

Progress Test in Science (PTS) has been designed to sample the main science knowledge and skills set out in the national curricula for England, Wales, Scotland and Northern Ireland. While the intentions are similar, the science curricula vary between regions, for example in the terminology used. This document provides additional information on the test questions and their links to regional science skill sets.

Reporting areas

Learning in science comprises scientific knowledge as well as the skills and understanding needed to apply knowledge in different contexts.

To capture the different aspects of learning, the questions in *PTS13* have been mapped to three reporting areas:

Reporting area	Questions
<p>Knowledge and Understanding</p> <ul style="list-style-type: none"> • Recognising, recalling and showing understanding of scientific knowledge 	1, 3, 4, 5, 7, 8, 9, 11, 12, 15, 17, 18, 20, 21, 22, 24, 28, 29, 30, 31, 32, 33, 34, 37, 39, 40, 41, 50, 57, 58, 59
<p>Application of Knowledge and Understanding</p> <ul style="list-style-type: none"> • Application of scientific knowledge and understanding, including that related to issues, uses and implications • Understanding of the nature, processes and methods of science through different types of science enquiries to help answer scientific questions about the world 	2, 6, 10, 13, 14, 16, 19, 23, 25, 26, 27, 35, 36, 38, 42, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 56
<p>Working scientifically</p> <ul style="list-style-type: none"> • Key features of scientific enquiry, so that students learn to use a variety of approaches to answer relevant scientific questions <ul style="list-style-type: none"> ○ Observing over time, pattern seeking, identifying, classifying and grouping, controlled investigations, researching using secondary sources ○ Collecting, analysing and presenting data 	16, 35, 36, 38, 48, 49, 50, 51, 52, 53, 54, 59

The reporting areas shown above are based on the National Curriculum in England Science programmes of study for KS3. The curricula for Wales, Scotland and Northern Ireland have similar requirements, although there is wide variation in the way they are defined.

Knowledge and skills

The question by question analysis in *PTS* reports provides detailed information on how students perform in the scientific disciplines of biology, chemistry and physics. The following tables map the test questions to the different regional curriculum content categories.

Some test questions may reflect content from previous years to ensure that knowledge has been embedded and progress is made across the range of scientific knowledge and skills. There are also some advanced questions to ensure that the more able students are challenged.

England

Aspects of the National Curriculum in England for KS2 and KS3 relevant to *PTS13*.

Biology

Material cycles and energy, structure and function of living organisms, interactions and interdependencies, genetics and evolution

Experimental skills and investigations, analysis and evaluation

- The dependence of almost all life on Earth on the ability of photosynthetic organisms – such as plants and algae – to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere
- The reactants in, and products of, photosynthesis, and a word summary for photosynthesis
- The interdependence of organisms in an ecosystem, including food webs and insect pollinated crops
- Reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms
- The structure and functions of the human skeleton, to include support, protection, movement and making blood cells
- Heredity as the process by which genetic information is transmitted from one generation to the next
- The structure and functions of the gas exchange system in humans, including adaptations to function
- The importance of bacteria in the human digestive system
- Aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life
- The variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection
- The hierarchical organisation of multicellular organisms: from cells to tissues

to organs to systems to organisms.

- The functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts
- Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- Apply mathematical concepts and calculate results

Questions

1, 2, 3, 4, 5, 30, 31, 32, 33, 34, 35, 36, 55, 56, 57, 58, 59

Chemistry

Chemical reactions, pure and impure substances, energetics, atoms elements and compounds, the particulate nature of matter, Earth and atmosphere, the Periodic Table, materials

Analysis and evaluation, experimental skills and investigations, scientific attitudes

- Combustion, thermal decomposition, oxidation and displacement reactions
- Diffusion in terms of the particle model
- Exothermic and endothermic chemical reactions (qualitative)
- Conservation of mass changes of state and chemical reactions
- What catalysts do
- Changes of state in terms of the particle model
- The Periodic Table: periods and groups; metals and non-metals
- The order of metals and carbon in the reactivity series
- Chemical symbols and formulae for elements and compounds
- The varying physical and chemical properties of different elements
- The structure of the Earth
- The rock cycle and the formation of igneous, sedimentary and metamorphic rocks
- Earth as a source of limited resources and the efficacy of recycling
- The composition of the atmosphere
- Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate
- Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety and evaluate risks
- Evaluate risks
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions

Questions

14, 15, 16, 17, 18, 19, 20, 21, 22, 37, 38, 39, 40, 41, 42, 43, 44, 45, 47

Physics

Electricity and electromagnetism, motion and forces, matter, energy, space physics, waves

Experimental skills and investigations

- The magnetic effect of a current, electromagnets, D.C. motors (principles only)
- Speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time)
- The difference between chemical and physical changes
- Using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces
- Atoms and molecules as particles
- Fuels and energy resources
- Heating and thermal equilibrium: temperature difference between two objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference: use of insulators
- Other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels
- Electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge
- Conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving
- The differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density, the anomaly of ice-water transition
- Use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye
- Our Sun as a star, other stars in our galaxy, other galaxies
- The seasons and the Earth's tilt, day length at different times of year, in different hemispheres
- Sound needs a medium to travel, the speed of sound in air, in water, in solids
- Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety

Questions

6, 7, 8, 9, 10, 11, 12, 13, 23, 24, 25, 26, 27, 28, 29, 46, 48

Wales

Aspects of the National Curriculum in Wales for KS2 and KS3 relevant to PTS13.

How things work

Behaviour of current, conservation of energy, electricity, energy resources, forces, light

Analysis, concluding, using mathematics

- The behaviour of current in electrical circuits
- The conservation of energy and ways in which energy can be stored
- How familiar devices/machines work by using electricity, light, sound and other energy transfers
- How renewable and non-renewable energy resources are used to generate electricity and the implications of decisions made about their use
- The ways in which forces can affect movement and how forces can be compared
- How light travels and how this can be used
- Identify, describe and explain trends, patterns and relationships
- Use scientific prior knowledge to explain links between cause and effect when concluding
- Work quantitatively, using appropriate mathematical conventions and using S.I. units appropriate to their work, e.g. kg, s, N, m, J, w

Questions

6, 7, 8, 9, 10, 11, 12, 20, 24, 27, 29, 48

Interdependence of organisms

Balanced diet, food webs, global environment, interactions and interdependencies, interdependence, material cycles, respiration, structure and function of living organisms

Concluding, finding information, making links, using mathematics

- How food is used by the body as fuel during respiration and why the components of a balanced diet are needed for good health
- The interdependence of organisms and their representation as food webs, pyramids of numbers and simple energy-flow diagrams
- The basic structure and function of some cells, tissues, organs and organ systems and how they support vital life processes
- How human activity affects the global environment, e.g. acid rain, greenhouse effect, and the measures taken to minimise any negative effects and monitor them, e.g. by Earth observation satellites
- Identify, describe and explain trends, patterns and relationships

- Linking the learning to dissimilar but familiar situations, within and outside school
- A range of options as to where and how to find relevant information and ideas
- Work quantitatively, using appropriate mathematical conventions and using S.I. units appropriate to their work, e.g. kg, s, N, m, J, w

Questions

1, 2, 3, 4, 5, 30, 31, 32, 33, 34, 35, 36, 56, 57, 58, 59

The sustainable Earth

Chemical reactions, Earth and space, elements compounds and mixtures, equipment and techniques, particle model, patterns in behaviour, physical and chemical changes, physical and chemical properties, Sun and planets

Predicting

- Investigations into the patterns of behaviour of elements and compounds and their use to describe and predict their behaviour in chemical reactions
- The physical and chemical properties of some elements, compounds and mixtures and how mixtures can be separated by simple techniques
- The properties of solids, liquids and gases and how the particle model can be used to explain these properties
- The differences between physical and chemical changes using some common examples
- The daily and annual movements of the Earth and their effect on day and year length
- The relative positions and key features of the Sun and planets in the solar system
- Predictions using previous knowledge, understanding and preliminary work
- Any potential hazards in their work
- The equipment and techniques required for the enquiry

Questions

13, 14, 15, 17, 18, 19, 23, 28, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47

In addition 'inheritance, analysis, measurement, and Earth and atmosphere' are addressed in questions 16, 21, 22, 25, 26, 49, 50, 51, 52, 53, 54 and 55.

Scotland

Aspects of Curriculum for Excellence: Sciences experiences and outcomes for Third and Fourth levels relevant to PTS13.

Biological systems

Body systems and cells, inheritance

- I have explored the structure and function of organs and organ systems and can relate this to the basic biological processes required to sustain life
- I have contributed to investigations into the role of microorganisms in producing and breaking down some materials
- Using a microscope, I have developed my understanding of the structure and variety of cells and of their functions
- By exploring the characteristics offspring inherit when living things reproduce, I can distinguish between inherited and non-inherited characteristics
- I understand the processes of fertilisation and embryonic development and can discuss possible risks to the embryo
- Through evaluation of a range of data, I can compare sexual and asexual reproduction and explain their importance for survival of species

Questions

3, 4, 5, 30, 31, 32, 33, 34, 55, 56, 58

Forces, electricity and waves

Electricity, forces, vibrations and waves

- I can help to design and carry out investigations into the strength of magnets and electromagnets. From investigations, I can compare the properties, uses and commercial applications of electromagnets and supermagnets
- I can use appropriate methods to measure, calculate and display graphically the speed of an object, and show how these methods can be used in a selected application
- By exploring reflections, the formation of shadows and the mixing of coloured lights, I can use my knowledge of the properties of light to show how it can be used in a creative way
- By exploring the refraction of light when passed through different materials, lenses and prisms, I can explain how light can be used in a variety of applications
- Through research on how animals communicate, I can explain how sound vibrations are carried by waves through air, water and other media

Questions

7, 8, 9, 10, 24, 27, 28, 29, 48

Materials

Chemical changes, Earth's materials, properties and uses of substances

Analysis and evaluation, experimental skills and investigations

- Having taken part in practical activities to compare the properties of acids and bases, I have demonstrated ways of measuring and adjusting pH and can describe the significance of pH in everyday life
- I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made
- Through experimentation, I can identify indicators of chemical reactions having occurred. I can describe ways of controlling the rate of reactions and can relate my findings to the world around me
- I can collect and analyse experimental data on chemical reactions that result in an obvious change in energy. I can apply my findings to explain the significance of the energy changes associated with chemical reactions
- Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rocks
- Through gaining an understanding of the structure of atoms and how they join, I can begin to connect the properties of substances with their possible structures
- Through evaluation of experimental results, I can demonstrate my understanding of conservation of mass
- I have developed my knowledge of the Periodic Table by considering the properties and uses of a variety of elements relative to their positions
- Having contributed to a variety of practical activities to make and break down compounds, I can describe examples of how the properties of compounds are different from their constituent elements

Questions

13, 17, 18, 19, 20, 22, 38, 39, 40, 41, 42, 43, 44, 45, 47

Planet Earth

Biodiversity and interdependence, energy sources and sustainability, processes of the planet, space

- I have collaborated on investigations into the process of photosynthesis and I can demonstrate my understanding of why plants are vital to sustaining life on Earth
 - I understand how animal and plant species depend on each other and how living things are adapted for survival. I can predict the impact of population growth and natural hazards on biodiversity
 - I can contribute to the design of an investigation to show the effects of different factors on the rate of aerobic respiration and explain my findings
 - Through exploring non-renewable energy sources, I can describe how they are used in Scotland today and express an informed view on the implications for their future use
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- I can use my knowledge of the different ways in which heat is transferred between hot and cold objects and the thermal conductivity of materials to improve energy efficiency in buildings or other systems
- By considering examples where energy is conserved, I can identify the energy source, how it is transferred and ways of reducing wasted energy
- I can apply my knowledge of how water changes state to help me understand the processes involved in the water cycle in nature over time
- Through exploring the carbon cycle, I can describe the processes involved in maintaining the balance of gases in the air, considering causes and implications of changes in the balance
- By observing and researching features of our solar system, I can use simple models to communicate my understanding of size, scale, time and relative motion within it
- By contributing to experiments and investigations, I can develop my understanding of models of matter and can apply this to changes of state and the energy involved as they occur in nature

Questions

1, 2, 6, 11, 12, 15, 23, 25, 26, 35, 36, 57, 59

Northern Ireland

Aspects of National Curriculum in Northern Ireland for KS2 and KS3 relevant to PTS13.

Organisms and health

Cells, genes, health, interactions and interdependencies, material cycles and energy, reproduction, respiration, structure and function of living organisms, tissues and organs

Recording evidence, presenting data, interpreting results

- Cells, genes and reproduction
- Healthy body and mind
- Interdependence of plants and animals
- Obtaining evidence

Questions

1, 2, 3, 4, 5, 30, 31, 32, 33, 34, 35, 36, 55, 56, 57, 58, 59

Forces and energy

Electricity, electromagnetism, energy transfer, forces, light, sound

Interpreting results, using mathematics

- Using electricity
- Forces and energy transfer
- Sound and light
- Presenting and interpreting results
- Develop creative and critical thinking in their approach to solving scientific problems

Questions

6, 7, 8, 9, 10, 11, 24, 25, 26, 27, 28, 29, 48

Chemical and material behaviour

Chemical changes, compounds, diffusion, elements, properties, states of matter

Planning, working safely

- Atoms and chemical changes
- Elements, compounds and mixtures
- Structures, properties, uses of materials
- Planning for investigations
- Develop a range of practical skills, including the safe use of science equipment

Questions

13, 14, 15, 16, 17, 18, 19, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47

Earth and universe

Earth and atmosphere, energy resources, the universe

- The environment and human influences
- The solar system and the universe

Questions

12, 20, 21, 22, 23

Feedback to parents and carers

A report on the individual student is available to support feedback to parents or carers. This *Individual report for parents* strips away much of the technical detail that is included in the *Group report for teachers*. A series of statements, tailored for parents, is included to explain what the results mean and how learning may be affected. Recommendations focus on how the parent or carer can work with the school to support the student at home.

In addition to the *Individual report for parents*, you may wish to provide supporting information, either orally or in writing, explaining the process and outcomes. The following list provides you with guidelines to assist with this communication.

- Stress the school's commitment to identifying and addressing the needs of each individual student in order to understand and maximise their potential.
- Explain that testing with *PTS13* is part of the school's regular assessment regime and that all students in the year group(s) have been tested.
- As part of the test, students were tested on their science knowledge and skills.
- You may wish to summarise the specific outcomes and recommendations from the test for that individual student (which are also shown on the *Individual report for parents*).
- Parents or carers should be reassured that if they have any questions or concerns or would like any further advice on how best to support their child, then they should contact the school.

A sample letter is provided (Figure 1) to support your communications with parents/carers after testing with *PTS13*.

Figure 1: Sample parent/carer feedback letter

Dear Parent or Carer,

In school, we wish to assess all our students to see what their needs are and how we can best help them learn and achieve.

As part of this process, your child has completed the *Progress Test in Science 13*, which assesses key aspects of science knowledge and skills.

A copy of the *Individual report for parents* is included*. This shows your child's results and describes what these mean in terms of the ways in which he/she will learn best and how you can support him/her at home.

[If the report is not included a relevant short extract can be included instead.]

If you have any queries or concerns please contact us.

Yours faithfully,

[School/Establishment name]

*If possible, it is helpful to parents to discuss the report with them on a suitable occasion before sending it out.