

Connect Physics is a set of three workshops for Key Stage 3 science students which answer the questions:

- What is physics?
- Why do physics?
- How do we do physics?

The workshops are suitable for students of all science abilities. The workshops encourage students to think of the bigger picture through connecting different ideas, such as topics from KS3 science, the latest physics research or their everyday lives. They are able to find out about careers that are available after studying

physics and they are given a chance to develop their skills using the scientific method and the peer-review process by tackling an open-ended problem with no given solution.



Autumn Term – Workshop 01: What Is Physics?

The aim of this workshop is to introduce students to the variety of topics that are part of the study of physics and encourage students to discover the links between these topics.

Grid 3

Time: 2m 28s

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Distance	Microphone	Ear	Liquid
Solid	Gas	North	South
Plasma	Attract	Speaker	Time
Compass	Echo	Speed	Acceleration

The workshop is divided into two parts. The first part feature our physics connecting wall, similar to the TV show *Only Connect*. In groups students have to guess how the sixteen topics presented can be grouped into four sets of four. The challenge is that some topics can fit into more than one group.

Our board works on any internet browser, such as Chrome. The topics presented can be modified if there are any recent KS3 science ideas recently covered that you would like to reinforce. These board are the warm up and should only take around a third of the total workshop time.

The remainder of the workshop is where the connections truly come in, the Connections Challenge. Here the class challenges the presenter to connect any two everyday objects / phenomena through a physics chain. A few cue cards are provided for inspiration, with objects such as *cow*, *internet*, and *pencil*.

Our trained presenters then start building a chain, with the help of the students. Some of these chains will even link from everyday objects, through a physics idea from the KS3 curriculum to some of the latest in physics research being carried out at the SEPnet universities. Presenters will also bring in simple, noisy, eye-catching demonstrations that are relevant to the physics in the chain.

Each run of the workshop is different as the students themselves control the direction of the chains. Our presenters are trained and well-practiced; we haven't found two objects that we couldn't connect through physics, after all physics underlies everything in the universe.

Example Chain



In a standard workshop, it is possible to go through three or four different chains. Towards the later chains, the more able students will start identifying the links themselves. Chains can also be engineered so that recent ideas you may have presented in KS3 science can be included.

Workshop Requirements:

The workshop works best in a lab as some of the demonstrations will require power and a tap. Some may also be messy. If you are concerned about any potential demonstrations, do get in touch with the presenter as each one will have a different set of demonstrations. Each presenter will also have a risk assessment for all their possible demonstrations.

Please note that some of the demonstrations may feature flashing lights and loud noises so do inform the presenter of any accessibility needs in your classes so they can adapt demonstrations. Do let them know if there is a particular aspect of Physics you would to see included.

A projector is needed for the first part of the workshop, ideally with computer that has some form of web browser on it, ideally Chrome, and PowerPoint.

Teamwork is an essential part of the workshop, so we do ask you to split the class into groups before the workshop as you will understand the class dynamics and now how the students work best between themselves.

Your role in the workshop:

We strongly encourage you to take part throughout the workshop! Help make a chain, suggest chain start and end points, or help groups that may struggle with the connecting wall.

At the end of the session all students should be able to:

- Understand that physics is the study of how everything around them works and not simply a set of isolated ideas.

- See that physics can connect many different ideas and objects.

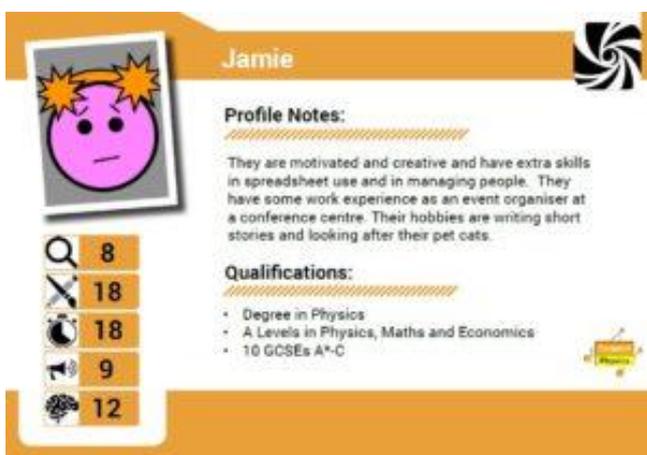
More able students / those with a higher science capital should be able to:

- Start making their own connections using physics.
- Understand that physics has many unanswered questions.

Spring Term – Workshop 02: Why Do Physics?

What careers can a physics degree lead to? The most common answer is ‘scientist’. The aim of this workshop is to show that scientist is just one option out of a multitude of interesting, satisfying possible careers.

This workshop is an innovative, interactive and competitive way of introducing careers to the classroom by making the students recruitment agencies. The presenter starts by talking about how to go about looking for jobs, introducing the idea of a recruitment agency.



Jamie

Profile Notes:
They are motivated and creative and have extra skills in spreadsheet use and in managing people. They have some work experience as an event organiser at a conference centre. Their hobbies are writing short stories and looking after their pet cats.

Qualifications:

- Degree in Physics
- A Levels in Physics, Maths and Economics
- 10 GCSEs A*-C

Skills: Inquisitiveness (8), Creativity (18), Organisation (18), Communication (9), Logic (12)

The class then works in groups, each a different agency with a different set of physics graduates as their clients. Throughout the workshop the agencies will compete against each other to ensure their clients get the jobs presented to them.

The clients have information on their qualifications, each showcasing different routes into a physics degree and the many different types of degree courses on offer at SEPnet universities.

This workshop introduces the idea of transferable skills you develop through studying physics and other STEM subjects. These are the little icons featured on the left of the client profiles. (Inquisitiveness, Creativity, Organisation, Communication and Logic). The gender, ethnicity and sexuality of each client are never disclosed. The image of each client is also kept in cartoon form. This way students can identify with clients based on their interests and skills, helping reinforce the message that anyone can do science.

The presenter helps the agencies through the first advertised job, talking about the sort of skills a graduate would need. Each agency then decides which of their physics graduates best fits the role. Each group does this by sending one of the students with the candidate and places them behind their recruitment agency logo on the front desk.

Robotics Consultant

We are a small company developing robotic prosthetic limbs to enable amputees to regain full control of their lives.

We are looking for someone to help in the development of the software and hardware side of things. If you're a practical and reliable person, we want to hear from you!

Skills Required:

- Good degree in a relevant discipline
- Great practical ability with electronics and mechanics
- Good mathematical skills
- Able to write and debug software a plus



Throughout there is an interactive score card which is displayed on screen (using Chrome or other browser) throughout the workshops which displays the job being advertised and keeps track of what graduates are selected.

After all agencies have selected a client, the presenter reveals what skills were important for the job. Each skills for the job will have a x1 or x2 multiplier. Here the students will realise how suitable their graduate was.

The presenter then reveals the total score of each agency. This is the sum of all the skills of their graduate multiplied by the multiplier. The graduate with the highest score gets the job. The agency that submitted that candidate then wins the round!

There are five jobs that can be presented throughout the workshop. Normally students go through three or four of them.

During testing we found that students of all abilities get very competitive. They pick up on the rules of the game

quickly and are keen to win.

Workshop Requirements:

The workshop works best in a standard classroom rather than the lab as there are no demonstrations or hands-on experiments. However, the workshop is by no means quiet.

A projector is needed for the workshop, ideally with computer that has some form of web browser on it, ideally Chrome and PowerPoint.

Teamwork is an essential part of the workshop, so we do ask you to split the class into groups before the workshop as you will understand the class dynamics and now how the students work best between themselves.

Your role in the workshop:

We strongly encourage you to take part throughout the workshop! Help groups pick graduates. We also have the option of adding an interview to any job that is advertised. Here we ask each agency to give a presentation on why their graduate is suited for the job. We would ask you to sit on the interview panel and help us score them.

At the end of the session all students should be able to:

- Understand that studying science subjects leads to many different jobs that go beyond being a scientist or a teacher.
- Start to understand the idea of transferable skills and how they are developed through science.

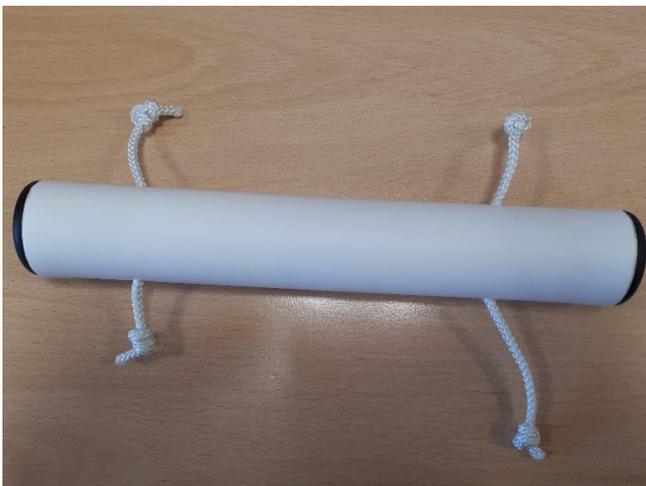
More able students / those with a higher science capital should be able to:

- See physics as a route to many different jobs, including ones they may be interested in doing.
- Understand what transferable skills are and see how physics helps develop these.



Summer Term – Workshop 03: How do we do Physics?

The aim of this workshop is to introduce students to the scientific method. The workshop is designed so that the students should not know the answer in advance or be able to solve the problem easily by guesswork.



At the start of the workshop the presenter will go over the scientific method, in particular how students would have used it in a classroom setting. Following this, they will expand on the method to show how it is used in current science research, including the concept of peer review. The key message here is to show the bulk of the method is very much the same.

At this stage we ask the students if they can solve the mystery tubes. Pairs of students are given a tube and simply told to have a play. Some will pull on each of the ropes, others will work together and pull on two ropes at the same time. Some will shake them.

After a few minutes of experimenting, each pair is asked to draw a diagram of what they think is inside the tube. Once completed, pairs will swap diagrams and comment on why their colleague's diagrams could be correct or incorrect based on their observations. This is an introduction to the peer review process. We do encourage each pair to justify comments, based on the tubes themselves and their interpretations of what is going on inside.

The final stage of the workshop introduces the idea of modelling. Each pair is given an open plastic tube with four holes, some string, and some nuts and bolts. This allows them to model their newly-reviewed diagrams. Throughout this process they will test their model against their original tube. Depending on

time, different pairs can then present their model to the rest of the class, emphasising the importance of sharing findings with other scientists.

At the end of the workshop, the presenter will go through the scientific method again, highlighting what the students themselves have done throughout the workshop. By following this process they have been doing science, and therefore they themselves are scientists. At no point will the students find out what is inside the tubes. This reinforces the idea that sometimes in science it is not possible to find out the final answer, and a model is the closest you can get!

Workshop Requirements:

The workshop works best in lab or a standard classroom as no extra equipment is needed.

A projector is needed for the workshop, ideally with a computer that has PowerPoint.

Your role in the workshop:

We strongly encourage you to take part throughout the workshop! Help students come back to the original tube as they draw, peer review and model.

At the end of the session all students should be able to:

- Realise that science is applying the scientific method to a process.
- Start to see that they can do and are doing science in the classroom.

More able students / those with a higher science capital should be able to:

- Understand how versatile the scientific method can be. They will start to understand that it can be applied to many different problems and settings.
- Feel confident in using the process and identify as being a scientist.



Why three workshops?

For many years SEPnet has been delivering one-off workshops with many schools. Sadly these workshops had very little long-term impact with students, especially those that hadn't already identified science as a pathway to their future career. Instead SEPnet is now focusing on fewer schools, instead having a greater number of interactions with the students from those schools. Once a term allows us to still be that exciting external visitor, but often enough that students should remember the workshops and be able to link the three.

By the end of the workshops all students should start to realise that:

- Anyone can do physics.
- Physics is exciting, relevant & important; it goes beyond the classroom.
- Studying physics further broadens career possibilities.

The workshops have been developed using the [ASPIRES](#) research. The workshops are designed to maintain and grow the [science capital](#) of the students that take part. For those with medium science capital, these workshops should encourage them to view STEM as a pathway to a potential career, for those with high science capital, they will be encouraged to think specifically about physics.

The workshops have been developed by [Science Theatre](#) on behalf of SEPnet.

Links to Curriculum:

The Connect Physics workshops supplement the KS3 Science Curriculum. KS3 science presents students with a very large number of ideas. With so many ideas to get through, science can sometimes be interpreted by students as a collection of singular concepts.

Connect Physics is designed to bring these ideas together, Connect them through physics. Not only Connect the ideas within the science curriculum, but take these ideas and Connect them with aspects of everyday life that students will be familiar with; Connect these ideas with careers and pathways to get there; Connect ideas with the methods of carrying out science.

These workshops help relate ideas in KS3 science to phenomena in the world around them, bring in connections between different subject areas, connect KS3 science ideas to the big ideas at the forefront of physics research and introduces the idea of modelling and peer review to develop and evaluate explanation, all key components and skills-building that work alongside all of the [KS3 Science National Curriculum](#).

Format of the workshops

Each workshop fits into a 45 to 60 minute science lessons. If you lessons are slightly shorter or longer, please let us know beforehand so the workshops can be altered.

Each workshop will be delivered by the same [SEPnet Outreach Officer](#) throughout the year, or one of their experienced and fully trained Undergraduate Ambassadors.

Ideally the workshops would be delivered one a term, across the year, to the same students. However timetabling is never easy! If possible please book the workshops in before the Autumn Half-Term, as the Officers' diaries do tend to get full-up, especially during March, June and July.

Testing and Evaluation

The workshops and their content have been tested throughout the South-East in over thirty different schools over two years. This testing forms part of an evaluation process which includes focus groups with Key Stage 3 students and other teachers. The results of this evaluation will be made available in September 2018.

For more information, feedback or to book a workshop e-mail outreach@sepnet.ac.uk

SEPnet Outreach & Public Engagement is formed of ten partner university physics departments working together to raise the profile of Physics.

