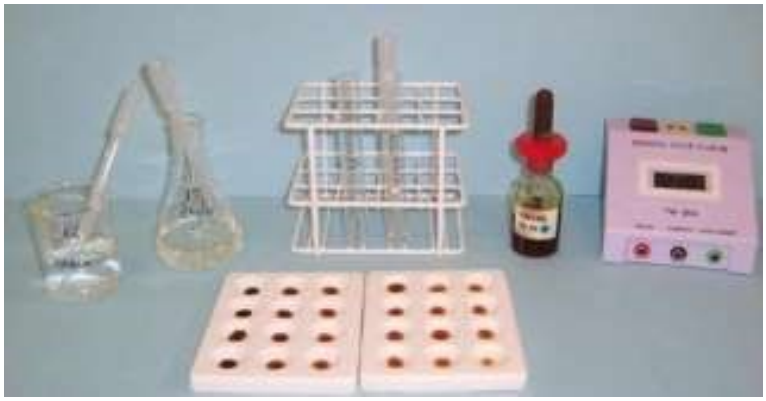
What are the properties and uses of the EM spectrum?	
EM wave	*Properties and uses*
R	
M	
I	
V	
U	
X	
G	

Describe the refraction of light as an incident ray goes from low density material (air) to high density (glass or water).		*Research Snell's law:* *What is the angle of refraction when light goes from water (n = 1.33) to glass (n = 1.50) if the angle of incidence is 50°?*

Investigative Skills

Investigating the effect of pH on amylase activity

Read the method below carefully and then identify the aspects from the table below. Write in full sentences, on lined paper e.g. "The independent variable is…"



1. Place single drops of iodine solution in rows on a spotting tile.
2. Label a test tube with the pH to be tested.
3. Use a syringe to place 2 cm^3 of amylase into the test tube.
4. Add 1 cm^3 of buffer solution to the test tube using a syringe.
5. Use another syringe to add 2 cm^3 of starch to the amylase/ buffer solution, start the stop clock and leave it on throughout the test. Mix using a plastic pipette.
6. After 10 seconds, use the plastic pipette to place one drop of the mixture on the first drop of iodine. The iodine solution should turn blue-black. If the iodine solution remains orange the

reaction is going too fast and the starch has already been broken down. Squirt the rest of the solution in the pipette back into the test tube.

7. Wait another 10 seconds. Then remove a second drop of the mixture to add to the next drop of iodine.
8. Repeat step **7** until the iodine solution and the amylase/ buffer/ starch mixture remain orange.
9. Count how many iodine drops you have used, each one equalling 10 seconds of reaction time.

Independent variable	What is the range of the independent variable?
Dependent variable	How is the dependent variable measured?

One important controlled variable	How is this controlled variable controlled?	Why must this variable be controlled?
Second important controlled variable	How is this controlled variable controlled?	Why must this variable be controlled?
Third important controlled variable	How is this controlled variable controlled?	Why must this variable be controlled?
Name a potential hazard in the experiment	What might happen to you?	What should you do to prevent it happening?
Name a second potential hazard in the experiment	What might happen to you?	What should you do to prevent it happening?
Name a third potential hazard in the experiment	What might happen to you?	What should you do to prevent it happening?

Further Investigation Skills

Plan an investigation to compare the **<u>diffusion rate in different tea bags</u>** (what different is, is up to you – you have so much choice of what you could change and investigate). You do not have to do the experiment (see the following optional task).

You must include:

A stepwise method

Independent variable		Range of the independent variable
Dependent variable		How the dependent variable is measured
One important controlled variable	How this controlled variable is controlled	Why this variable must be controlled
Second important controlled variable	How this controlled variable is controlled	Why this variable must be controlled
Third important controlled variable	How this controlled variable is controlled	Why this variable must be controlled
Name a potential hazard in the experiment	What might happen to you?	What should you do to prevent it happening?
Name a second potential hazard in the experiment	What might happen to you?	What should you do to prevent it happening?
Name a third potential hazard in the experiment	What might happen to you?	What should you do to prevent it happening?

Optional task – more skills!
Carry out your investigation! For this, write a mini lab report showing of your results, a table of results, a graph, conclusions and evaluations of both the method and your data.

You might find this BBC bitesize link useful throughout on practical skills
https://www.bbc.co.uk/bitesize/guides/zh7sfcw/revision/1

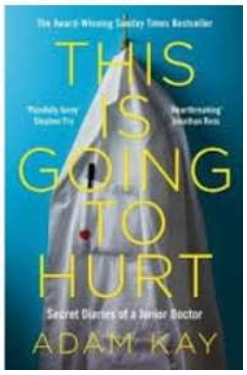
Stretching your learning further…
Check out any of the following websites:

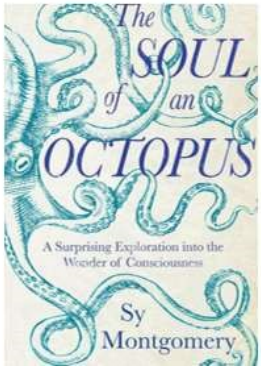
PROSPECTS

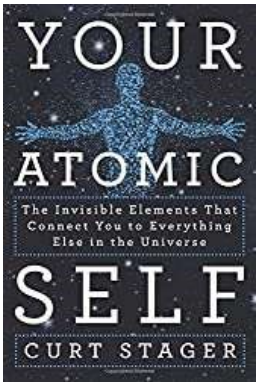
UCAS

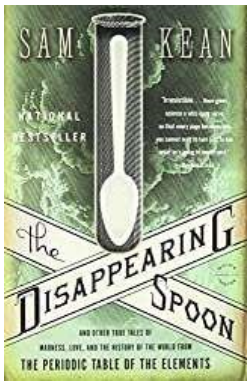
Reading list

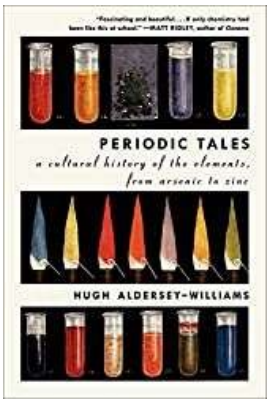
Further reading

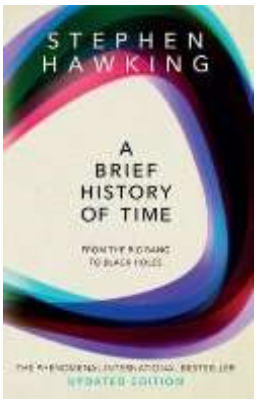


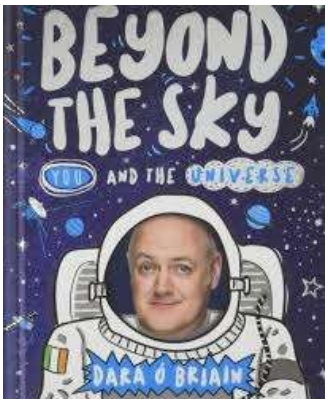


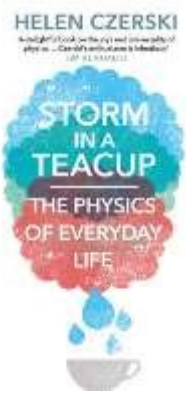




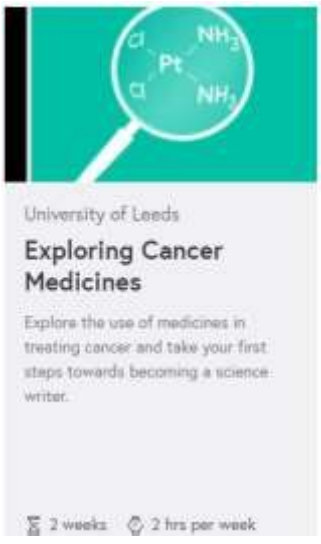








Future learn courses (click images for links)



University of Reading

Small and Mighty: Introduction to Microbiology

Understand the basics of microbiology and explore the diversity of microbial life in our world.

3 weeks · 3 hrs per week

University of Leeds

Anatomy: Know Your Abdomen

Discover the human abdomen as you explore its key features, how it works, and learn about common gastrointestinal problems.

2 weeks · 2 hrs per week

University of Leeds

Discovering Science: Science Writing

What science discoveries will you choose to write about?

2 weeks · 5 hrs per week

University of Birmingham

Good Brain, Bad Brain: Basics

What do we know and what are we discovering about the form and function of the human brain? Find out with this online course.

3 weeks · 3 hrs per week

The University of Sheffield

Forensic Facial Reconstruction: Finding Mr. X

Learn about the forensic technique of facial reconstruction from the experts involved in a real crime case.

2 weeks · 2 hrs per week

University of Aberdeen

How Does the Body Use DNA as a Blueprint?

Get an introduction to the basics of molecular biology, and how DNA code works.

3 weeks · 4 hrs per week

Podcasts (click images for links)