Links to national curricula Form B

PT SCIENCE 14

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 *PTS*14 have been mapped to three reporting areas:

Reporting area	Questions
Knowledge and Understanding • Recognising, recalling and showing understanding of scientific knowledge	1, 2, 3, 4, 5, 6, 8, 9, 11, 14, 15, 16, 19, 21, 23, 24, 25, 26, 32, 34, 37, 38, 40, 42, 46, 50, 54, 55, 56, 57, 58, 59
Application of Knowledge and Understanding • 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	7, 10, 12, 13, 17, 18, 20, 22, 27, 28, 29, 30, 31, 33, 35, 36, 39, 41, 43, 44, 45, 47, 48, 49, 51, 52, 53, 60
Working scientifically • Key features of scientific enquiry, so that students learn to use a variety of approaches to answer relevant scientific questions o Observing over time, pattern seeking, identifying, classifying and grouping, controlled investigations, researching using secondary sources o Collecting, analysing and presenting data	6, 13, 14, 20, 23, 25, 27, 29, 30, 36, 39, 41, 45, 49, 52, 53, 57, 59, 60

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 *PTS*14.

Biology

Genetics and evolution, interactions and interdependencies, material cycles and energy, structure and function of living organisms
Analysis and evaluation, experimental skills and investigations, scientific attitudes

- Biomechanics: the interaction between skeleton and muscles, including the measurement of force exerted by different muscles
- The structure and functions of the human skeleton, to include support, protection, movement and making blood cells
- The impact of exercise, asthma and smoking on the human gas exchange system
- The importance of bacteria in the human digestive system
- 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
- The process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration
- Heredity as the process by which genetic information is transmitted from one generation to the next
- Changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
- 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 interdependence of organisms in an ecosystem, including food webs and insect pollinated crops
- The reactants in, and products of, photosynthesis, and a word summary for photosynthesis

- Make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review

Questions

1, 2, 3, 4, 5, 18, 19, 20, 21, 22, 30, 35, 36, 37, 38, 49, 50, 51

Chemistry

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

Measuring, analogies and evaluation, experimental skills and investigations

- Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature
- The Periodic Table: periods and groups; metals and non-metals
- The varying physical and chemical properties of different elements
- Earth as a source of limited resources and the efficacy of recycling
- Differences between atoms, elements and compounds
- The carbon cycle
- The use of carbon in obtaining metals from metal oxides
- The structure of the Earth
- Changes of state in terms of the particle model
- Diffusion in terms of the particle model
- Simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography
- Changes of state in terms of the particle model.
- Exothermic and endothermic chemical reactions (qualitative)
- What catalysts do
- Reactions of acids with alkalis to produce a salt plus water
- 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
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions"

Questions

6, 7, 8, 9, 10, 11, 24, 25, 27, 28, 39, 40, 41, 42, 52, 53

Physics

Motion and forces, electricity and electromagnetism, energy, matter, space physics, waves

Experiential skills and investigations, scientific attitudes, analysis and evaluation

- Using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces
- The differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density, the anomaly of ice-water transition
- Pressure in liquids, increasing with depth; upthrust effects, floating and sinking
- 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
- Fuels and energy resources
- Separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects
- Potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current
- The magnetic effect of a current, electromagnets, D.C. motors (principles only)
- Gravity force, weight = mass x gravitational field strength (g), on Earth g = 10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only)
- The seasons and the Earth's tilt, day length at different times of year, in different hemispheres
- Colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection.
- The light year as a unit of astronomical distance.
- 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
- Apply mathematical concepts and calculate results
- Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety

- Pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate

Questions

12, 13, 14, 15, 16, 17, 26, 31, 32, 33, 34, 43, 44, 45, 46, 47, 54, 55, 56, 57, 58

Wales

Aspects of the National Curriculum in Wales for KS2 and KS3 relevant to *PTS*14.

How things work

Energy, energy resources, energy transfers, forces, electricity, Earth and space, variables, light

Collecting reliable data, equipment and techniques, 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 forces in devices and their relationship to work done and power
- The daily and annual movements of the earth and their effect on day and year length
- The equipment and techniques required for the enquiry
- The number of observations or measurements that need to be made and their range and values to ensure reliability of evidence
- Work quantitatively, using appropriate mathematical conventions and using S.I. units appropriate to their work, e.g. Kg, s, n, m, j, w
- When carrying out a fair test, control variables appropriately and identify any variables that cannot be readily controlled

Questions

9, 12, 13, 14, 16, 17, 31, 32, 33, 34, 43, 45, 47, 56, 57, 58, 59

Interdependence of organisms

Drugs, structure and function of living organisms, respiration, inheritance, interdependence, food webs, environmental factors, material cycles

Analysis, evaluation, the nature of science

- 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 beneficial and detrimental effects of some drugs on the organs of the human body and other consequences of their use, e.g. Insulin, steroids, paracetamol, caffeine
- How and why food webs are affected by environmental factors, e.g. light intensity, water availability, temperature, and their fluctuations
- The basic structure and function of some cells, tissues, organs and organ systems and how they support vital life processes

- Identify, describe and explain trends, patterns and relationships
- Justifying any improvements made to the planned approach/method

Questions

1, 2, 3, 4, 5, 18, 19, 20, 21, 22, 35, 36, 37, 38, 49, 50, 51

The sustainable Earth

Chemical reactions, compounds and mixtures, elements, energetics, hazards, material cycles, particle model, structure of the Earth, the Periodic Table, units, separating techniques

Analysis, concluding, measuring

- 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 interdependence of organisms and their representation as food webs, pyramids of numbers and simple energy-flow diagrams
- The number of observations or measurements that need to be made and their range and values to ensure reliability of evidence
- Use scientific prior knowledge to explain links between cause and effect when concluding
- Identify, describe and explain trends, patterns and relationships
- Any potential hazards in their work

Questions

6, 7, 8, 10, 11, 15, 24, 25, 26, 27, 28, 39, 40, 41, 42, 52, 53, 54, 55

Other

Light, Earth and space

Evaluation, concluding, drawing graphs, collecting reliable data

- Justifying any improvements made to the planned approach/method
- Use scientific prior knowledge to explain links between cause and effect when concluding
- Communicate logically by speech, writing, drawings, diagrams, charts, tables, bar charts, line graphs, videos and ICT packages using a wide range of scientific vocabulary, terms, symbols and conventions
- The number of observations or measurements that need to be made and their range and values to ensure reliability of evidence

Questions

23, 44, 46, 48, 60

Scotland

Aspects of Curriculum for Excellence: Sciences experiences and outcomes for Second, Third and Fourth levels relevant to *PTS*14.

Biological systems

Body systems and cells, inheritance

- By investigating some body systems and potential problems which they may develop, I can make informed decisions to help me to maintain my health and wellbeing
- 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
- I can use my understanding of how characteristics are inherited to solve simple genetic problems and relate this to my understanding of DNA, genes and chromosomes
- Through evaluation of a range of data, I can compare sexual and asexual reproduction and explain their importance for survival of species

Questions

1, 2, 3, 4, 5, 18, 19, 38, 49

Forces, electricity and waves

Electricity, forces, vibrations and waves

Evaluating, analysis

- Through investigation, I understand the relationship between current, voltage and resistance. I can apply this knowledge to solve practical problems
- By contributing to investigations of energy loss due to friction, I can suggest ways of improving the efficiency of moving systems
- I have collaborated in investigations to compare magnetic, electrostatic and gravitational forces and have explored their practical applications
- 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 have collaborated in investigations into the effects of gravity on objects and I can predict what might happen to their weight in different situations on Earth and in space
- 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
12, 14, 16, 33, 34, 44, 47, 56, 57, 58

Materials

Chemical changes, Earth's materials, units, processes of the planet, properties and uses of substances
Analysis, experimental skills and investigations

- 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 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
- 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
- Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rocks
- I can participate in practical activities to extract useful substances from natural resources
- 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
- I have developed my knowledge of the Periodic Table by considering the properties and uses of a variety of elements relative to their positions
- I can differentiate between pure substances and mixtures in common use and can select appropriate physical methods for separating mixtures into their components

Questions
6, 7, 8, 9, 10, 25, 27, 28, 39, 40, 41, 42, 53, 54, 55, 59

Planet Earth

Biodiversity and interdependence, energy sources and sustainability, variables, processes of the planet, space
Analysis, experimental skills and investigations, predicting, recording, taking measurements

- 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 use my knowledge of the interactions and energy flow between plants and animals in ecosystems, food chains and webs. I have contributed to the design or conservation of a wildlife area

- 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 can sample and identify living things from different habitats to compare their biodiversity and can suggest reasons for their distribution
- By considering examples where energy is conserved, I can identify the energy source, how it is transferred and ways of reducing wasted energy
- 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
- 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
- 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 researching developments used to observe or explore space, I can illustrate how our knowledge of the universe has evolved over time
- 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

Questions

11, 13, 15, 17, 20, 21, 22, 26, 31, 32, 35, 36, 37, 43, 45, 46, 50, 51, 52, 54, 55

Topical science

Topical science, scientific attitudes

- I have collaborated with others to find and present information on how scientists from Scotland and beyond have contributed to innovative research and development

Questions

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Northern Ireland

Aspects of National Curriculum in Northern Ireland for KS1, KS2 and KS3 relevant to *PTS*14.

Chemical and material behaviour

Chemical changes, chemical reactions, Earth and atmosphere, energetics, materials, mixtures, states of matter, the Periodic Table, units

Working safely, interpreting results, recording

- Atoms and chemical changes
- The environment and human influences
- Presenting and interpreting results
- Structure, properties, uses of materials
- Elements, compounds and mixtures
- Obtaining evidence
- Develop a range of practical skills, including the safe use of science equipment

Questions

6, 7, 8, 9, 10, 11, 24, 25, 27, 28, 39, 40, 41, 42, 52, 53

Earth and universe

The solar system, the universe

Questions

46

Forces and energy

Electricity and electromagnetism, energy, forces, light, variables, states of matter

Collecting reliable data, taking measurements, interpreting results

- Forces and energy transfer
- Using electricity
- Sound and light
- Atoms and chemical changes
- Planning for investigations
- Obtaining evidence
- Presenting and interpreting results

Questions

12, 13, 14, 15, 16, 17, 26, 31, 32, 33, 34, 44, 45, 47, 54, 55, 56, 57, 58

Organisms and health

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

Planning, the nature of science, interpreting results

- Cells, genes and reproduction
- Healthy body and mind
- Interdependence of plants and animals
- Presenting and interpreting results
- Planning for investigations

Questions

1, 2, 3, 4, 5, 18, 19, 20, 21, 22, 30, 35, 36, 37, 38, 49, 50, 51

Place

Our place in the universe

Questions

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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 *PTS*14 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 *PTS*14.

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* 14, 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.