

Saturday innovation & practical STEM skills workshops for Y10s

HIGHGATE
CHRYSALIS

The Importance of Being Playful

**Innovative STEM student science projects
(especially physics and engineering)**

Who are we?



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Contents

1. Getting to something new & surprising, messy & uncertain
2. Teamworking, Six Hats and Random Binomials
3. Planning & Building
4. Testing and Collecting Data
5. Analysing Results, using the power of spreadsheets & graphs
6. Improving the project, re-thinking the project, go back to 1 or 2 or 4?
7. Telling the World All About It !

Example projects and how they worked out

Tips & Tricks on getting to a practical project

1. Innovation and Invention: Brainstorming & the Science of Surprises

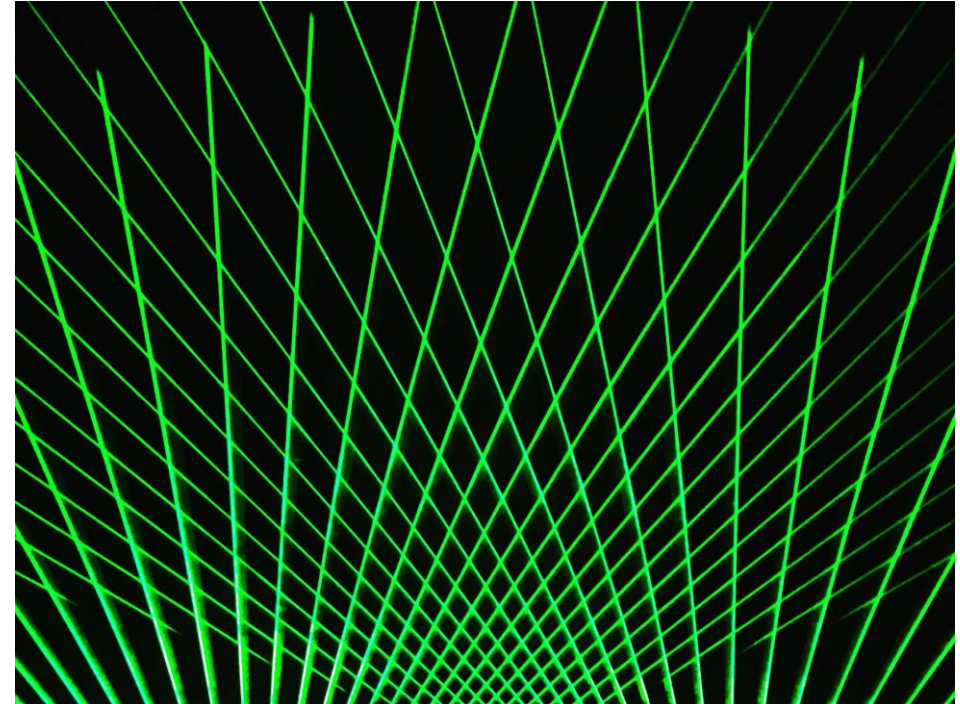
Finding problems

Finding solutions to solve problems

Finding problems to use solutions

Messiness, Uncertainty &
Playfulness

Mistakes are OK!



Innovation and Guide Words

- HAZOP
- TRIZ
- List-Storming

15) DYNAMICS
 a) automatically extensible/opened doors, air-locks, etc., reacting when it is needed
 b) automatic gears in mobiles
 c) undercarriages in cars of variable stiffness characteristics, tuned exactly to terrain conditions during the driving
 d) electronic controllers for carburettor, electronically controlled fuel injection in dependency of driving conditions

16) EXCESSIVE (OR PARTIAL) ACTION
 a) in close fit of both piston and cylinder of the engine
 b) to spray excessively paint, and then to remove the excess of the paint
 c) to fulfill the fuel tank, and then remove the excess of fuel

17) ANOTHER DIMENSION
 a) two colliding tools in 1D should be rearranged in 2D plane; likewise, tools colliding on 2D plane should be rearranged into 3D space
 b) to stack vertically containers, chairs, laptops, etc.
 c) science of complex symmetries in crystallography

18) MECHANICAL SELF-INDUCED VIBRATIONS (IN RESONANCE)
 a) piezoelectric engine - a conceptual design
 b) quartz generators, in electric circuits

19) PERIODICAL ACTION, OR PULSED ACTION
 a) hammer drill
 b) pulsed laser, against conventional lasers of continuous operational mode
 c) "pseudo-analogue" driving (PWM) (Pulse Width Modulation)
 d) pulse DC power unit
 e) pulse amplifiers
 f) step motors

20) CONTINUITY ACTION OF USEFUL ACTION
 a) enlarging drill, operating in both directions
 b) nozzles of cartridge, printing also in returning direction (without idle mode)
 c) steam turbines of generators for one power plants, working continuously (in optimal mode), while the others working as pump-storage power plants, in aim of storing of energy for afternoon hours (mode: pumping of the waters into upper reservoir on mornings, while emptying upper reservoir into lower one on afternoons)

21) SKIPPING, QUICK MODE, OR PACE OF REALIZATION
 a) wood-borne materials in quick thermal processing
 b) laser treatments of biological tissues (hard) or in processing of hardly processed materials (without thermal deformations, scorching, burnings)
 c) pico-second pulsed lasers (femto-second lasers) against laser of micro- and nano-seconds pulsed (various materials virtually have been vapoured, while treated with pico-second pulsed laser beam energy)
 d) steel hardening process in abrupt temperatures changes

22) "BLESSING IN DISGUISE" (CONVERT HARM INTO BENEFIT)
 a) burning out the main fire in outskirts of the main fire, to out of the main fire's fuel
 b) to blow out the outskirts fire from top of the well in detonation blast
 c) permafrost materials are to be "treated" with liquid nitrogen

23) FEEDBACK PRINCIPLE
 a) basically, as well as particularly:
 b) autopilot provided with 3-axis gyro system
 c) robot arms movement's back-controlled in set of:
 1) diode - 2) photodiode - 3) semi-transparent either: protactor, or: linear scale - placed in between

24) INTERMEDIATE MEANS, "FITTING" PRINCIPLE
 a) in electronic circuits
 b) fitting in mean of:
 - pressure-flowing (fluid mechanics),
 - loading of force moments,
 - in transition gears (mechanical fitting)
 - stress of two interfacing surfaces (endurance)

25) SELF-SERVICING PRINCIPLE
 a) self-servicing system
 b) tungsten sublimates to halogens then, to redeposit on tungsten glowler

26) COPYING, IMAGING PRINCIPLE (application of optical mapping)
 a) use of ultrasonics
 b) magnetic resonance mapping
 c) X-rays radiography
 d) in mapping of material structures the application of:
 - infrared
 - ultraviolet
 - basically of optical methods
 e) use of fluorescence and of scintillation's materials

27) INEXPENSIVE SHORT-LIVED OBJECTS (CHEAP CADUCITY, & OF DISPOSABLE MATERIALS)
 a) kitchen utensils, dishes, cutlery made of plastic
 b) disposable syringes, gloves, etc.
 c) plastic bags, packaging wrappers, etc.
 d) printing head integrated with ink cartridge (formerly, each printer possessed built-in printing head) (presently, each of ink cartridge has its own printing head)

28A) PRINCIPLE OF SUBSTITUTING OF MECHANICAL SYSTEM WITH FUNCTIONALLY EQUIVALENT ELECTRO-MAGNETIC SYSTEMS
 to substitute with interaction of:
 electric field
 magnetic field
 mechanical pressure
 or fastening

28B) SUBSTITUTING OF MECH. SYS. WITH ELECTRO-MAGN. SYSTEMS
 B) magnetic borne pressure of the machined materials
 C) mobile fields instead of static fields
 D) heterogeneous fields

29A) PNEUMATICS & HYDRAULICS
 - pneumatic automobile tyre,
 - pneumatics (air-light) dampers,
 - automobile airbags,
 - pneumatic "discrete", driving of operational actuators, for instance: in automatic welding of packaging covers made of plastic wrapping
 on the figure above, in blue: approximate section of automobile pneumatic tyre

29B) PNEUMATICS & HYDRAULICS
 - automobile brakes,
 - in driving of plane elevator,
 - where the precision of driving is needed, as well as enormous force transition
 $F_2 >> F_1$
 $F_2 = S_2 F_1$
 $S_2 = S_1$

30) FLEXIBLE FILMS, FOILS, MEMBRANES
 a) not wettable surfaces, prohibits evaporation of water
 b) wrapping packaging
 c) flappable balloons, domes, barriers
 air-pumped bubbles

31) POROUS MATERIALS
 a) aerated concrete (porous concrete)
 b) porous abrasive tools
 c) polyurethane foam
 d) catalyzing surfaces in chemistry
 e) "vacuum" as a "construction, building material"
 f) openwork structures reinforcements
 g) porous, sponge materials in kitchen getters

32) COLOUR CHANGING (ALTERNATING)
 in lapping process for inner surfaces of engine pistons & cylinders, the probing of phosphorescence distribution can be used

33) HOMOGENEITY
 the two interfacing surfaces should be made of the same material
 moreover, the similarities can be applied, regarding:
 - comparable mat.'s hardness, chemical inertion, structures
 - comparable thermal expansion's coefficients, (in case of dental materials; metal-glass conjunctions),
 - comparable electro-chemical potentials (in avoiding electro-chemical borne corrosion)
 - same fatigue characteristics, and amortization specifics

34) DISCAR (REJECT & MAKE INERT)
 a) dissolvable medication capsul made of (biologically inert material)

35) CHANGING PROPERTIES
 1) high temperature food processing
 $temp >> 0^{\circ}C$
 $0^{\circ}C$

36) PHASE TRANSITION
 a binary, for refrig heat
 $temp < 0^{\circ}C$
 $temp > 0^{\circ}C$
 necking

37) THERMAL FITTING
 1) thermal shaft fitting
 $temp < 0^{\circ}C$
 $0^{\circ}C$

38) STRONG OXIDATION
 a) oxygen in oxidation (iron will vapour at 3000°C)
 b) iron will vapour at 3000°C
 c) iron will vapour at 3000°C

39) NEUTRALIZATION
 a) CO_2
 b) N_2O
 c) N_2
 both

40) COMPOSITE
 1) elements of blades in wind turbine
 2) yacht's & ultra-st

Happy Hunting Grounds for New Ideas

- Sensors
- Interdisciplinary science projects
 - Biomimetics, medical engineering, transport, materials science



Serendipity: play, random chance & invention

- Random Binomials
- The importance of homonyms

Random Binomial Trigger Words

down return	screen force	stick sun
shape address	gas increase	dozen sheet
force total	sleep liquid	wind slow
refuse time	test steam	vision handle
slow steam	truck mountain	drink bit
plane liquid	sun video	distance roll
wave skin	skin normal	total vision
time plane	crowd boat	return corner
wind strike	vacuum sheet	coach beat
nuclear reader	speed vacuum	replace spot
driver screen	turn time	farm variety
pattern hole	key mountain	strength slow



PROCESS



Blue Hat - Process

Thinking about thinking.
What thinking is needed?
Organizing the thinking.
Planning for action.

CREATIVITY



Green Hat - Creativity

Ideas, alternatives, possibilities.
Solutions to black hat problems.

FACTS



White Hat - Facts

Information and data.
Neutral and objective.
What do I know?
What do I need to find out?
How will I get the information I need?

BENEFITS



Yellow Hat - Benefits

Positives, plus points.
Why an idea is useful.
Logical reasons are given.

FEELINGS



Red Hat - Feelings

Intuition, hunches, gut instinct.
My feelings right now.
Feelings can change.
No reasons are given.

CAUTIONS



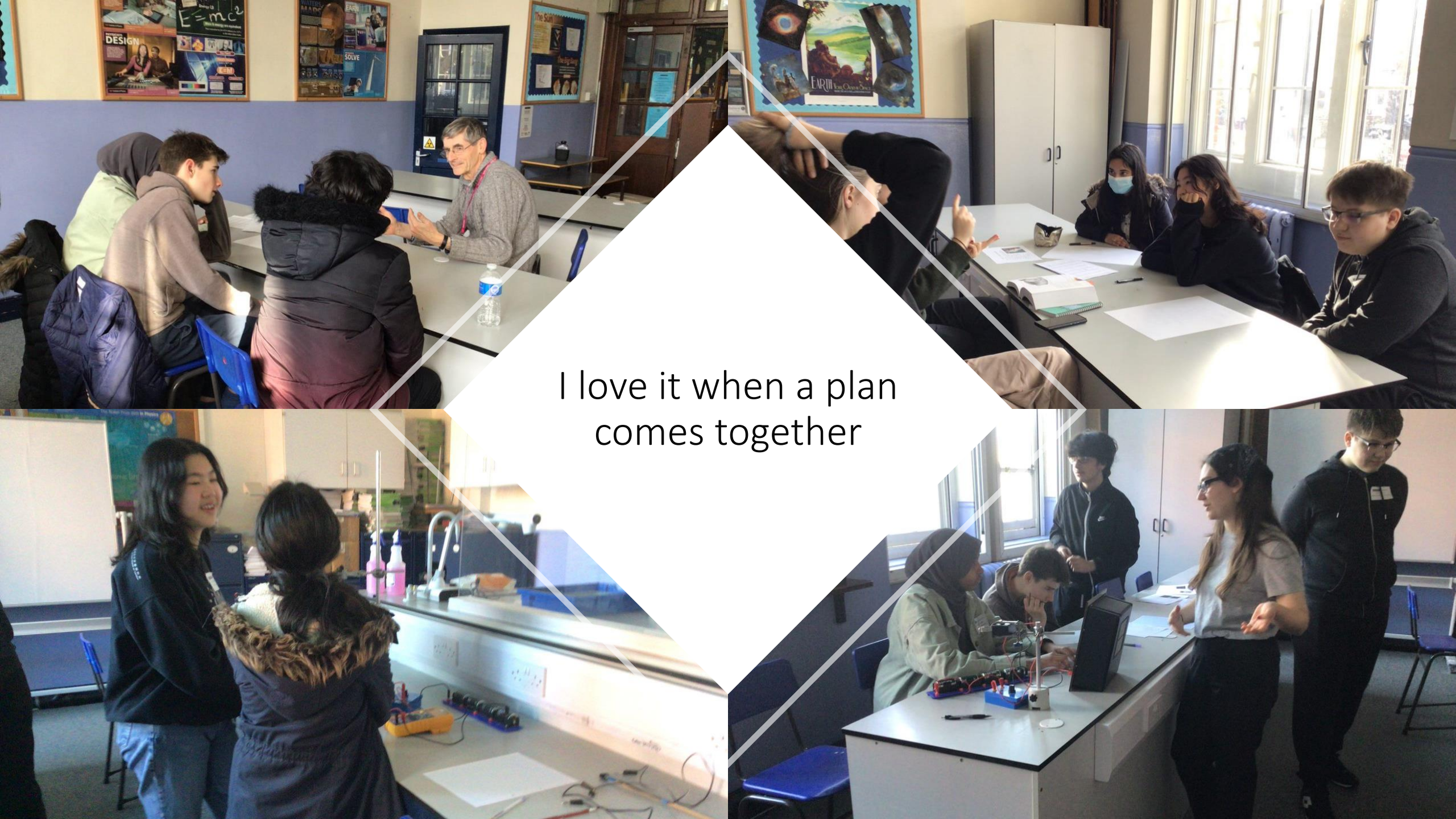
Black Hat - Cautions

Difficulties, weaknesses, dangers.
Spotting the risks.
Logical reasons are given.

Teamwork – using the ‘Hive Mind’

- Six Hats works better with a team – but its OK for one person too
- Using Specialist Roles in the team
 - If a team member is obviously keen & able doing computers or electronics – then give them computers or electronics to do
 - If two things need doing and can be done in parallel – then do them in parallel
 - Do you need a leader? Maybe
 - Coordinator? Instead of leader, someone who organises – a co-ordinator
- Support team – teachers, technicians, highly able sixth formers, external expert from university or industry?
- Hive Mind: just getting everyone thinking and telling what they think – but avoiding the negative side of Hive Mind – Groupthink*
- Hive Mind and Crosswords
 - Don't believe it? Try doing a cryptic crossword
 - Now do it with someone else – or maybe a couple of other people

*It may help if everyone notes down what they think at the beginning of a discussion



I love it when a plan
comes together

4. Testing & Collecting Data: What do you test?

- ***The Obvious***: the intended function or purpose – how well it solves its intended problem
- Friction affects a lot of things & temperature affects almost everything
- Think about imperfections in the design
- Material properties – properties of fluids, properties of solids
- Dynamics – movement, gravity
- Electrical properties
- Change of scale effects
- Test something that you (think you) can analyse !

5. What on earth is going on?

ANALYSIS of RESULTS

- Draw diagrams: visual understanding and communication
 - Use big sheets of paper – or maybe a whiteboard – you can photograph it
- Select symbols, label diagrams
- Try to analyse, at least at first, in the simplest way possible
 - Pick as few variables as you dare
 - Can you neglect friction, assume an angle is small?
 - Can you use a one-dimensional analysis
 - Is there a symmetry in the project which make it simpler to analyse?
- Check out **scaling**
- Check out length-mass-time dimensional analysis
- *REDUCTIO AD ABSURDUM*
- Put some numbers in, do they check out with your testing?

Curriculum links

Working scientifically

Through the content across all three disciplines, students should be taught so that they develop understanding and first-hand experience of:

1. The development of scientific thinking

- the ways in which scientific methods and theories develop over time
- using a variety of concepts and models to develop scientific explanations and understanding
- appreciating the power and limitations of science and considering ethical issues which may arise
- explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments
- evaluating risks both in practical science and the wider societal context, including perception of risk
- recognising the importance of peer review of results and of communication of results to a range of audiences.

2. Experimental skills and strategies

- using scientific theories and explanations to develop hypotheses
- planning experiments to make observations, test hypotheses or explore phenomena
- applying a knowledge of a range of techniques, apparatus, and materials to select those appropriate both for fieldwork and for experiments
- carrying out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations
- recognising when to apply a knowledge of sampling techniques to ensure any samples collected are representative
- making and recording observations and measurements using a range of apparatus and methods
- evaluating methods and suggesting possible improvements and further investigations.

3. Analysis and evaluation

- applying the cycle of collecting, presenting and analysing data, including:
 - presenting observations and other data using appropriate methods
 - translating data from one form to another
 - carrying out and representing mathematical and statistical analysis
 - representing distributions of results and making estimations of uncertainty
 - interpreting observations and other data, including identifying patterns and trends, making inferences and drawing conclusions
 - presenting reasoned explanations, including relating data to hypotheses
 - being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error
- communicating the scientific rationale for investigations, including the methods used, the findings and reasoned conclusions, using paper-based and electronic reports and presentations.

4. Vocabulary, units, symbols and nomenclature

- developing their use of scientific vocabulary and nomenclature
- recognising the importance of scientific quantities and understanding how they are determined
- using SI units and IUPAC chemical nomenclature unless inappropriate
- using prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano)
- interconverting units
- using an appropriate number of significant figures in calculations.



Problems in
need of
solutions



Off-Shore Wind Turbines

What needs to be monitored?

Off-Shore Wind Turbines

Possible problems



HOW FAST IS OUR
TURBINE SPINNING?



IS OUR TURBINE
SWAYING?



IS OUR TURBINE
SINKING?

Health and Medicine

- What sensors could be used in a hospital to monitor a patient's vital signs?
- What sensors could be used to keep track of a person's health in their daily life?



Health and Medicine



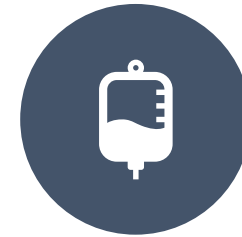
TEMPERATURE



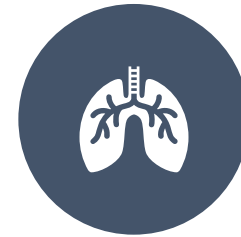
BLOOD
PRESSURE



PULSE RATE



BLOOD OXYGEN
LEVEL



RESPIRATION
RATE / VOLUME



The London Underground

What needs to be monitored



The London Underground

- How many people have passed this point?
- Is the air safe to breathe?
- What is the maximum volume of noise on this journey?
- Is our tunnel flooding?

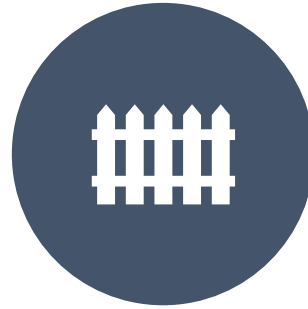
FROM JOHN HUGHES
HOME ALONE
A FAMILY COMEDY WITHOUT THE FAMILY



Home Sensors

What sensors would be useful to have around your home?

Home Sensors



WHICH DOORS ARE
OPEN/CLOSED?

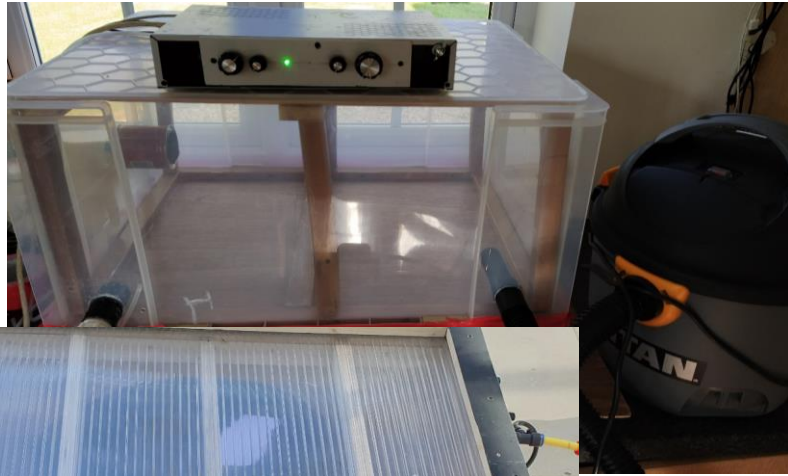


IS ANYTHING/ANYONE
MOVING IN A ROOM?



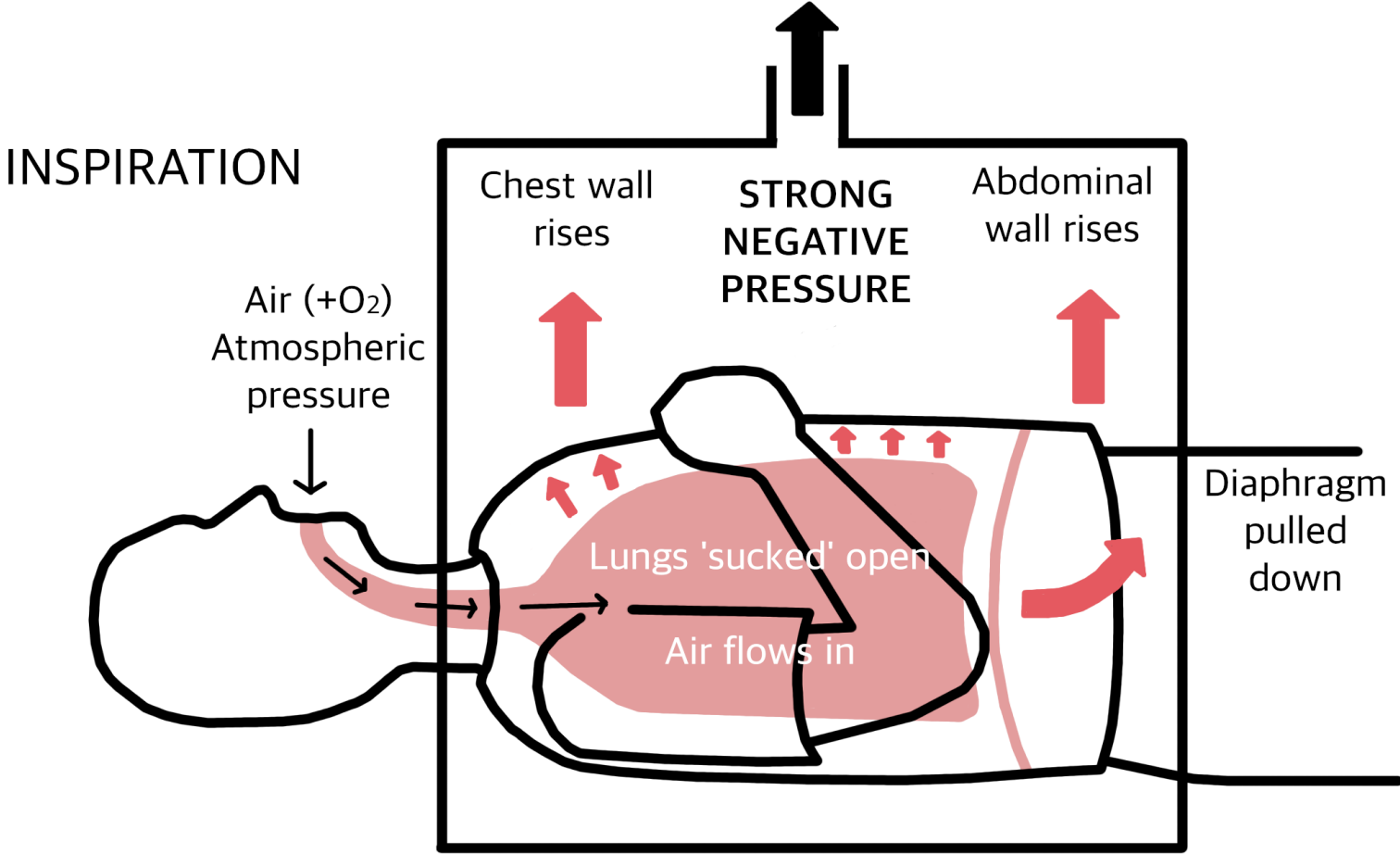
WHICH LIGHTS ARE
ON/OFF?

Exovent™: What are we talking about ?



- A registered charity for machines which help breathing

NPV NEGATIVE PRESSURE VENTILATION



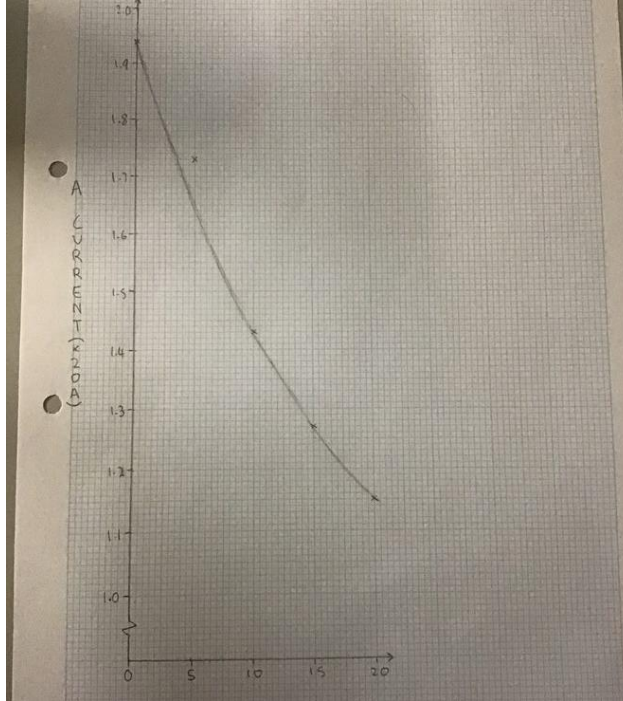
NPV 'sucks' air into lungs by creating negative pressure around abdomen and chest



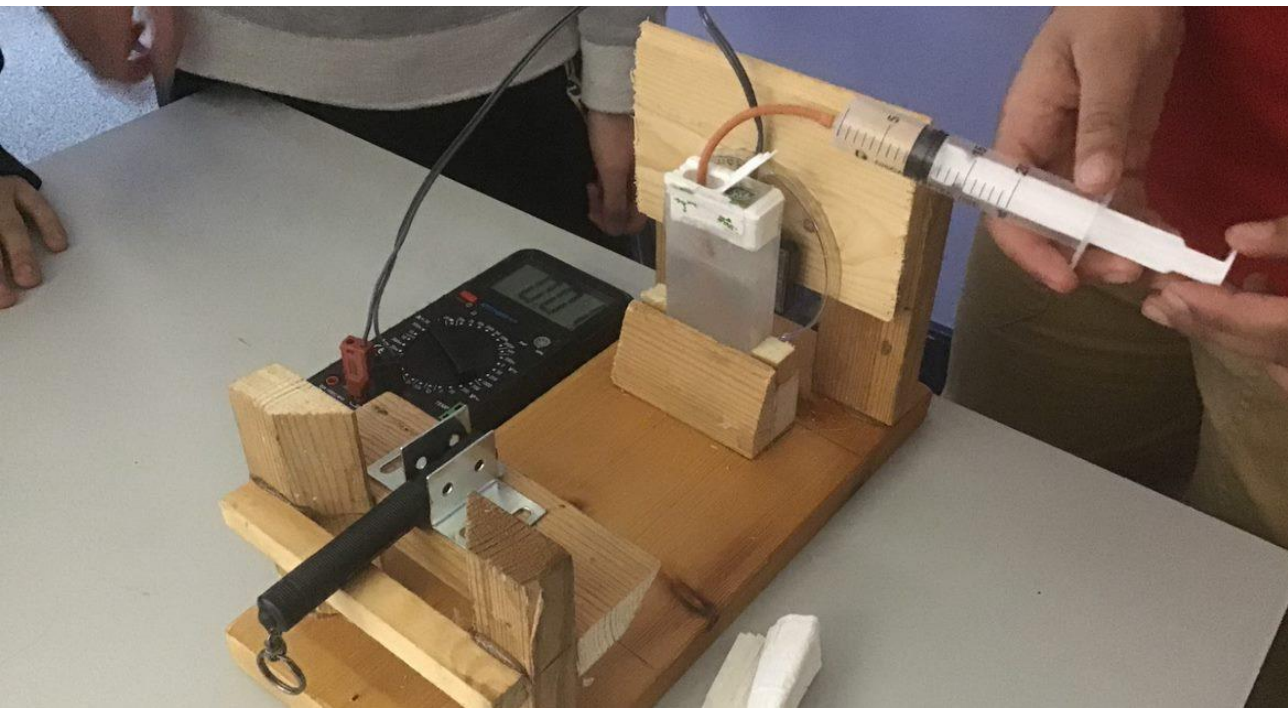
The power of tinkering

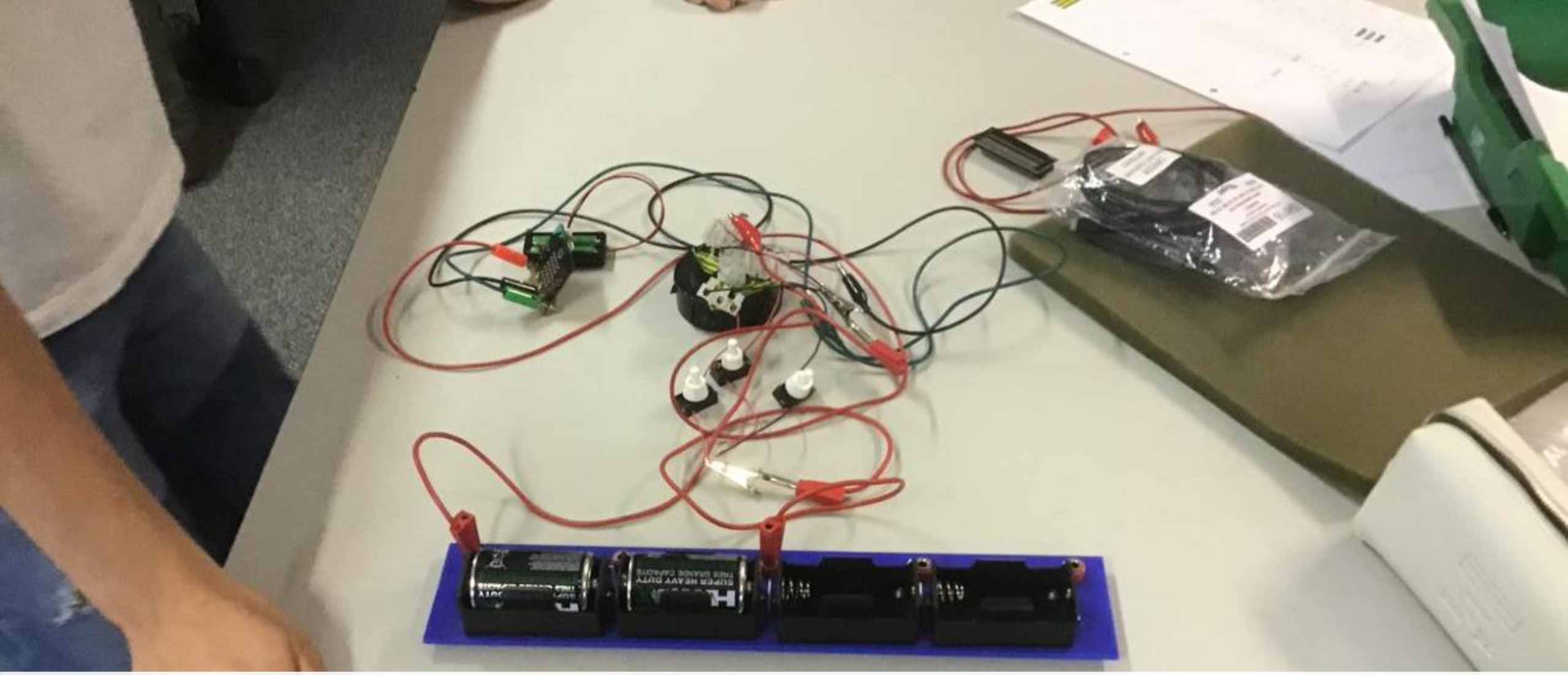
Project examples

- Using LEDs to determine the colour of an object
 - Proposed use: automated fruit selection
- Using ultrasound reflection to determine the dampness of cloth
 - Proposed use: a sensor to reduce waste energy use by tumble dryers
- Monitoring CO₂ using light and lime water
 - Proposed use: a simple CO₂ sensor
- Measuring respiration rate using light and fabric
 - Proposed use: a sensor to determine if a patient is in need of immediate medical attention.



- Monitoring CO₂ using light and limewater





Using LEDs to determine the colour of an object

7. Telling the World about it: presenting your innovation and results

- Abstract: in a few words, what is the idea, how well did it work?
- Introduction
- Lots of diagrams and photos
- Results of analysis: simple formulae, understandable symbols
- Results of tests: numbers, graphs
- Summarise what you achieved
- **WHAT NEXT** what you might do next

Telling the World about it (cont)

- You don't need stop telling the world about it !
- You can talk about it to your friends – spread the word about the great things that doing a project does for you
- You can apply new things you learn at school to the project – see how they fit
- You can talk about it when you apply for university

AND... even more importantly...

- You can use it in **UCAS**

AND... even MORE importantly...

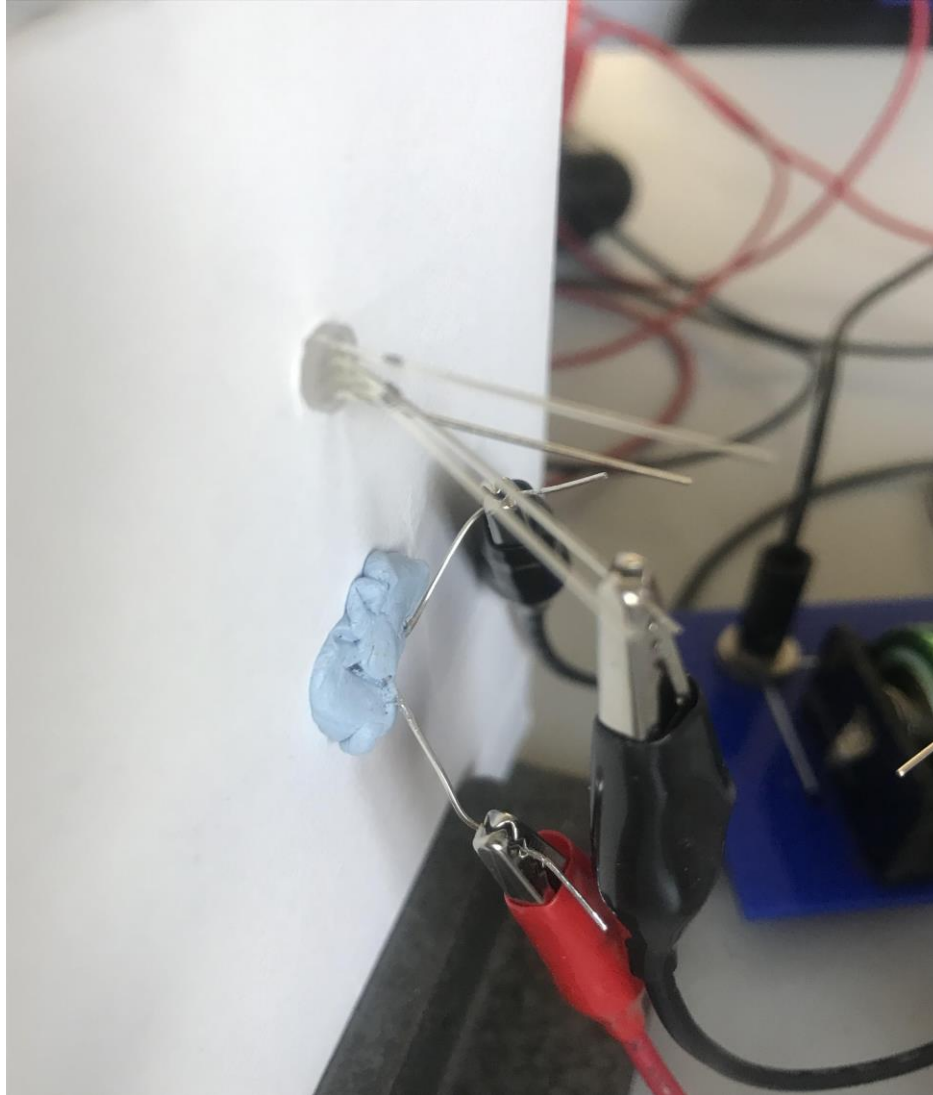
- **Job interviews** – a story about how you worked in a team, brainstormed something new, applied your knowledge, made it work – and interesting science – it's a great story that might just get you a job in the future

Phototransistor & LED



- We set up the phototransistor and Led and poked them through black card, which we attached to the clamp

- We attached the phototransistor to the multimeter so we could see the voltage



-We placed an apple 5cm away from the led and phototransistor

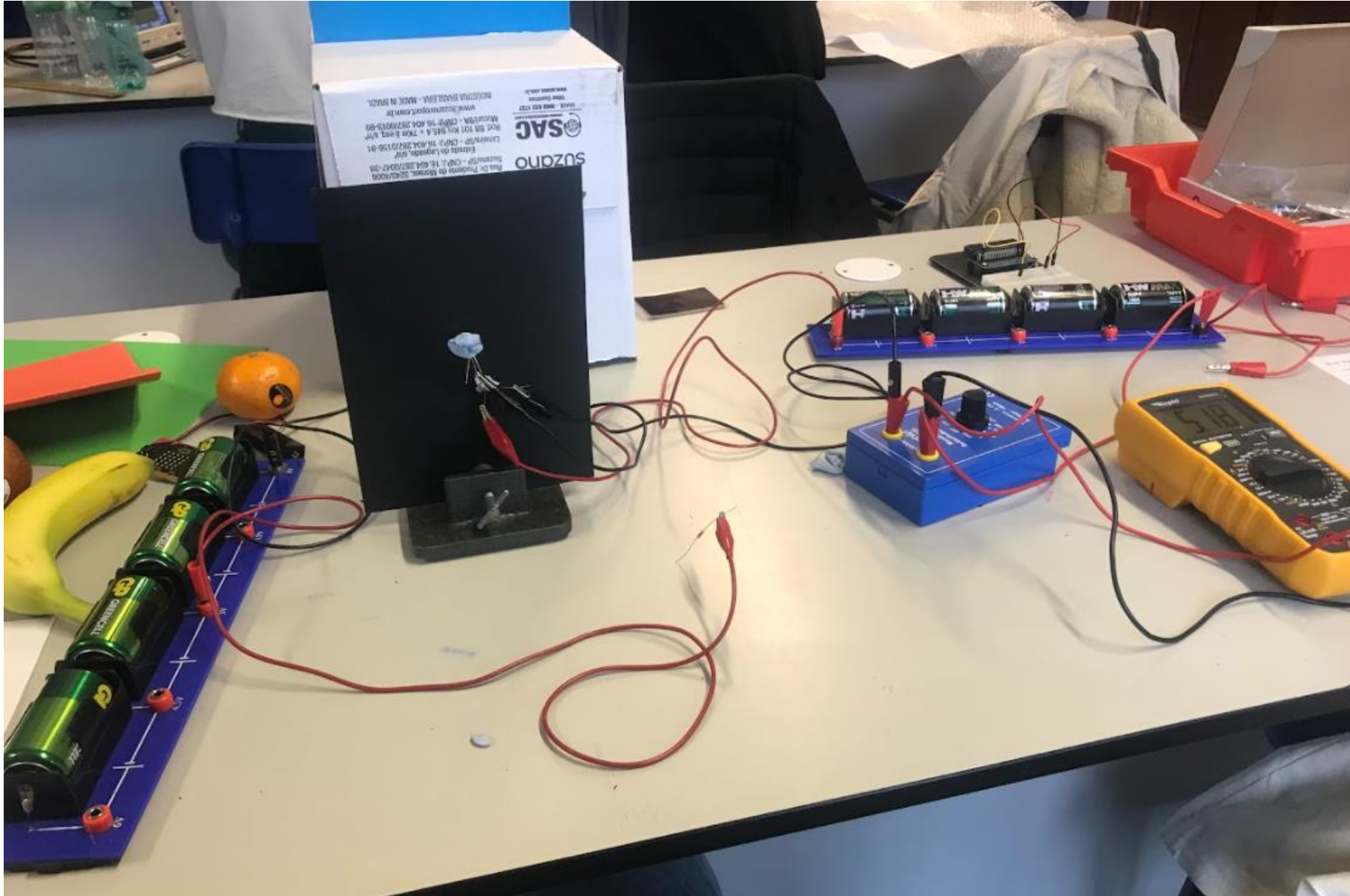
- We put a box over the apple, phototransistor and led to reduce the amount of background brightness



- We measured the voltage when each colour light was shone at the apple

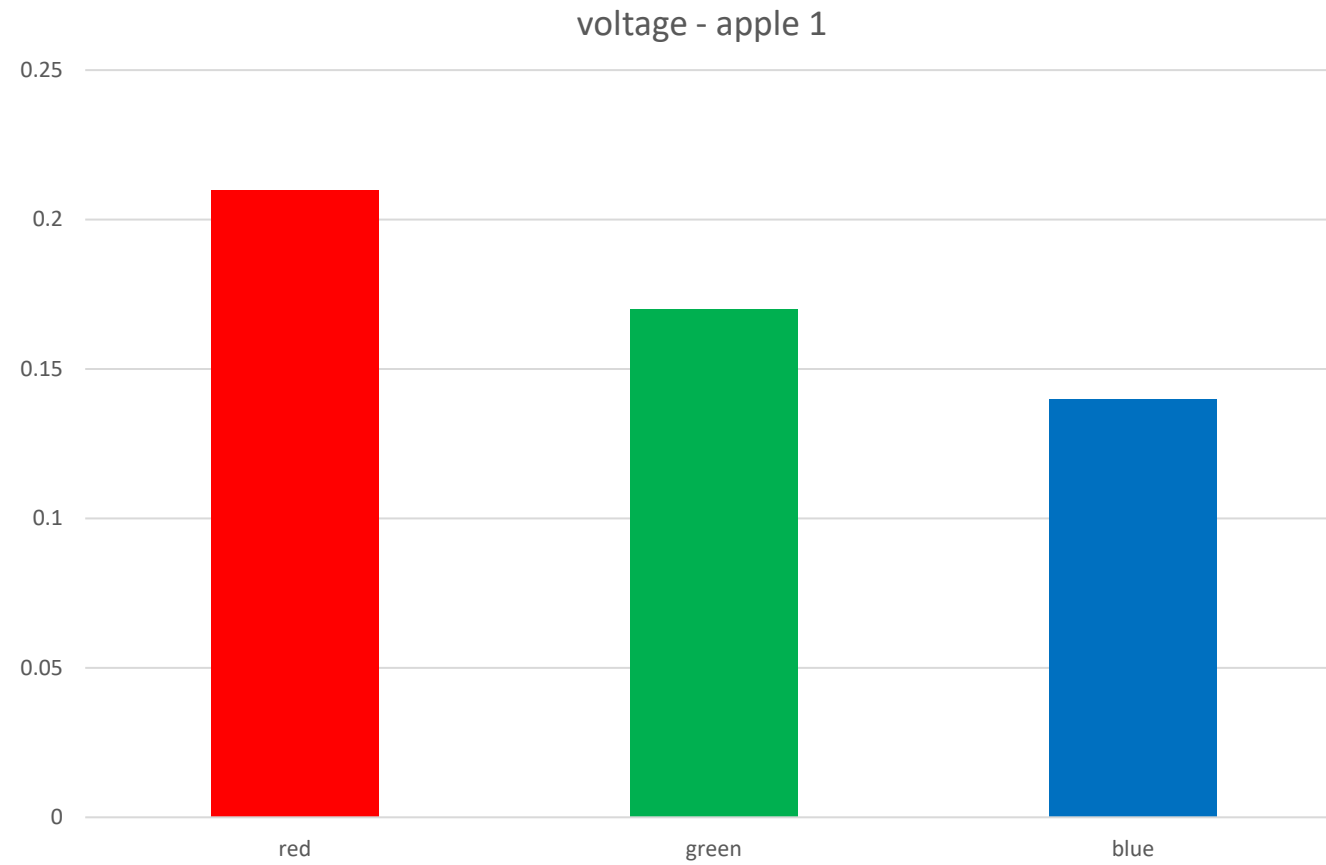


How it came all together

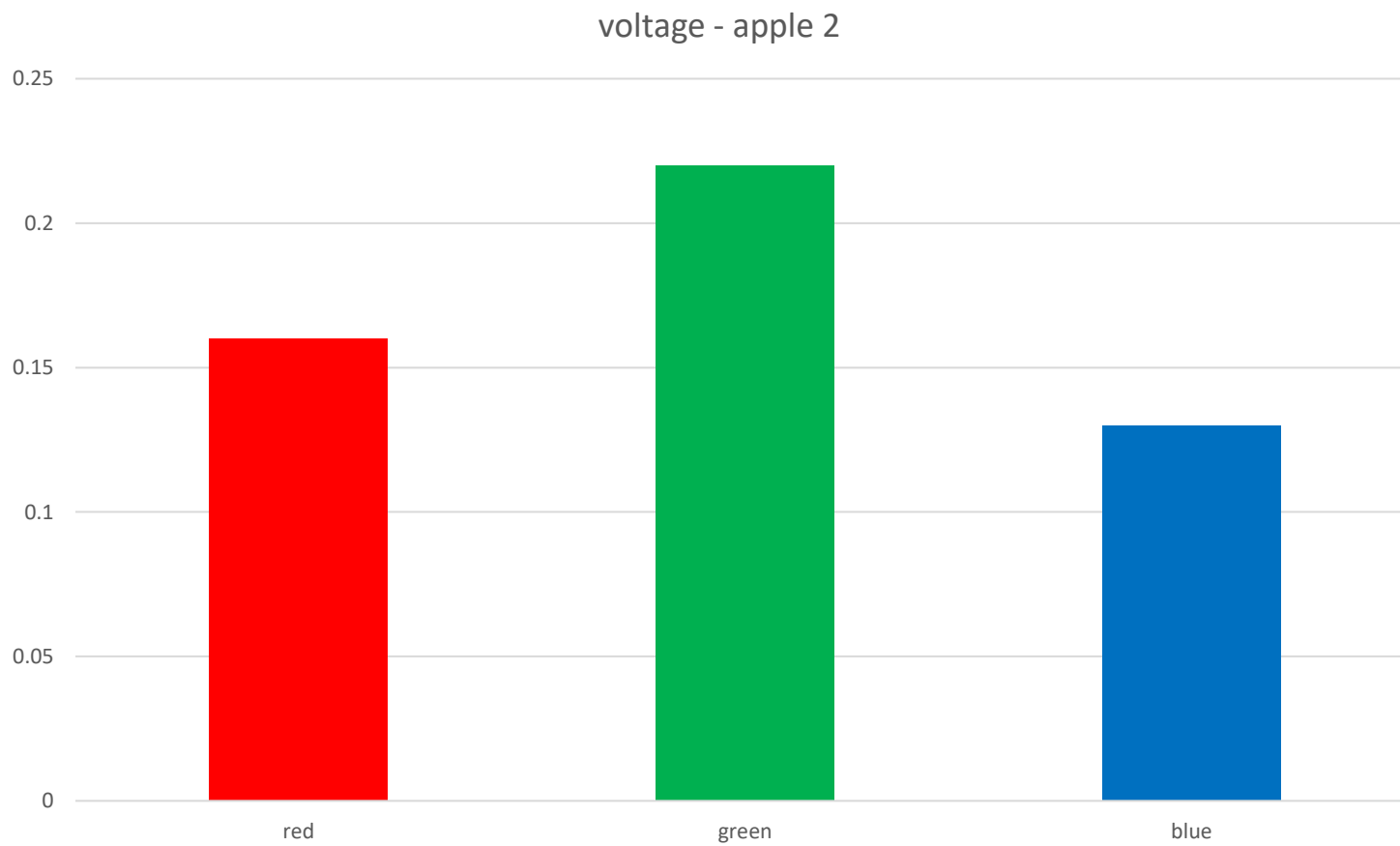


Our data

Ripe apple:



Unripe apple:



Learning by failing, and failing better.



How do we measure Respiratory rate continuously?

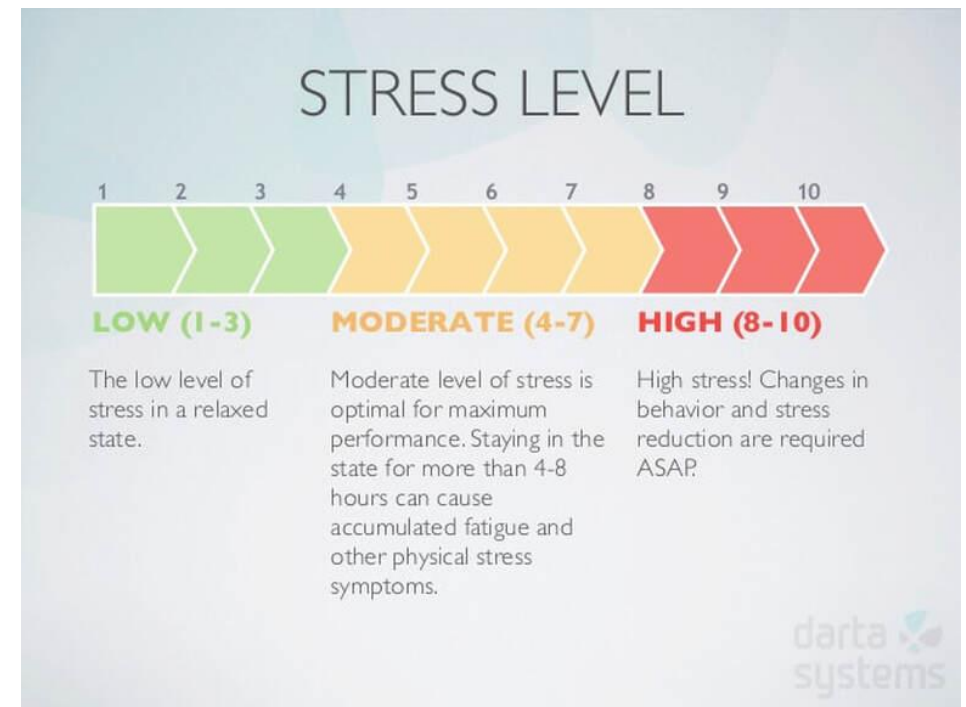
THE QUARKS.

Initial ideas

As a team, we initially had many ideas of what wanted to do our project on. We chose to measure stress levels as we found it interesting and an aspect that would be relatively useful to measure.

When thinking about a purpose of measuring stress levels we came to the conclusion that it would cater to the many problems some people may have daily such as:

- Uncontrollable sweating – where we could use a moisture sensor
- Measuring Heart rhythm- by measuring the variation in heartbeat
- Increased/decreased body temperature- random spikes in temperature
- hyperventilation



Some problems we had when designing

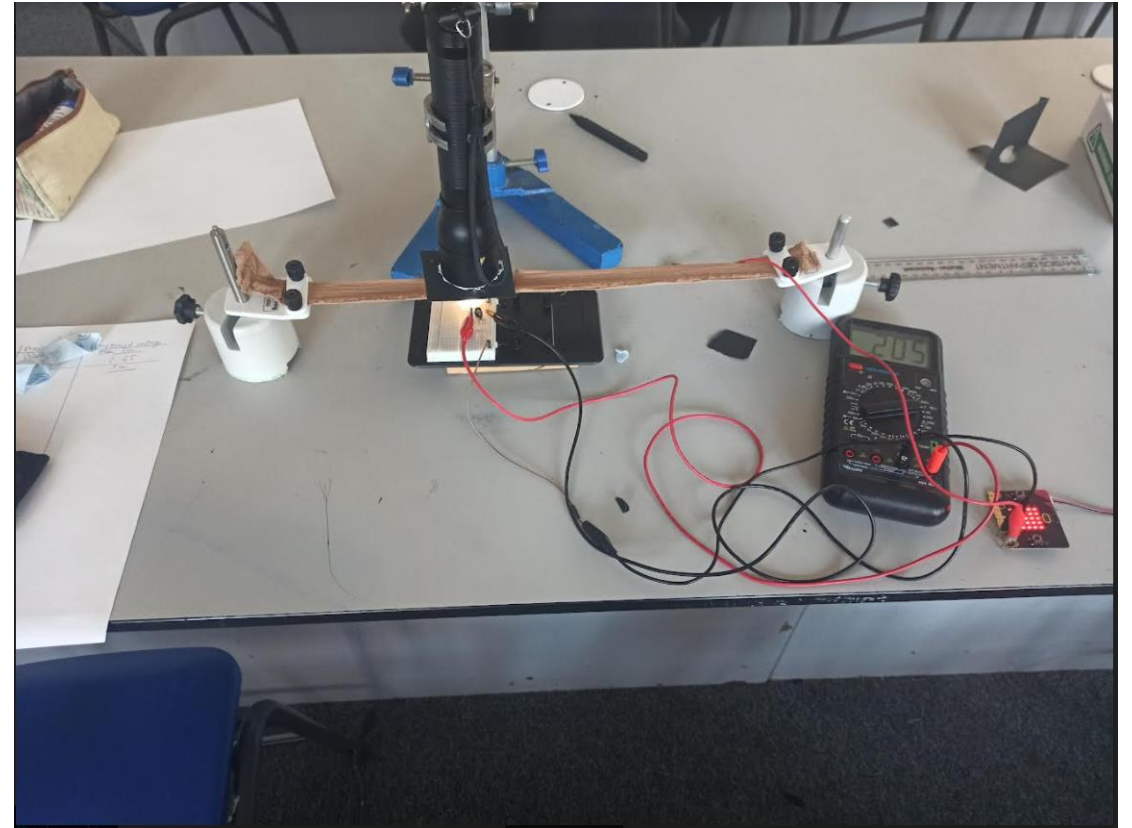
- However, our problems did not end here. With the many symptoms accompanied with stress levels, we found it nearly impossible to measure all of them and come to the conclusion to how stressed someone was.
- We disregarded the idea and decided to choose a new topic; measuring the pressure exerted by a foot using a sensor. The pressure exerted would be an indication to the best possible shoe sole for the person. This would be useful for patients suffering from arthritis and many other related conditions that might cause discomfort and potentially require a more comfortable shoe sole.

Furthermore...

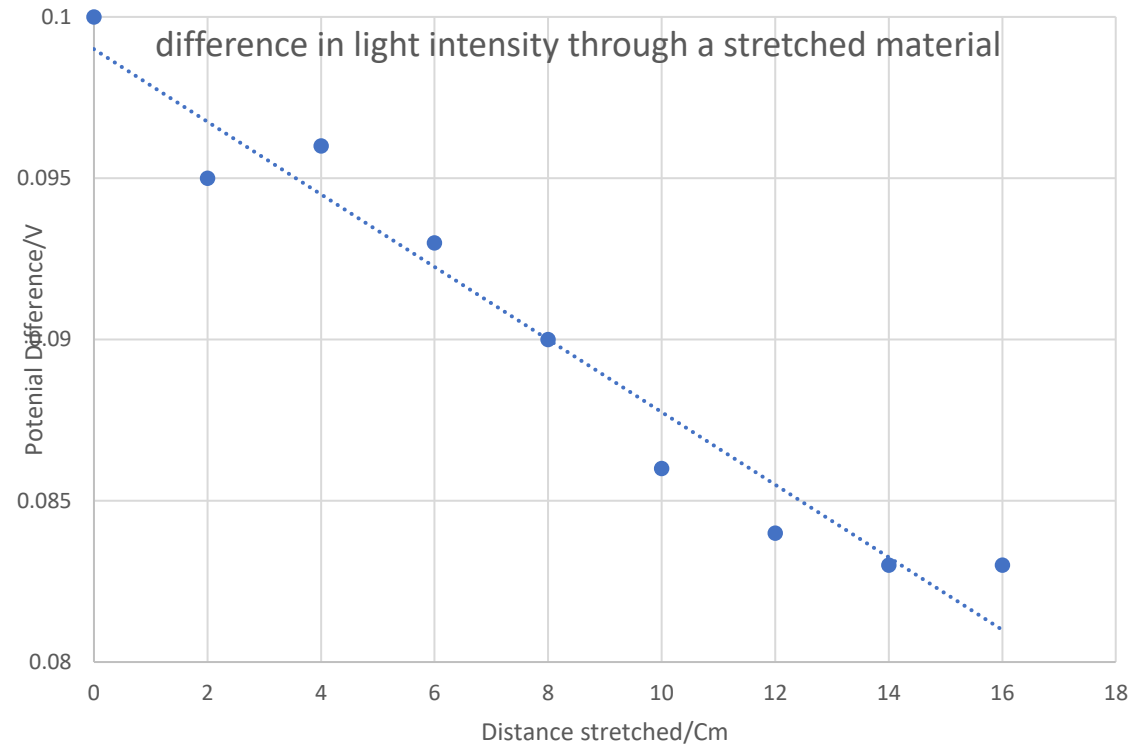
- Once again we found this idea particularly difficult to execute. Whilst the other groups were beginning to do trial and error with their new projects, we found ourselves at the beginning still thinking about the solution to our problems.
- We had many innovative ideas but what we failed to realise was that the solutions to our problems was simplicity. It's brilliant that we thought of so many ideas but we just had to channel our thoughts and direct into one project (breathing). Although we had further problems with this topic such as deciding on how to measure breathing rates in an unique way- we finally chose a method.

Our method

- We used a phototransistor to measure the intensity of the light through an elasticated material
- As the fibre of the material stretched the light passing through would differ- and we would get a different signal from the multi meter, this meant we had a reliable way of detecting the when the patient breaths in and breaths out



Our data



Our data shows a negative correlation with the difference in light intensity through a stretched material. The further it stretched in distance, the voltage decreased and therefore the light passing through was less. This means a larger difference in voltage therefore showing they are inhaling and exhaling

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9-11	12-20		21-24	≥25
SpO ₂ Scale 1(%)	≤91	92-93	94-95	≥96			
SpO ₂ Scale 2(%)	≤83	84-85	86-87	88-92 ≥93 on air	93-94 on oxygen	95-96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91-100	101-110	111-219			≥220
Pulse (per minute)	≤40		41-50	51-90	91-110	111-130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1-36.0	36.1-38.0	38.1-39.0	≥39.1	

Some problem we had a long the way

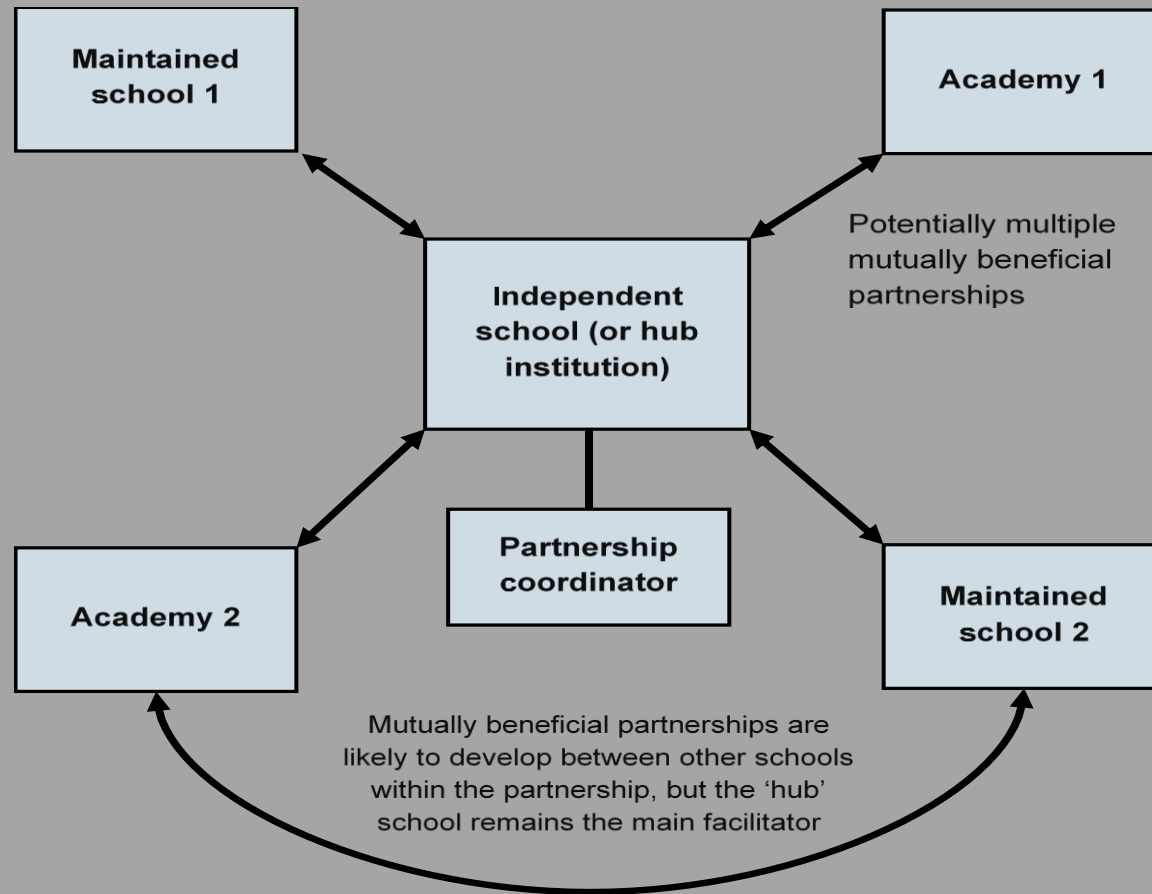
- We encounters a lot of problems, for example:
- Systematic problems
- What if the patient was excessively moving
- Comfort
- Our microbit doesn't work
- We were not able to test on lots of material

How to get started?

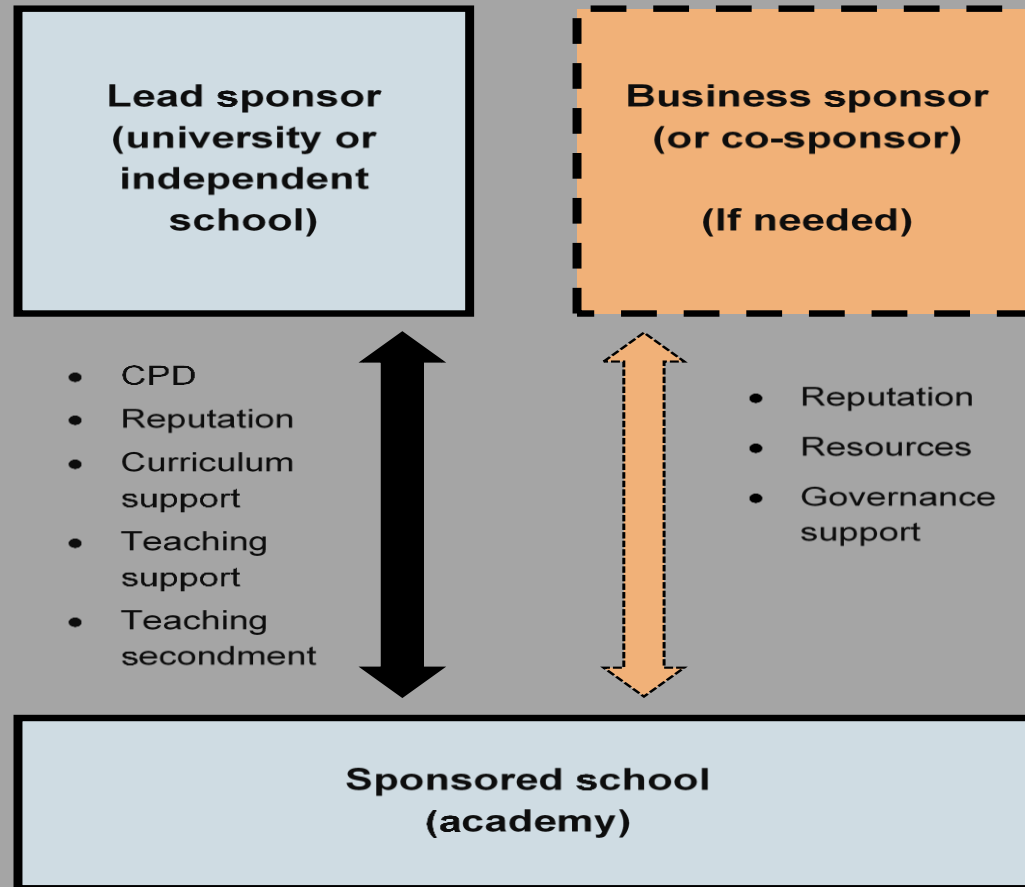
- Industrial partnership
- Partnership schools

- Start small and then iterate!
- An expert is someone who has made all the mistakes in a particular domain
- Have fun!

Hub and Spoke Partnerships



Partnership Models – Academy Sponsorship



Highgate Chrystalis Partnerships

51
Partner State Schools

32
Secondary Schools and Sixth Forms

14
Primary Schools

3
Virtual Schools

2
Special Educational Needs Schools

22.5%*
Of pupils in our partner schools are eligible for Free School Meals, compared to the London average of 16.8% (Data form 2019)

OUR PARTNER SCHOOLS

Barnet

The Henrietta Barnett School
The Holmewood School London

Camden

Acland Burghley School
Brookfield Primary School
Camden School for Girls
Camden Virtual School
Hampstead School
Haverstock School
La Sainte Union Catholic Secondary School
Maria Fidelis Catholic School
Parliament Hill School
Regent High School
St. Joseph's Catholic Primary School
UCL Academy
William Ellis School

Ealing

Drayton Manor High School

Lambeth

King's College Mathematics School

Islington

Grafton Primary School
Islington Virtual School

Haringey

Alexandra Park School
Crowland School
Duke's Aldridge Academy
Fortismere School
Gladesmore Community School
Greig City Academy
Haringey Sixth Form College
Haringey Virtual School
Heartlands High School
Highgate Primary School
Highgate Wood School
Holy Trinity CE Primary
Hornsey School for Girls

Hackney

Stoke Newington School

Newham

Kingsford Community School
London Academy of Excellence Stratford
St Angela's Ursuline School

St Aloysius RC College
St Mary Magdalene Academy
Whitehall Park School

London Academy of Excellence Tottenham
Park View School
Seven Sisters Primary School
St Thomas More Catholic School
St. Ann's CE Primary School
St. Mary's CE Primary School
St. Michael's CE Primary School (N22)
St. Michael's CE Primary School (N6)
St. Paul's and All Hallows CE School
Tiverton Primary School
TreeHouse School
Woodside High School

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Highgate Chrysalis Partnerships

A HISTORY OF PARTNERSHIP AT HIGHGATE

1565

Queen Elizabeth I grants letters patent to her 'well beloved and faithful subject', Sir Roger Cholmeley, to found a grammar school 'for the most liberal education and instruction of the boys and young men' around Highgate. The statute mandates provision 'in some convenient manner for the **Relief and Support of certain poor persons.**'

1865

From starting 300 years prior with 40 scholars, Highgate now has 80 day boys, 50 boarders and **50 foundationers who receive financial support.**

1963

A **Public Service Scheme** was established where boys undertook community work, first in Highgate then in other areas of North London. Some decorated homes for the elderly, some taught English and others taught disabled children to swim. This became part of the **Duke of Edinburgh Award** which the school joined in the same year.

2008

Highgate's partnership work, which we call **Chrysalis**, began. The first project was a Year 12 Summer School with twelve schools mostly in Haringey. Chrysalis has now become a **year-round programme** with more than twenty Highgate teachers working on projects with nearly fifty partner schools.

2020

Highgate launches **Highgate is Here**. Originally established as the institutional response to the COVID-19 crisis, it will evolve into a **bold new charitable vision for Highgate**, expanding the reach and scope of Chrysalis partnerships and the impact Highgate can have in our community.

16th

Century

Highgate villagers started to worship at the School Chapel as parish churches of Hornsey and Saint Pancras lay several miles away. This continued until 1830.

1876

Highgate officially lifts its restrictive limit on pupil numbers and **introduces scholarships to widen access to education.**

2008

Great Lakes High School in Uganda is founded, providing educational opportunities in a country where the poorest do not often attend school. Highgate was involved, and supportive, from the start, undertaking fundraising, sponsoring pupils and visiting GLHS each summer.

2017

The London Academy of Excellence Tottenham, a sixth form free school in the heart of Tottenham opens. Highgate is the main educational sponsor and has recruited and deployed the full-time equivalent of 6.6 members of the total teaching and support staff, as well as assisting with wider administrative, pastoral and management support.

2021

Highgate announces the establishment of **Chrysalis East**. It closely follows the model of Highgate's work in the west of Haringey, building on LAET's work with their four Tottenham feeder schools to **increase academic aspiration and GCSE outcomes of bright local students with potential**, in time increasing the proportion of these students who go on to study at LAET and eventually at leading universities in the UK and around the world.

Highgate School's Ethos

Learning and Scholarship

- Cultivate individual curiosity and intellectual rigour in our pupils to enable their interests to take flight
- Believe in the enjoyment of learning for its own sake, and as a way of living
- Nurture confidence, creativity and risk taking in our pupils as they study, in preparation for higher education, the world of work and happy, curious lives

A Reflective Community

- Encourage our pupils to look outwards, to play an active part in their community – both within the School and further afield
- Strive for continual learning and improvement, particularly with regards to equality, inclusion, diversity and sustainability
- Facilitate our pupils to use their minds and voices to make a difference to the world around them

Exemplar For the Healthy Life

- Promote kindness, empathy and friendship
- Nurture self-reflection and celebrate individuality, encouraging our pupils to find and develop their unique skills
- Encourage pupils to develop personal qualities such as self-motivation, collaboration and leadership

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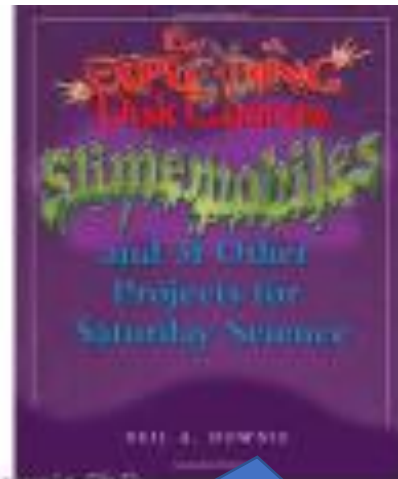
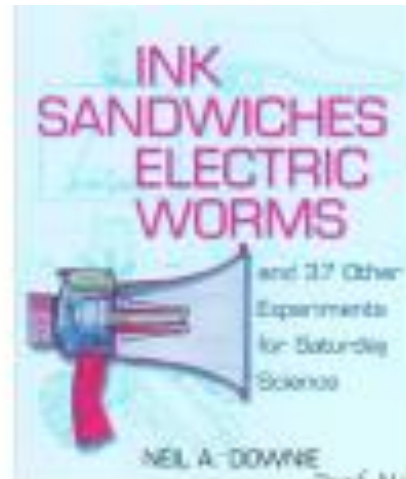
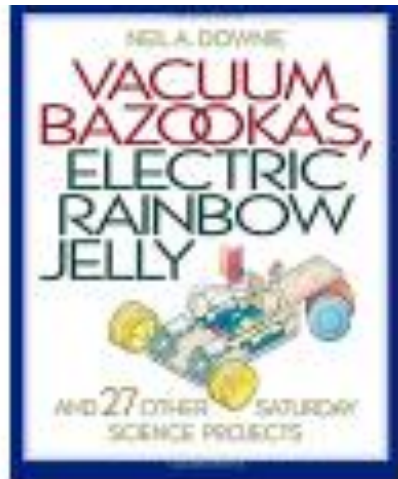
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