Project 1	**Three point bend test** Measure the strength of materials by bending them.
Student level	Suitable for GCSE students or possibly younger. Need at least a familiarity with Excel or equivalent spreadsheet software for calculations and plotting.
Student team size	2 to 5
Project	This project will focus on measuring and comparing the strengths of different materials using three point bend testing. Three point bend tests are used measure the strength of a rod or bar-shaped samples: the two ends are supported as the middle is pushed down. The stronger the material, the more force you need to deflect the middle by a certain amount. This project contains both virtual and practical parts: for the virtual part, you will do the three-point bend test as a computer simulation, on materials used to build real-world engineering structures; for the practical part, you will use a simple three point bend test kit to measure the strength of household objects such as spaghetti and cable ties.
Area	In Advanced Engineering Materials, we ensure that materials used in engineering components are reliable are suitable for making into computer electronics, aeroplane components, cutting tools, and even medicines. We do this by measuring material properties such as mechanical strength, electrical and thermal conductivity, liquid permeability in fabrics, and resistance to grinding damage. Microscopes help us to observe and relate the structure of these materials to their properties, and to their performance as engineering components.
Hardware requirements	For the simulated experiment: Excel or equivalent software, and to a Windows computer (for running the simulation). For the practical experiment: NPL will send teams a three point bend test rig. You will also need kitchen scales, a flat top surface and about 30 ml of water.

Project 2	**Measuring speed of sound through phase matching**
Student level	Suitable for GCSE students. Need at least a familiarity with Excel or equivalent spreadsheet software for plotting.
Student team size	2 to 6
Project	The speed of sound varies with pressure and temperature, but the technique of matching phases to measure distances is one used in interferometry to measure very precise dimensions, making them traceable to the speed of light and the second. This project will be carried out totally virtually, using a simulated laboratory experiment. The equipment used is a signal generator, a speaker, a microphone and a dual input oscilloscope
Area	Engineering / Advanced Engineering Materials
Hardware requirements	Specifically, a Windows PC to run simulation software, also spreadsheet and PowerPoint (or similar).

Project 3	**Using a Red-Green-Blue sensor to determine by colour the temperature of a hot body** "Red hot" interest! Make a pocket-size super-hot body temperature indicator.
Student level	GCSE, BTEC or "A" level students who like to wire things up and want to learn how to write simple code for a processor
Student team size	2
The Project	We shall use an RGB sensor to determine the hue of light emitted from a glowing hot object. Using the same science astronomers use to evaluate star surface temperatures (including our sun) our system will report 'colour temperature' which is also used in domestic light bulb specifications. The project involves electronics (linking the RGB sensor and a display to a microcontroller), programming (coding the controller to read sensor values, evaluate colour temperature and display results) and calibration (scaling values to a standard to increase trust in results).
The area	The NPL Training group provides courses and qualifications across a range of subjects at different technical skills levels for apprentices, businesses and organisations. Their training and qualifications are perfect for manufacturers who require absolute confidence in their measurements and sensing applications, across all industry sectors. This project is typical of hands-on activities they run.
Hardware requirements	A Raspberry Pi/Arduino microprocessor. A compatible RGB sensor A computer to program the microcontroller. A display for the microprocessor. The ability to use Excel and PowerPoint will be very helpful.

Project 4	**Using mass spectrometry imaging and data analysis to map molecules** Uncovering molecular differences in biological samples using mass spectrometry imaging and statistical analyses.
Student level	Better suited to A-level or Highers students (all STEM areas). Need at least a familiarity with Excel and PowerPoint.
Student team size	2 to 3
Project	This project will focus on the analysis of data from biological samples to understand the similarities and differences between regions defined by mass spectrometry imaging to learn about the underlying biology and chemistry. This will involve the analysis of mass spectrometry imaging data; the project is flexible and will suit those with a basic understanding of statistics and Excel or can be adapted to those with a more advanced capability or those with an interest in coding (Python).
Area	In National Centre of Excellence in Mass Spectrometry Imaging (NiCE-MSI) we use mass spectrometry to help us understand a wide range of samples including biological materials and inorganic materials, such as semi-conductors. The techniques we use are mass spectrometry imaging (MSI) methods which allow us to create spatial maps of molecules from the surface of our samples. This data provides important information to help us understand where specific chemical compounds are localised in 2D, and even 3D, space.
Hardware requirements	Computer running Excel and PowerPoint.

Project 5	**Using gas analysis techniques and data analysis to quantify unknown impurities in gas samples** Gas analysis for a greener, cleaner planet
Student level	Better suited to A-level or Highers students (all STEM areas) Need at least a familiarity with Excel and PowerPoint.
Student team size	2 to 3
Project	This project is for students interested in the application of science to tackle global issues. It will involve case studies which relate to climate change, air pollution and clean energy, and how specialised work performed by a research scientist can help address these topics. The work will centre around data analysis and aims to provide students with an understanding of the following: 1. The context of the global issues which have created a demand for deeper scientific investigation of gases. 2. How automated machines analyse gas mixtures and produce large sets of unprocessed or "raw" data. 3. The techniques used to process and interpret raw data and obtain meaningful information such as the quality and composition of a gas sample. 4. How statistics can be used to assign a level of confidence to a scientific conclusion. 5. The wider impact of this scientific work.
Area	NPL's Gas Metrology Group carry out world-leading research in measurement science. It provides a range of scientific services to organisations such as universities, research institutions, the UK government and private companies which are called stakeholders. The services revolve around measurement and analysis of gases with the aim of achieving highly accurate results and preparing high purity reference gas standards.
Hardware requirements	Computer running Excel and PowerPoint.

Project 6	**Quantification in nuclear medicine** Perform analysis of medical imaging data used in the European MRTDosimetry project to gain insight in the data analysis techniques for nuclear medicine.
Student level	Better suited to A-level or Highers students (all STEM areas) Need at least a familiarity with Excel and some coding experience is desirable.
Student team size	2
Project	This project employs two modalities - SPECT and CT imaging. The project will use data collected during the MRTDosimetry project performed in the European Metrology for Innovation Programme (Metrology for clinical implementation of dosimetry in molecular radiotherapy - Project Details - EURAMET). The team will be analysing sets of imaging data to extract the necessary statistical information from each modality. The project is flexible and will suit those with a basic understanding of statistics and Excel or can be adapted to those with a more advanced capability or those with an interest in coding (ImageJ).
Area	In the Nuclear Medicine Imaging Laboratory, we have a clinical SPECT-CT-PET scanner which is used for research applications using state of the art models of the human body (phantoms). These phantoms can be produced using 3D printing to reproduce individual patient geometries and can also have motion and other dynamics introduced.
Hardware requirements	Computer running Excel and PowerPoint (or equivalent), and the open-source software ImageJ (https://fiji.sc/).

Project 7	**Enhanced world metrology data** Help research the international measurement arena.
Student level	GCSE or A level Familiarity with Excel and web-searching and a knowledge of informatics would be very valuable.
Student team size	2
Project	This project will build upon the information that NPL holds on the metrology systems in other countries around the world. It will update and add to what we know and create an informatic to relate the data to a map, assisting the perspective of users of the data. The metrology information can be supplemented with information on the wider quality infrastructure and ways to enhance the absorption of the data can be explored.
Area	The International Office is to NPL what the Foreign, Commonwealth and Development Office is to Government. It supports NPL's interactions with National Measurement Institutes around the world and with international organisations involved in metrology.
Hardware requirements	Computer running Excel and a search engine.

Project 8	**Developing a corporate communications plan and content** Create a communications strategy and content plan for Net Zero week linking to NPL's environment research.
Student level	Better suited to A-level.
Student team size	2 to 3
Project	This project will focus on the development of a communications plan (including developing a press release/news story, quote, social media, email/newsletter, case study and webpage) to raise awareness of the importance of Net Zero and NPL's research and capabilities in this area. Net Zero week is an annual National Awareness Week in the UK, taking place between 2-8 July. Net Zero is a vital part of mitigating the impacts of climate change and this week highlights the challenges and provides advice and insight into solutions.
Area	The Marketing and Communications team helps NPL to expand internal and external reach, generate leads and opportunities, and develop new ways of working to show our impact with customers, partners, academics, and other external influencers.
Hardware requirements	Computer running Word and access to the internet (for research purposes).