



CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R074, R075, R076, R077, R078

A comprehensive 117 page overview of how the following qualifications match to the Learning Outcomes for Cambridge National in Science in the Workplace showing opportunities for holistic teaching.

21st Century Biology A 2012 J243

21st Century Chemistry A 2012 J244

21st Century Physics A 2012 J245

Gateway Biology B 2012 J263

Gateway Chemistry B 2012 J264

Gateway Physics B 2012 J265

GCSE Mathematics B J567 Foundation Bronze

GCSE Mathematics B J567 Foundation Gold

GCSE Mathematics B J567 Foundation Initial

GCSE Mathematics B J567 Foundation Silver

GCSE Mathematics B J567 Higher Silver

Cambridge National ICT Level 1/2 J800/J810/J820

The suggested matches in this document are not definitive. They are examples of where Maths, Science and ICT can be applied in Cambridge National in Science.

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CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

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CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

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R078 The science of production

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R074 Foundation Initial
R074 Foundation Bronze

Mapping GCSE Maths B J567 to R074 – How scientists use analytical techniques to collect data

| | Keywords | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|-----|--|-------------------------------------|---|---|---|
| LO1 | Principles of good lab practice Measuring, collecting data, sampling, repeatability and reproducibility, interpret data, report on data, evaluate and validate results | Number skills Measuring data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes – relates to mass) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes - mass) | Use number skills to analyse scientific data. Measure scientific quantities (eg mass of chemicals, volumes) |
| LO2 | Separate and identify substances in mixture Quantitative analysis – area under peaks | Graph plotting Areas | FIA4-5 Algebra (graphs) FIG5 Geometry and measures (areas) | FBA5 Algebra (graphs) FBS8 (graphs) FBG6 Geometry and measures (areas) | Use and plot graphs representing scientific data Calculate area under graphs representing scientific data |
| LO3 | Examine and record features of samples Calculating magnification and scale | Magnification and scale factor | | FBG8 Geometry and measures (scale factor) | Calculate magnification and scale in relation to features of samples |
| LO4 | Identify cations and anions in sample | | | | |
| LO5 | Determine concentration of acid or base Choice of measuring equipment, Calculation of concentration | Measuring data | FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes – relates to mass) | FBG4 Geometry and measures (volumes - mass) | Measure scientific quantities (eg mass of chemicals, volumes) Using number skills to calculate concentration |
| LO6 | Determine concentration of coloured substances Visual comparison. Plot and use calibrated curves | Number skills Graph plotting | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIA4-5 Algebra (graphs) | FBN1-9 Number (basic maths) FBA5 Algebra (graphs) FBS8 (graphs) | Use number skills to analyse scientific data. Use and plot graphs representing scientific data |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R074 Foundation Silver
R074 Foundation Gold

Mapping GCSE Maths B J567 to R074 – How scientists use analytical techniques to collect data

| | Keywords | Theme | Foundation Silver | Foundation Gold | Theme comments |
|-----|--|---------------------------------|--|---|---|
| LO1 | Principles of good lab practice Measuring, collecting data, sampling, repeatability and reproducibility, interpret data, report on data, evaluate and validate results | Number skills Measuring data | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) | Use number skills to analyse scientific data. Measure scientific quantities (eg mass of chemicals, volumes) |
| LO2 | Separate and identify substances in mixture Quantitative analysis – area under peaks | Graph plotting | FSA4 Algebra (linear tables and graphs) | FGA4-6 Algebra (plot and use linear/non-linear graphs) | Use and plot linear and non-linear graphs representing scientific data Determine areas under peaks |
| LO3 | Examine and record features of samples Calculating magnification and scale | Magnification and scale factor | FSN5 Number (ratio and proportion) | FGG7 Geometry and measures (scale factor) | Calculate magnification, scale, ratio and proportion in relation to features of samples |
| LO4 | Identify cations and anions in sample | | | | |
| LO5 | Determine concentration of acid or base Choice of measuring equipment | Measuring data | | FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) | Measure scientific quantities (eg mass of chemicals, volumes) |
| LO6 | Determine concentration of coloured substances Visual comparison. Plot and use calibrated curves | Number skills Graph plotting | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) FGA4-6 Algebra (plot and use linear/non-linear graphs) | Use number skills to analyse scientific data. Use and plot linear and non-linear graphs representing scientific data |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R074 Higher Silver
R074 Higher Gold

Mapping GCSE Maths B J567 to R074 – How scientists use analytical techniques to collect data

| | Keywords | Theme | Higher Silver | Higher Gold | Theme comments |
|-----|--|---------------------------------|--|--|--|
| LO1 | Principles of good lab practice Measuring, collecting data, sampling, repeatability and reproducibility, interpret data, report on data, evaluate and validate results | Number skills | HSN1-4 Number (higher maths skills) | HGN4-5 Number (calculators, exponentials) | Use higher level number skills to analyse scientific data. |
| LO2 | Separate and identify substances in mixture Quantitative analysis – area under peaks | Graph plotting | HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGA5-6 Algebra (power and sin/cosine functions) | Use and plot complex graphs representing scientific data (eg straight line graphs) |
| LO3 | Examine and record features of samples Calculating magnification and scale | Magnification and scale factor | | HSG6 Geometry and measures (scale factor) | Calculate magnification and scale in relation to features of samples |
| LO4 | Identify cations and anions in sample | | | | |
| LO5 | Determine concentration of acid or base Choice of measuring equipment | Measuring data | FGN1-6 Number (higher maths skills) | | Using number skills to calculate concentration |
| LO6 | Determine concentration of coloured substances Visual comparison. Plot and use calibrated curves | Number skills Graph plotting | HSN1-4 Number (higher maths skills) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use and plot complex graphs representing scientific data (eg straight line graphs) |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R075 Foundation Initial
R075 Foundation Bronze

Mapping GCSE Maths B J567 to R075 – How scientific data is used

| | Keywords | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|-----|--|--|--|---|---|
| LO1 | Know/understand how scientists obtain scientific info Identify control variables. Solve problems using multiple techniques. Collecting samples [I] Calibration [I] | Number skills Variables and solving problems | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIA2-3 Algebra (simple equations) | FBN1-9 Number (basic maths) FBA2-4 Algebra (equations) | Use number skills to analyse scientific data. Use and manipulate equations representing scientific formulae |
| LO2 | Analyse and process information Calculate mean, range, % error for data. Identify outliers and unexpected values. Measure uncertainly from systematic/random errors. Qualitative techniques? Quantitative techs for Rf value – concentration, scaling images, calibration graphs | Number skills Statistical analysis Graph plotting Magnification and scale factor (graphs) Identifying outliers and unexpected values | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIN7 Number (percentages) FIS1-5 Statistics (statistical analysis) FIA4-5 Algebra (graphs) FIA4-5 Algebra (axes and coordinates/graphs) | FBN1-9 Number (basic maths) FBS1-3 Statistics (statistical analysis) FBA5 Algebra (graphs) FBS8 Statistics (graphs) FBG8 Geometry and measures (scale factor) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) | Use number skills to analyse scientific data. Perform statistical analysis on scientific data (eg percentage error) Use and plot graphs representing scientific data (eg calibration graphs) Calculate magnification and scale in relation to features of samples Understand outliers and unexpected values on scientific data and graphs |

Mapping GCSE Maths B J567 to R075 – How scientific data is used

| Keywords | | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|----------|---|---|--|--|--|
| LO3 | Evaluate information Draw conclusions from data. Repeatability/ reproducibility Comparison with other information. Use secondary data for support | | | | |
| LO4 | Communicate scientific info Maths symbols and conventions. Communicate – diagrams, flow charts, pictures, tables | Number skills Variables and solving problems Graph plotting | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIA2-3 Algebra (simple equations) FIA4-5 Algebra (graphs) | FBN1-9 Number (basic maths) FBA2-4 Algebra (equations) FBA5 Algebra (graphs) FBS8 Statistics (graphs) | Use number skills to analyse scientific data. Use and manipulate equations representing scientific formulae Use and plot graphs representing scientific data |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R075 Foundation Silver
R075 Foundation Gold

Mapping GCSE Maths B J567 to R075 – How scientific data is used

| | Keywords | Theme | Foundation Silver | Foundation Gold | Theme comments |
|-----|--|--|--|---|---|
| LO1 | Know/understand how scientists obtain scientific info Identify control variables. Solve problems using multiple techniques. Collecting samples [I] Calibration [I] | Number skills Variables and solving problems | FSN1-6 Number (maths skills) FSA1-5 Algebra (linear algebra) | FGN1-6 Number (higher maths skills) FGA1-3 Algebra (linear algebra) | Use number skills to analyse scientific data. Use and manipulate equations representing linear scientific formulae |
| LO2 | Analyse and process information Calculate mean, range, % error for data. Identify outliers and unexpected values. Measure uncertainly from systematic/random errors. Qualitative techniques? Quantitative techs for Rf value – concentration, scaling images, calibration graphs | Number skills Statistical analysis Graph plotting Magnification and scale factor (graphs) Identifying outliers and unexpected values | FSN1-6 Number (maths skills) FSS1-5 Statistics (statistical analysis – more complex [I]) FSA4 Algebra (linear tables and graphs) FSN5 Number (ratio and proportion) FSA4 Algebra (plot linear graphs from tables) FSS3 Statistics (draw and interpret graphs) | FGN1-6 Number (higher maths skills) FGS1-3 Statistics (statistical analysis – more complex [I]) FGA4-6 Algebra (plot and use linear/non-linear graphs) FGG7 Geometry and measures (scale factor) FGA5 Algebra (linear and non-linear graphs) | Use number skills to analyse scientific data. Undertake more complex statistical analysis of scientific data Use and plot linear and non-linear graphs representing scientific data Calculate magnification, scale, ratio and proportion in relation to features of samples Understand outliers and unexpected values on scientific data and graphs |

Mapping GCSE Maths B J567 to R075 – How scientific data is used

| Keywords | | Theme | Foundation Silver | Foundation Gold | Theme comments |
|------------|---|--|--|--|---|
| LO3 | Evaluate information Draw conclusions from data. Repeatability/ reproducibility Comparison with other information. Use secondary data for support | Number skills | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) | Use number skills to analyse scientific data. |
| | | Statistical analysis | FSS1-5 Statistics (statistical analysis – more complex [I]) | FGS1-3 Statistics (statistical analysis – more complex [I]) | Undertake more complex statistical analysis of scientific data |
| | | Graph plotting | FSA4 Algebra (linear tables and graphs) | FGA4-6 Algebra (plot and use linear/non-linear graphs) | Use and plot linear and non-linear graphs representing scientific data |
| | | Magnification and scale factor (graphs) | FSN5 Number (ratio and proportion) | FGG7 Geometry and measures (scale factor) | Calculate magnification, scale, ratio and proportion in relation to features of samples |
| | | Identifying outliers and unexpected values | FSA4 Algebra (plot linear graphs from tables) FSS3 Statistics (draw and interpret graphs) | FGA5 Algebra (linear and non-linear graphs) | Understand outliers and unexpected values on scientific data and graphs |
| LO4 | Communicate scientific info Maths symbols and conventions. Communicate – diagrams, flow charts, pictures, tables | Number skills | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) | Use number skills to analyse scientific data. |
| | | Variables and solving problems | FSA1-5 Algebra (linear algebra) | FGA1-3 Algebra (linear algebra) | Use and manipulate equations representing linear scientific formulae |
| | | Graph plotting | FSA4 Algebra (linear tables and graphs) | FGA4-6 Algebra (plot and use linear/non-linear graphs) | Use and plot linear and non-linear graphs representing scientific data |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R075 Higher Silver
R075 Higher Gold

Mapping GCSE Maths B J567 to R075 – How scientific data is used

| | Keywords | Theme | Higher Silver | Higher Gold | Theme comments |
|-----|--|--|---|---|--|
| LO1 | Know/understand how scientists obtain scientific info Identify control variables. Solve problems using multiple techniques. Collecting samples [I] Calibration [I] | Number skills Variables and solving problems | HSN1-4 Number (higher maths skills) HSA1-4 Algebra (solver harder linear equations) | HGN4-5 Number (calculators, exponentials) HGA1-4 Algebra (harder quadratics) | Use higher level number skills to analyse scientific data. Use and manipulate more complex equations representing scientific formulae |
| LO2 | Analyse and process information Calculate mean, range, % error for data. Identify outliers and unexpected values. Measure uncertainly from systematic/random errors. Qualitative techniques? Quantitative techs for Rf value – concentration, scaling images, calibration graphs | Number skills Statistical analysis Graph plotting Magnification and scale factor (graphs) Identifying outliers and unexpected values | HSN1-4 Number (higher maths skills) HSS1-4 Statistics (higher stats) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) HSG6 Geometry and measures (scale factor) | HGN4-5 Number (calculators, exponentials) HGS1-4 Statistics (higher stats) HGA5-6 Algebra (power and sin/cosine functions) HGA5-6 (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Perform statistical analysis on scientific data (eg percentage error) Use and plot graphs representing scientific data (eg calibration graphs) Calculate magnification and scale in relation to features of samples Understand outliers and unexpected values on scientific data and graphs |

Mapping GCSE Maths B J567 to R075 – How scientific data is used

| Keywords | | Theme | Higher Silver | Higher Gold | Theme comments |
|------------|---|-----------------------------------|--|---|--|
| LO3 | Evaluate information Draw conclusions from data. Repeatability/ reproducibility Comparison with other information. Use secondary data for support | Number skills | HSN1-4 Number (higher maths skills) | HGN4-5 Number (calculators, exponentials) | Use higher level number skills to analyse scientific data. |
| | Statistical analysis | | HSS1-4 Statistics (higher stats) | HGS1-4 Statistics (higher stats) | Perform statistical analysis on scientific data (eg percentage error) |
| | Graph plotting | | HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGA5-6 Algebra (power and sin/cosine functions) | Use and plot graphs representing scientific data (eg calibration graphs) |
| | Magnification and scale factor (graphs) | | HSG6 Geometry and measures (scale factor) | | Calculate magnification and scale in relation to features of samples |
| | Identifying outliers and unexpected values | | HSA7 Algebra (straight line- $y=mx+c$) | HGA5-6 (power and sin/cosine functions) | Understand outliers and unexpected values on scientific data and graphs |
| LO4 | Communicate scientific info Maths symbols and conventions. Communicate – diagrams, flow charts, pictures, tables | Number skills | HSN1-4 Number (higher maths skills) | HGN4-5 Number (calculators, exponentials) | Use higher level number skills to analyse scientific data. |
| | | Variables and solving problems | HSA1-4 Algebra (solver harder linear equations) | HGA1-4 Algebra (harder quadratics) | Use and manipulate more complex equations representing scientific formulae |
| | | Graph plotting | HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGA5-6 Algebra (power and sin/cosine functions) | Use and plot complex graphs representing scientific data (eg straight line graphs) |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R076 Foundation Initial
R076 Foundation Bronze

Mapping GCSE Maths B J567 to R076 – Environmental science

| | Keywords | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|-----|---|--|--|--|---|
| LO1 | Understand stable ecosystems – balanced and biological environment | | | | |
| LO2 | Impact of human and nature on environment | | | | |
| LO3 | Physical conditions in environment – monitoring local and global Measuring values of - particulate level, concentration of gasses, chemicals, noise, amount of litter | Number skills Measuring data Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes – relates to mass) FIA4-5 Algebra (axes and coordinates/graphs) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes - mass) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) FBS8 Statistics (graphs) | Use number skills to analyse scientific data. Measure scientific quantities (eg particulates, concentration of gases, noise) Use and plot graphs representing scientific data |
| LO4 | Use standard processes to monitor physical factors in environment Measuring values of - temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Number skills Measuring data Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes – relates to mass) FIA4-5 Algebra (axes and coordinates/graphs) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes - mass) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) FBS8 Statistics (graphs) | Use number skills to analyse scientific data. Measure scientific quantities (eg temperature, rainfall, sunlight, UV, wind speed) Use and plot graphs representing scientific data |

Mapping GCSE Maths B J567 to R076 – Environmental science

| Keywords | | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|----------|---|--|--|--|--|
| LO5 | Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, pH, microbiological count | Number skills Measuring data Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes – relates to mass) FIA4-5 Algebra (axes and coordinates/graphs) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes - mass) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) FBS8 Statistics (graphs) | Use number skills to analyse scientific data. Measure scientific quantities (eg particulates, CO, CO ₂ , NO _x) Use and plot graphs representing scientific data |
| LO6 | Understand how environment is managed – local and global | | | | |
| LO7 | Structure of environmental organisations | | | | |
| LO8 | Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R076 Foundation Silver
R076 Foundation Gold

Mapping GCSE Maths B J567 to R076 – Environmental science

| Keywords | | Theme | Foundation Silver | Foundation Gold | Theme comments |
|----------|---|--|---|--|---|
| LO1 | Understand stable ecosystems – balanced and biological environment | | | | |
| LO2 | Impact of human and nature on environment | | | | |
| LO3 | Physical conditions in environment – monitoring local and global Measuring values of - particulate level, concentration of gasses, chemicals, noise, amount of litter | Number skills Measuring data Plotting graphs from data | FSN1-6 Number (maths skills) FSA4 Algebra (linear tables and graphs) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGA4-6 Algebra (plot and use linear/non-linear graphs) | Use number skills to analyse scientific data. Measure scientific quantities (eg particulates, concentration of gases, noise) Use and plot linear and non-linear graphs representing scientific data |
| LO4 | Use standard processes to monitor physical factors in environment Measuring values of - temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Number skills Measuring data Plotting graphs from data | FSN1-6 Number (maths skills) FSA4 Algebra (linear tables and graphs) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGA4-6 Algebra (plot and use linear/non-linear graphs) | Use number skills to analyse scientific data. Measure scientific quantities (eg temperature, rainfall, sunlight, UV, wind speed) Use and plot linear and non-linear graphs representing scientific data |

Mapping GCSE Maths B J567 to R076 – Environmental science

| Keywords | | Theme | Foundation Silver | Foundation Gold | Theme comments |
|----------|--|--|---|--|---|
| LO5 | Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NOx, nitrates, phosphates. Indirect: oxygen, pH, microbiological count | Number skills Measuring data Plotting graphs from data | FSN1-6 Number (maths skills) FSA4 Algebra (linear tables and graphs) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGA4-6 Algebra (plot and use linear/non-linear graphs) | Use number skills to analyse scientific data. Measure scientific quantities (eg particulates, CO, CO ₂ , NOX) Use and plot linear and non-linear graphs representing scientific data |
| LO6 | Understand how environment is managed – local and global | | | | |
| LO7 | Structure of environmental organisations | | | | |
| LO8 | Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R076 Higher Silver
R076 Higher Gold

Mapping GCSE Maths B J567 to R076 – Environmental science

| Keywords | | Theme | Higher Silver | Higher Gold | Theme comments |
|----------|---|--|--|--|--|
| LO1 | Understand stable ecosystems – balanced and biological environment | | | | |
| LO2 | Impact of human and nature on environment | | | | |
| LO3 | Physical conditions in environment – monitoring local and global Measuring values of - particulate level, concentration of gasses, chemicals, noise, amount of litter | Number skills Plotting graphs from data | HSN1-4 Number (higher maths skills) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use and plot complex graphs representing scientific data (eg straight line graphs) |
| LO4 | Use standard processes to monitor physical factors in environment Measuring values of - temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Number skills Plotting graphs from data | HSN1-4 Number (higher maths skills) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use and plot complex graphs representing scientific data (eg straight line graphs) |
| LO5 | Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, pH, microbiological count | Number skills Plotting graphs from data | HSN1-4 Number (higher maths skills) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use and plot complex graphs representing scientific data (eg straight line graphs) |

Mapping GCSE Maths B J567 to R076 – Environmental science

| Keywords | | Theme | Higher Silver | Higher Gold | Theme comments |
|----------|--|-------|---------------|-------------|----------------|
| LO6 | Understand how environment is managed – local and global | | | | |
| LO7 | Structure of environmental organisations | | | | |
| LO8 | Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R077 Foundation Initial
R077 Foundation Bronze

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| | Keywords | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|-----|---|--|--|--|---|
| LO1 | Understand musculoskeletal system Hinges. Levers – 1st, 2nd and 3rd order Forces to lift, pull and compress | Number skills Measuring data Algebra (levers) | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIA2-3 Algebra (simple equations) | FBN1-9 Number (basic maths) FBA2-4 Algebra (equations) | Use number skills to analyse scientific data. Measure scientific data (eg forces to lift, pull and compress) Use algebra to solve problems (eg forces and levers) |
| LO2 | Understand circulatory system Flow rates Heat transfer Measuring performance: pulse and heart rate, blood pressure, ECG | Number skills Measuring data Algebra (flow and heat transfer) Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes) FIA2-3 Algebra (simple equations) FIA4-5 Algebra (axes and coordinates/graphs) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes) FBA2-4 Algebra (equations) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) FBS8 Statistics (graphs) | Use number skills to analyse scientific data. Measure scientific data (eg heat and flow) Use algebra to solve problems (eg heat and flow in circulatory system) Plot and use graphs representing data (eg heat and flow in circulatory system) |

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| Keywords | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|--|---|--|--|--|
| LO3 Understand respiratory system Measuring performance: tidal volume, vital capacity (lung volume) | Number skills Measuring data Algebra (volume calculations) Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes) FIA2-3 Algebra (simple equations) FIA4-5 Algebra (axes and coordinates/graphs) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes) FBA2-4 Algebra (equations) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) FBS8 Statistics (graphs) | Use number skills to analyse scientific data. Measure scientific data (eg volume and lung capacity) Use algebra to solve problems (eg volume and lung capacity) Plot and use graphs representing data (eg volume and lung capacity) |
| LO4 Understand consequences of health and fitness on wellbeing | | | | |
| LO5 Create a fitness programme Determine goals and targets for: Muscle strength, speed, stamina, flexibility Measuring Planning | Number skills | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) | FBN1-9 Number (basic maths) | Use number skills to analyse scientific data when determining a fitness programme |

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| Keywords | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|--|---|---|--|---|
| LO6 Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | Number skills Measuring data Algebra (volume calculations) Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG5 Geometry and measures (volumes) FIA2-3 Algebra (simple equations) FIA4-5 Algebra (axes and coordinates/ graphs) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes) FBA2-4 Algebra (equations) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) FBS8 Statistics (graphs) | Use number skills to analyse scientific data Measure scientific data (eg volume and lung capacity, heart rate, cholesterol, glucose data) Use algebra to solve problems (eg volume and lung capacity) Plot and use graphs representing data (eg volume and lung capacity) |
| LO7 Structure of sports/health/ fitness organisations | | | | |
| LO8 Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R077 Foundation Silver
R077 Foundation Gold

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| Keywords | Theme | Foundation Silver | Foundation Gold | Theme comments |
|--|----------------------------------|--|---|--|
| LO1 Understand musculoskeletal system Hinges. Levers – 1st, 2nd and 3rd order Forces to lift, pull and compress | Number skills | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) | Use number skills to analyse scientific data. |
| | Measuring data | | FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) | Measure scientific data (eg forces to lift, pull and compress) |
| | Algebra (levers) | FSA1-5 Algebra (linear algebra) | FGA1-3 Algebra (linear algebra) | Use linear algebra to solve problems (eg forces and levers) |
| LO2 Understand circulatory system Flow rates Heat transfer Measuring performance: pulse and heart rate, blood pressure, ECG | Number skills | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) | Use number skills to analyse scientific data. |
| | Measuring data | | FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGG5 Geometry and measures (volumes - mass) | Measure scientific data (eg heat and flow) |
| | Algebra (flow and heat transfer) | FSA1-5 Algebra (linear algebra) | FGA1-3 Algebra (linear algebra) | Use linear algebra to solve problems (eg heat and flow in circulatory system) |
| | Plotting graphs from data | FSA4 Algebra (linear tables and graphs) | FGA4-6 Algebra (plot and use linear/non-linear graphs) | Plot and use linear graphs/tables representing data (eg heat and flow in circulatory system) |

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| Keywords | | Theme | Foundation Silver | Foundation Gold | Theme comments |
|------------|--|-------------------------------------|--|---|--|
| LO3 | Understand respiratory system Measuring performance: tidal volume, vital capacity (lung volume) | Number skills Measuring data | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGG5 Geometry and measures (volumes - mass) | Use number skills to analyse scientific data. Measure scientific data (eg volume and lung capacity) |
| | | Algebra (volume calculations) | FSA1-5 Algebra (linear algebra) | FGA1-3 Algebra (linear algebra) | Use linear algebra to solve problems (eg volume and lung capacity) |
| | | Plotting graphs from data | FSA4 Algebra (linear tables and graphs) | FGA4-6 Algebra (plot and use linear/non-linear graphs) | Plot and use linear graphs/tables representing data (eg volume and lung capacity) |
| LO4 | Understand consequences of health and fitness on wellbeing | | | | |
| LO5 | Create a fitness programme Determine goals and targets for: Muscle strength, speed, stamina, flexibility Measuring Planning | Number skills | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) | Use number skills to analyse scientific data when determining a fitness programme |

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| Keywords | Theme | Foundation Silver | Foundation Gold | Theme comments |
|--|--|---|---|---|
| LO6 Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | Number skills Measuring data Algebra (volume calculations) Plotting graphs from data | FSN1-6 Number (maths skills) FSA1-5 Algebra (linear algebra) FSA4 Algebra (linear tables and graphs) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGG5 Geometry and measures (volumes - mass) FGA1-3 Algebra (linear algebra) FGA4-6 Algebra (plot and use linear/ non-linear graphs) | Use number skills to analyse scientific data Measure scientific data (eg volume and lung capacity, heart rate, cholesterol, glucose data) Use linear algebra to solve problems (eg volume and lung capacity) Plot and use linear graphs/tables representing data (eg volume and lung capacity) |
| LO7 Structure of sports/health/ fitness organisations | | | | |
| LO8 Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R077 Higher Silver
R077 Higher Gold

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| | Keywords | Theme | Higher Silver | Higher Gold | Theme comments |
|-----|---|---|--|---|---|
| LO1 | Understand musculoskeletal system Hinges. Levers – 1st, 2nd and 3rd order Forces to lift, pull and compress | Number skills Variables and solving problems (levers) Graph plotting | HSN1-4 Number (higher maths skills) HSA1-4 Algebra (solver harder linear equations) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA1-4 Algebra (harder quadratics) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use algebra to solve more complex problems (eg forces and levers) Use and plot complex graphs representing scientific data (eg straight line graphs) |
| LO2 | Understand circulatory system Flow rates Heat transfer Measuring performance: pulse and heart rate, blood pressure, ECG | Number skills Variables and solving problems (flow and transfer) Graph plotting | HSN1-4 Number (higher maths skills) HSA1-4 Algebra (solver harder linear equations) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA1-4 Algebra (harder quadratics) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use algebra to solve more complex problems (eg heat and flow in circulatory system) Plot and use graphs representing data (eg heat and flow in circulatory system) |
| LO3 | Understand respiratory system Measuring performance: tidal volume, vital capacity (lung volume) | Number skills Variables and solving problems (volumes) Graph plotting | HSN1-4 Number (higher maths skills) HSA1-4 Algebra (solve harder linear equations) HSG7 Geometry and measures (volumes) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA1-4 Algebra (harder quadratics) HGG4 Geometry and measures (volumes – complex shapes) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use algebra to solve more complex problems (eg volume and lung capacity) Plot and use graphs representing data (eg volume and lung capacity) |

Mapping GCSE Maths B J567 to R077 – The science of fitness and health

| Keywords | | Theme | Higher Silver | Higher Gold | Theme comments |
|----------|---|---|---|---|---|
| LO4 | Understand consequences of health and fitness on wellbeing | | | | |
| LO5 | Create a fitness programme Determine goals and targets for: Muscle strength, speed, stamina, flexibility Measuring Planning | Number skills | | | |
| LO6 | Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | Number skills Variables and solving problems (volumes) Graph plotting | HSN1-4 Number (higher maths skills) HSA1-4 Algebra (solver harder linear equations) HSG7 Geometry and measures (volumes) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA1-4 Algebra (harder quadratics) HGG4 Geometry and measures (volumes – complex shapes) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use algebra to solve more complex problems (eg volume and lung capacity) Plot and use graphs representing data (eg volume and lung capacity) |
| LO7 | Structure of sports/health/fitness organisations | | | | |
| LO8 | Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R078 Foundation Initial
R078 Foundation Bronze

Mapping GCSE Maths B J567 to R078 – The science of production

| Keywords | | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|----------|---|---|--|--|--|
| LO1 | Understand bulk production of chemicals | | | | |
| LO2 | Be able to produce a bulk chemical Measure volumes Yield by mass, theoretical yield, percentage yield. Evaluate percentage yield obtained | Number skills Measuring data Percentages and yield Algebra (volume and mass calculations) Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG4 Geometry and measures (diameter) FIG5 Geometry and measures (volume sand mass) FIN7 Number (percentages) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes and mass) FBN6 Number (percentages) | Use number skills to analyse scientific data Measure scientific data (eg volume and mass of chemicals) Determine percentage yield of chemical reactions Use algebra to solve problems (eg volume and mass of chemical yield) Plot and use graphs representing data (eg percentage yield) |
| LO3 | Understand factors that affect growth of plants (commercial) | | | | |

Mapping GCSE Maths B J567 to R078 – The science of fitness and health

| Keywords | | Theme | Foundation Initial | Foundation Bronze | Theme comments |
|----------|--|---|--|--|---|
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Number skills Measuring data Algebra (height/diameter/mass calculations) Plotting graphs from data | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) FIG1-2 Geometry and measures (measuring data) FIG4 Geometry and measures (diameter) FIG5 Geometry and measures (volumes) FIA2-3 Algebra (simple equations) FIA4-5 Algebra (axes and coordinates/graphs) | FBN1-9 Number (basic maths) FBG4 Geometry and measures (volumes) FBA2-4 Algebra (equations) FBA5 Algebra (graphs) FBS4 Statistics (real data graphs + misleading diagrams) FBS8 Statistics (graphs) | Use number skills to analyse scientific data Measure scientific data (eg stem height, stem diameter, fresh and dry mass) Use algebra to solve problems (relationship between height, diameter and wet mass) Plot and use graphs representing data (eg plant growth data) |
| LO5 | Understand how products are made from micro-organisms Units of temperature, oxygen, pH, food quantity [I] | Number skills | FIN1-12 Number (basic maths) FIA1-3 Algebra (algebra) | FBN1-9 Number (basic maths) | Use number skills to analyse scientific data |
| LO6 | Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R078 Foundation Silver
R078 Foundation Gold

Mapping GCSE Maths B J567 to R078 – The science of production

| Keywords | | Theme | Foundation Silver | Foundation Gold | Theme comments |
|----------|---|---|---|---|---|
| LO1 | Understand bulk production of chemicals | | | | |
| LO2 | Be able to produce a bulk chemical Measure volumes Yield by mass, theoretical yield, percentage yield. Evaluate percentage yield obtained | Number skills Measuring data Percentages and yield Algebra (volume and mass calculations) Plotting graphs from data | FSN1-6 Number (maths skills) FSN3 Number (percentages) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGG5 Geometry and measures (volumes - mass) FGN4 Number (percentages) | Use number skills to analyse scientific data Measure scientific data (eg volume and mass of chemicals) Determine percentage yield of chemical reactions |
| LO3 | Understand factors that affect growth of plants (commercial) | | | FSA1-5 Algebra (linear algebra) FSA4 Algebra (linear tables and graphs) | FGA1-3 Algebra (linear algebra) FGA4-6 Algebra (plot and use linear/non-linear graphs) |

Mapping GCSE Maths B J567 to R078 – The science of fitness and health

| Keywords | Theme | Foundation Silver | Foundation Gold | Theme comments |
|---|---|--|---|---|
| LO4 Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Number skills Measuring data | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) FGG1 Geometry and measures (measuring data) FGG2 Geometry and measures (rates and compound measures) FGG5 Geometry and measures (volumes - mass) | Use number skills to analyse scientific data Measure scientific data (eg stem height, stem diameter, fresh and dry mass) |
| | Algebra (height/diameter/mass calculations) | FSA1-5 Algebra (linear algebra) | FGA1-3 Algebra (linear algebra) | Use linear algebra to solve problems (relationship between height, diameter and wet mass) |
| | Plotting graphs from data | FSA4 Algebra (linear tables and graphs) | FGA4-6 Algebra (plot and use linear/non-linear graphs) | Plot and use linear graphs/tables representing data (eg plant growth data) |
| LO5 Understand how products are made from micro-organisms Units of temperature, oxygen, pH, food quantity [I] | Number skills | FSN1-6 Number (maths skills) | FGN1-6 Number (higher maths skills) | Use number skills to analyse scientific data |
| LO6 Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

R078 Higher Silver
R078 Higher Gold

Mapping GCSE Maths B J567 to R078 – The science of production

| Keywords | | Theme | Higher Silver | Higher Gold | Theme comments |
|----------|--|---|---|---|---|
| LO1 | Understand bulk production of chemicals | | | | |
| LO2 | Be able to produce a bulk chemical Measure volumes Yield by mass, theoretical yield, percentage yield. Evaluate percentage yield obtained | Number skills Variables and solving problems (volumes, mass, percentage yield) Graph plotting | HSN1-4 Number (higher maths skills) HSA1-4 Algebra (solver harder linear equations) HSG7 Geometry and measures (volumes) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA1-4 Algebra (harder quadratics) HGG4 Geometry and measures (volumes – complex shapes) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use algebra to solve more complex problems (eg volume and mass of chemical yield) Plot and use graphs representing data (eg percentage yield) |
| LO3 | Understand factors that affect growth of plants (commercial) | | | | |
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Number skills Variables and solving problems (volumes, mass, percentage yield) Graph plotting | HSN1-4 Number (higher maths skills) HSA1-4 Algebra (solver harder linear equations) HSG7 Geometry and measures (volumes) HSA5 Algebra (quadratics and cubics) HSA7 (straight line - $y=mx+c$) | HGN4-5 Number (calculators, exponentials) HGA1-4 Algebra (harder quadratics) HGG4 Geometry and measures (volumes – complex shapes) HGA5-6 Algebra (power and sin/cosine functions) | Use higher level number skills to analyse scientific data. Use algebra to solve more complex problems (relationship between height, diameter and wet mass) Plot and use graphs representing data (eg plant growth data) |

Mapping GCSE Maths B J567 to R078 – The science of fitness and health

| Keywords | | Theme | Higher Silver | Higher Gold | Theme comments |
|----------|---|---------------|--|--|--|
| LO5 | Understand how products are made from micro-organisms Units of temperature, oxygen, pH, food quantity [I] | Number skills | HSN1-4 Number (higher maths skills) | HGN4-5 Number (calculators, exponentials) | Use higher level number skills to analyse scientific data. |
| LO6 | Research career opportunities | | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Biology J243

R074 How scientists use analytical techniques to collect data

R075 How scientific data is used

R076 Environmental science

R077 The science of fitness and health

R078 The science of production

Gateway Biology J263

R074 How scientists use analytical techniques to collect data

R075 How scientific data is used

R076 Environmental science

R077 The science of fitness and health

R078 The science of production

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Biology

Mapping 21st Century Biology A J243 to R074 – How scientists use analytical techniques to collect data

| | Keywords | Theme | 21st Century Biology | Theme comments |
|-----|---|-------|----------------------|----------------|
| LO1 | Principles of good lab practice | | | |
| LO2 | Separate and identify substances in mixture Chromatography, stationary and mobile phases, Rf values, electrophoresis, gas chromatography, mass spectrometer | | | |
| LO3 | Examine and record features of samples Visual observation, light microscope. Electron microscope, X-ray analysis, ultrasound | | | |
| LO4 | Identify cations and anions in sample Flame test – barium, calcium, copper, lithium, potassium, sodium. Chemical test (cations) – aluminium, copper, iron, lead. Chemical test (anions) – carbonate, chloride, sulphate. Ion chromatography, atomic emission spectrometry. | | | |
| LO5 | Determine concentration of acid or base Indicators – for acids and bases – bromothymol, methyl orange, phenolphthalein pH meter auto-titration | | | |
| LO6 | Determine concentration of coloured substances Visual comparison, colorimetry, calibration curves. Wavelength - spectrophotometer | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Biology

Mapping 21st Century Biology A J243 to R075 – How scientific data is used

| Keywords | Theme | 21st Century Biology | Theme comments |
|--|-------|----------------------|----------------|
| LO1 Know/understand how scientists obtain scientific info Use/limitations of scientific equipment. Equipment advantages/disadvantages. Collecting samples. Calibration of equipment. | | | |
| LO2 Analyse and process information | | | |
| LO3 Evaluate information | | | |
| LO4 Communicate scientific info | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Biology

Mapping 21st Century Biology A J243 to R076 – Environmental science

| Keywords | Theme | 21st Century Biology | Theme comments |
|--|--|--|--|
| LO1 Understand stable ecosystems – balanced and biological environment Ecosystem – living organisms and physical environment. Abiotic and biotic components – carbon, nitrogen, water | Ecosystems, stability and effects of pollution [D] | B3.1 Systems in balance – how do different species depend on each other? B3.2 How has life on Earth evolved? B3.3 What is the importance of biodiversity? B7.4 What can we learn from natural ecosystems? | Understand how climate and environmental changes can be measured using indicators (eg nitrate level, temperature, CO ₂ and by changes in living organisms) Understand how living organisms are dependent on the environment and each other for survival. Understand how energy from the Sun flows through ecosystems and how humans and plants can harness it (eg photosynthesis). Understand how carbon is recycled through the environment (eg combustion, respiration, photosynthesis and decomposition). Understand how biodiversity relates to the variety of life on Earth. Understand the ecosystem as a closed loop system. Understand the stability of ecosystems. |
| LO2 Impact of human and nature on environment Human events – agriculture, land use, industrial/domestic emissions, new species, GM organisms Nature – volcano, earthquake, flood, erosion, tsunami Consequences – biodiversity, climate change, sea level, drought, floods, safety, annoyance, unusable land | Genetic modification [D] | B7.5 New technologies B3.3 What is the importance of biodiversity? | Recall examples of genetic modification such as in bacterial synthesis of medications and in resistant crop plants. |

Mapping 21st Century Biology A J243 to R076 – Environmental science

| Keywords | Theme | 21st Century Biology | Theme comments |
|---|---|---|---|
| LO3 Physical conditions in environment – monitoring local and global Global picture - Satellite imaging, weather balloons, seismic sensors, marine sonar Local monitoring – particulate level, concentration of gasses, chemicals, noise, amount of litter | Measuring climate and environmental changes [D] | B3.1 Systems in balance – how do different species depend on each other? | Understand how climate and environmental changes can be measured using indicators (eg nitrate level, temperature, CO ₂ and by changes in living organisms) |
| LO4 Use standard processes to monitor physical factors in environment Temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Measuring climate and environmental changes [I] | B3.1 Systems in balance – how do different species depend on each other? | Understand how climate and environmental changes can be measured using indicators (eg nitrate level, temperature, CO ₂ and by changes in living organisms) |
| LO5 Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, pH, microbiological count | Measuring climate and environmental changes [D] | B3.1 Systems in balance – how do different species depend on each other? | Understand how climate and environmental changes can be measured using indicators (eg nitrate level, temperature, CO ₂ and by changes in living organisms) |
| LO6 Understand how environment is managed – local and global Conservation of natural resources, habitat protection, control of hazards, control of emission ads waste. Industry regulated | | | |
| LO7 Structure of environmental organisations | | | |
| LO8 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Biology

Mapping 21st Century Biology A J243 to R077 – The science of fitness and health

| Keywords | Theme | 21st Century Biology | Theme comments |
|--|----------------------------|--|---|
| LO1 Understand musculoskeletal system Skull, vertebral column, humerus, radius/ulna, pelvis, femur, tibia/fibula Muscles, tendons Function: supporting, protecting, moving, making blood cells Joints: Hinge, ball and socket, pivot, glide, fixed Antagonistic muscles: biceps/triceps – forces to lift, pull, compress Levers: first order, second order, third order | Skeletons and joints [D] | B7.1 Peak performance – movement and exercise | Understand function of the skeleton. Recall the structure and function of body joints (eg cartilage, ligaments and tendons) |
| LO2 Understand circulatory system Heart, blood vessels, blood Function: transport of oxygen, defence, heat transfer Performance: pulse and heart rate, blood pressure, ECG | The circulatory system [D] | B2.3 What factors increase the risk of heart disease? B7.2 Peak performance – circulation | Understand the factors that affect heart disease, including the beneficial effects of good lifestyle, good diet and exercise. Understand the function and operation of the circulatory system. |
| LO3 Understand respiratory system Nose, mouth, throat Trachea, bronchi, bronchioles, alveoli Gas exchange: alveoli, capillaries, blood cells Performance: tidal volume, vital capacity (lung volume) | | | |

Mapping 21st Century Biology A J243 to R077 – The science of fitness and health

| Keywords | Theme | 21st Century Biology | Theme comments |
|--|---|---|---|
| LO4 Understand consequences of health and fitness on wellbeing Diet, weight, exercise Unhealthy: smoking, drugs, over/under exercise, under/over eating, unbalanced diet Risks: High BP, high cholesterol, coronary heart disease, stroke Resps: reduced lung capacity, emphysema, type 2 diabetes, arthritis | Genetics and infections [I] Peak performance [D] | B1.1 What are genes and how do they affect the way that organisms develop? B2.1 How do our bodies resist infection? B2.3 What factors increase the risk of heart disease? B7.3 Peak performance – energy balance | Understand how genetics affect characteristics such as weight. Understand how our bodies can resist infection. Understand that lifestyle factors that can increase the risk of heart disease include a poor diet Understand that regular moderate exercise reduces the risk of developing heart disease Understand the effects of blood sugar levels including diabetes. Interpret data on the risks associated with an unhealthy lifestyle. |
| LO5 Create a fitness programme Muscle strength, speed, stamina, flexibility How long and hard: age, gender, health, fitness, skill Warmup Spacing out | Medical history, lifestyle and exercise [D] | B7.1 Peak performance – movement and exercise | Explain how medical history or lifestyle affects exercise regime. Recall common injuries that can be caused by excessive exercise. |
| LO6 Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | Medical history, lifestyle and exercise [D] | B7.1 Peak performance – movement and exercise | Explain how medical history or lifestyle affects exercise regime. Understand body mass index (BMI) |
| LO7 Structure of sports/health/fitness organisations | | | |
| LO8 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Biology

Mapping 21st Century Biology A J243 to R078 – The science of production

| | Keywords | Theme | 21st Century Biology | Theme comments |
|-----|---|---|---|--|
| LO1 | Understand bulk production of chemicals Bulk production of chemicals – ammonia sulphate (fertiliser), sodium hydroxide (soap) Neutralisation reactions: salt + acid = > salt + water | | | |
| LO2 | Be able to produce a bulk chemical Indicators to determine neutralisation Yield – from mass of reactants | | | |
| LO3 | Understand factors that affect growth of plants (commercial) Plant growth factors: temp, water supply, minerals, light, CO ₂ , pests Maximising growth: increased light, fertilisers, pesticides Plant variety selection: quality, yield, hardiness, resistance to disease Genetic improvements | Cloning [D] Plants and ecosystems [I] Photosynthesis [D] How plants grow and develop [D] Genetics [I] | B1.4 How is a clone made? B3.1 Systems in balance – how do different species depend on each other? B3.2 How has life on Earth evolved? B4.1 How do chemical reactions take place in living things? B4.2 How do plants make food? B5.1 How do organisms develop? B5.2 How does an organism produce new cells? B5.3 How do genes control growth and development within the cell? B7.5 New technologies | Understand how plants can reproduce asexually to form clones. Understand how living organisms are dependent on the environment and each other for survival. Understand how energy from the Sun flows through ecosystems and how humans and plants can harness it (eg photosynthesis). Understand how carbon is recycled through the environment (eg combustion, respiration, photosynthesis and decomposition). Understand how life on Earth has evolved including the process of natural selection. Understand how chemical reactions take place in living things (eg photosynthesis in plants) Understand the processes by which plants make food including how this affects growth. Understand growth and development factors for plants (including meristems for cloning and environmental effects such as phototropism). Understand the main processes of the cell cycle. Recall that the genetic code is in the cell nucleus of a plant. Recall examples of genetic modification such as in bacterial synthesis of medications and in resistant crop plants. |

Mapping 21st Century Biology A J243 to R078 – The science of production

| Keywords | | Theme | 21st Century Biology | Theme comments |
|----------|--|--|--|--|
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Photosynthesis [D] | B4.2 How do plants make food? | Describe techniques used to measure the effects of light on plants. |
| LO5 | Understand how products are made from micro-organisms Micro-organisms from waste/other processes: ethanol and CO ₂ by anaerobic respiration of yeast, lactic acid, antibiotics from fermentation. Production requires: food source, oxygen, temp, pH Products: bread, beer, yoghurt, antibiotics, lactic acid, ethanol Mycoprotein | Harmful micro-organisms [I] Pollutants and micro-organisms [I] Micro-organisms, enzymes and products [D] | B2.2 What are vaccines and antibiotics and how do they work? B3.1 Systems in balance – how do different species depend on each other? B4.3 How do living organisms obtain energy? B7.5 New technologies | Understand how vaccines and antibiotics work against micro-organisms. Understand how carbon is recycled through the environment (eg combustion, respiration, photosynthesis and decomposition). Describe anaerobic respiration in micro-organisms including biogas and fermentation in food production (eg bread and alcohol making) Understand how bacteria and fungi are used in the production of antibiotics and in enzymes (eg for food processing, making washing powder and biofuels). |
| LO6 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Biology

Mapping Gateway Biology B J263 to R074 – How scientists use analytical techniques to collect data

| | Keywords | Theme | Gateway Biology | Theme comments |
|-----|---|-------|-----------------|----------------|
| LO1 | Principles of good lab practice | | | |
| LO2 | Separate and identify substances in mixture Chromatography, stationary and mobile phases, Rf values, electrophoresis, gas chromatography, mass spectrometer | | | |
| LO3 | Examine and record features of samples Visual observation, light microscope. Electron microscope, X-ray analysis, ultrasound | | | |
| LO4 | Identify cations and anions in sample Flame test – barium, calcium, copper, lithium, potassium, sodium. Chemical test (cations) – aluminium, copper, iron, lead. Chemical test (anions) – carbonate, chloride, sulphate. Ion chromatography, atomic emission spectrometry. | | | |
| LO5 | Determine concentration of acid or base Indicators – for acids and bases – bromothymol blue, methyl orange, phenolphthalein pH meter auto-titration | | | |
| LO6 | Determine concentration of coloured substances Visual comparison, colorimetry, calibration curves. Wavelength - spectrophotometer | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Biology

Mapping Gateway Biology B J263 to R075 – How scientific data is used

| | Keywords | Theme | Gateway Biology | Theme comments |
|-----|---|-------|-----------------|----------------|
| LO1 | Know/understand how scientists obtain scientific info Use/limitations of scientific equipment. Equipment advantages/disadvantages. Collecting samples. Calibration of equipment. | | | |
| LO2 | Analyse and process information | | | |
| LO3 | Evaluate information | | | |
| LO4 | Communicate scientific information | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Biology

Mapping Gateway Biology B J263 to R076 – Environmental science

| Keywords | Theme | Gateway Biology | Theme comments |
|--|--|---|---|
| LO1 Understand stable ecosystems – balanced and biological environment Ecosystem – living organisms and physical environment. Abiotic and biotic components – carbon, nitrogen, water | Stable ecosystems [D] Ecology and the environment [D] | B2a: Classification B2b: Energy flow B2c: Recycling B2d: Interdependence B2e: Adaptations B2f: Natural selection B2g: Population and pollution B4a: Ecology in the local environment B6e: Life in soil | Understand the classification of living organisms to understand their evolutions and ecological relationships. Understand how energy from the Sun flows through ecosystems and how humans can harness it. Understand natural and man-made waste and how it is recycled. Understand how animals, plants and organisms co-exist and how they cope with competition and predation. Recall how animals and plants adapt to their habitats to better compete for limited resources. Understand evolution and the process of natural selection. Explain how an increasing population has led to an increased demand on natural resources and also an increase in pollution. Appreciate the variety and diversity of organisms in the environment. Understand the components of soil and their importance in plant growth. |

Mapping Gateway Biology B J263 to R076 – Environmental science

| Keywords | Theme | Gateway Biology | Theme comments |
|---|---------------------------------|---|---|
| LO2 Impact of human and nature on environment Human events – agriculture, land use, industrial/domestic emissions, new species, GM organisms Nature – volcano, earthquake, flood, erosion, tsunami Consequences – biodiversity, climate change, sea level, drought, floods, safety, annoyance, unusable land | Stable ecosystems [D] | B2c: Recycling B2g: Population and pollution B2h: Sustainability | Understand natural and man-made waste and how it is recycled. Explain how an increasing population has led to an increased demand on natural resources and also an increase in pollution. Understand why organisms become extinct and the reasons for conservation programmes. Explain the significance of population size, waste products, food and energy to achieving sustainable development. |
| | Farming and the environment [D] | B4h: Farming | Appreciate basic farming processes, including their effect on the environment. |
| | Pollutants and water life [D] | B6f: Microscopic life in water | Recognise the effects of pollutants in water to microscopic life. |
| LO3 Physical conditions in environment – monitoring local and global Global picture - Satellite imaging, weather balloons, seismic sensors, marine sonar Local monitoring – particulate level, concentration of gasses, chemicals, noise, amount of litter | Pollution [D] | B2g: Population and pollution B6f: Microscopic life in water | Explain how an increasing population has led to an increased demand on natural resources and also an increase in pollution. Recognise the effects of pollutants in water to microscopic life. |
| LO4 Use standard processes to monitor physical factors in environment Temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Pollution [I] | B2g: Population and pollution B6f: Microscopic life in water | Explain how an increasing population has led to an increased demand on natural resources and also an increase in pollution. Recognise the effects of pollutants in water to microscopic life. |
| LO5 Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, pH, microbiological count | Pollution [D] | B2g: Population and pollution B6f: Microscopic life in water | Explain how an increasing population has led to an increased demand on natural resources and also an increase in pollution. Recognise the effects of pollutants in water to microscopic life. |

Mapping Gateway Biology B J263 to R076 – Environmental science

| Keywords | Theme | Gateway Biology | Theme comments |
|--|---------------------------------|--|---|
| LO6 Understand how environment is managed – local and global Conservation of natural resources, habitat protection, control of hazards, control of emission ads waste. Industry regulated | Pollution [D] | B2c: Recycling B2g: Population and pollution B6f: Microscopic life in water | Understand natural and man-made waste and how it is recycled. Explain how an increasing population has led to an increased demand on natural resources and also an increase in pollution. Recognise the effects of pollutants in water to microscopic life. |
| | Farming and the environment [D] | B4h: Farming | Appreciate basic farming processes, including their effect on the environment. |
| LO7 Structure of environmental organisations | | | |
| LO8 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Biology

Mapping Gateway Biology B J263 to R077 – The science of fitness and health

| Keywords | Theme | Gateway Biology | Theme comments |
|--|--|--|---|
| LO1 Understand musculoskeletal system Skull, vertebral column, humerus, radius/ulna, pelvis, femur, tibia/fibula Muscles, tendons Function: supporting, protecting, moving, making blood cells Joints: Hinge, ball and socket, pivot, glide, fixed Antagonistic muscles: biceps/triceps – forces to lift, pull, compress Levers: first order, second order, third order | Skeletons [D] | B5a: Skeletons | Understand the structure of the skeleton including bones and joints. |
| LO2 Understand circulatory system Heart, blood vessels, blood Function: transport of oxygen, defence, heat transfer Performance: pulse and heart rate, blood pressure, ECG | The circulatory system [D] Running repairs [] | B1a: Fitness and health B3e: The circulatory system B5b: Circulatory systems and the cardiac cycle B5c: Running repairs | Explain and measure blood pressure. Recognise factors that increase risks of developing heart disease. Explain the function and operation of the circulatory system. Understand the circulatory system and the cardiac cycle. Understand the types of repairs required to the circulatory system (eg to repair heart and blood conditions). |
| LO3 Understand respiratory system Nose, mouth, throat Trachea, bronchi, bronchioles, alveoli Gas exchange: alveoli, capillaries, blood cells Performance: tidal volume, vital capacity (lung volume) | The respiratory system [D] | B3c: Respiration B5d: Respiratory systems | Understand the processes involved with respiration. Understand the respiratory system, including conditions and diseases. |

Mapping Gateway Biology B J263 to R077 – The science of fitness and health

| Keywords | Theme | Gateway Biology | Theme comments |
|--|--|--|--|
| LO4 Understand consequences of health and fitness on wellbeing Diet, weight, exercise Unhealthy: smoking, drugs, over/under exercise, under/over eating, unbalanced diet Risks: High BP, high cholesterol, coronary heart disease, stroke Resps: reduced lung capacity, emphysema, type 2 diabetes, arthritis | Fitness and lifestyle [D] Staying in balance [D] Variations and inheritance [] | B1a: Fitness and health B1b: Human health and diet B1c: Staying healthy B1e: Drugs and you B1f: Staying in balance B1h: Variation and inheritance | Evaluate different ways of measuring fitness. Explain what a balanced diet should include. Interpret diet, daily requirements and body mass index. Understand how lifestyle may affect resistance to diseases and might increase or reduce risk of cancers. Understand how drugs can be beneficial or harmful (includes smoking and alcohol as part of lifestyle). Recognise that the body requires to maintain steady levels of water, temperature and CO ₂ . Recall that insulin controls blood sugar levels – including understanding diabetes. Analyse human characteristics, such as intelligence, body mass and height and determine if they are inherited or affected by environment. |
| LO5 Create a fitness programme Muscle strength, speed, stamina, flexibility How long and hard: age, gender, health, fitness, skill Warmup Spacing out | Evaluating fitness and health [D] | B1a: Fitness and health | Evaluate different ways of measuring fitness. |

Mapping Gateway Biology B J263 to R077 – The science of fitness and health

| Keywords | | Theme | Gateway Biology | Theme comments |
|----------|---|---|---|---|
| LO6 | Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | Evaluating fitness and health [D] Growth and repairs [I] | B1a: Fitness and health B5h: Growth and repair | Evaluate different ways of measuring fitness. Understand how the body grows and repairs itself, including the effect health, diet, exercise and disease. |
| LO7 | Structure of sports/health/fitness organisations | | | |
| LO8 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Biology

Mapping Gateway Biology B J263 to R078 – The science of production

| | Keywords | Theme | Gateway Biology | Theme comments |
|-----|--|-------|-----------------|----------------|
| LO1 | Understand bulk production of chemicals Bulk production of chemicals – ammonia sulphate (fertiliser), sodium hydroxide (soap) Neutralisation reactions: salt + acid = salt + water | | | |
| LO2 | Be able to produce a bulk chemical Indicators to determine neutralisation Yield – from mass of reactants | | | |

Mapping Gateway Biology B J263 to R078 – The science of production

| Keywords | Theme | Gateway Biology | Theme comments |
|---|--|---|---|
| LO3 Understand factors that affect growth of plants (commercial) Plant growth factors: temp, water supply, minerals, light, CO ₂ , pests Maximising growth: increased light, fertilisers, pesticides Plant variety selection: quality, yield, hardiness, resistance to disease Genetic improvements | Plants and plant growth [D] Photosynthesis [D] Transport in plants [D] Soils, minerals and plant growth [D] Genetics [I] | B1g: Controlling plant growth B2e: Adaptations B2f: Natural selection B3f: Growth and development B3g: New genes for old B3h: Cloning B4b: Photosynthesis B4c: Leaves and photosynthesis B4d: Diffusion and osmosis B4e: Transport in plants B4f: Plants need minerals B4h: Farming B6e: Life in soil B6h: Gene technology | Understand how plant growth is controlled by plant growth regulators (hormones) Recall how animals and plants adapt to their habitats to better compete for limited resources. Understand evolution and the process of natural selection. Explain the parts of a plant cell. Understand the factors that affect plant growth including how it can be measured (ie length, wet mass, dry mass and yield) Understand genetic modification (GM), its risks and its benefits. Understand natural and man-made cloning. Explain the process of photosynthesis including how this affects plant growth. Understand the function of leaves to the process of photosynthesis. Recall that substances move in and out of cells through diffusion. Understand that lack of water can cause plants to droop. Describe how water travels through plants – including how transpiration rate is affected by light, temperature, air movement and humidity. Understand how plants need minerals to survive and grow. Understand how farming process can lead to better plant or crop growth. Understand the components of soil and their importance in plant growth. Understand the basic principles of genetic engineering (eg for plant and crop modification). |

Mapping Gateway Biology B J263 to R078 – The science of production

| Keywords | | Theme | Gateway Biology | Theme comments |
|----------|--|--|--|---|
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Controlling and measuring plant growth [D] | B1g: Controlling plant growth B3f: Growth and development | Understand how plant growth is controlled by plant growth regulators (hormones) Understand the factors that affect plant growth including how it can be measured (ie length, wet mass, dry mass and yield) |
| LO5 | Understand how products are made from micro-organisms Micro-organisms from waste/other processes: ethanol and CO ₂ by anaerobic respiration of yeast, lactic acid, antibiotics from fermentation. Production requires: food source, oxygen, temp, pH Products: bread, beer, yoghurt, antibiotics, lactic acid, ethanol Mycoprotein | Decay and plant growth [I] Micro-organisms, enzymes and products [D] Harmful micro-organisms [I] Pollutants and micro-organisms [I] | B4g: Decay B6a: Understanding microbes B6c: Useful micro-organisms B6d: Biofuels B6g: Enzymes in action - D B6b: Harmful micro-organisms B6f: Microscopic life in water | Understand the process of decay including how it is important for plant growth. Understand microbes, including their function in food production (eg yeast). Describe how useful micro-organisms can be used in production of products such as yoghurt and alcohol. Explain how fuels such as biogas are produced from plants (biomass). Describe the uses of enzymes in everyday products (eg washing powders, cheese making, and other food products). Recognise harmful micro-organisms such as bacteria can be controlled by antibiotics. Recognise the effects of pollutants in water to microscopic life. |
| LO6 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Chemistry J244

R074 How scientists use analytical techniques to collect data

R075 How scientific data is used

R076 Environmental science

R077 The science of fitness and health

R078 The science of production

Gateway Chemistry J264

R074 How scientists use analytical techniques to collect data

R075 How scientific data is used

R076 Environmental science

R077 The science of fitness and health

R078 The science of production

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE 21st Century Chemistry

Mapping 21st Century Chemistry A J244 to R074 – How scientists use analytical techniques to collect data

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|-------------------------------------|--|--|--|
| LO1 Principles of good lab practice | Atomic structure and the periodic table [D] Chemical reactions [D] Chemical analysis [D] | C4.1 What are the patterns in the properties of elements? C4.2 How do chemists explain the patterns in the properties of elements? C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements? C6.1 Chemicals and why we need them C6.2 Planning, carrying out and controlling a chemical synthesis C7.5 Analysis | Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements). Understand the structure of an atom, and relate this to elements in the periodic table. Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity). Recall alkalis and acids including how they are tested for (eg pH Value, litmus tests and universal indicators). Interpret chemical symbol equations. Understand chemical reactions (eg acid with an alkali to form a salt). Understand neutralisation reactions. Understand exothermic and endothermic reactions. Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield). Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction. Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration. |

Mapping 21st Century Chemistry A J244 to R074 – How scientists use analytical techniques to collect data

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|---|---|---|--|
| LO2 Separate and identify substances in mixture Chromatography, stationary and mobile phases, Rf values, electrophoresis, gas chromatography, mass spectrometer | Salts [I] Atomic structure and the periodic table [D] Chemical reactions [D] Chemical analysis [D] | C3.2 Where does salt come from and why is it so important? C4.1 What are the patterns in the properties of elements? C4.2 How do chemists explain the patterns in the properties of elements? C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements? C6.1 Chemicals and why we need them C6.2 Planning, carrying out and controlling a chemical synthesis C7.5 Analysis | Understand the importance of salt and its production for the food industry and in other applications. Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements). Understand the structure of an atom, and relate this to elements in the periodic table. Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity). Recall alkalis and acids including how they are tested for (eg pH Value, litmus tests and universal indicators) Interpret chemical symbol equations. Understand chemical reactions (eg acid with an alkali to form a salt). Understand neutralisation reactions. Understand exothermic and endothermic reactions. Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield). Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction. Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration. |

Mapping 21st Century Chemistry A J244 to R074 – How scientists use analytical techniques to collect data

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|---|--|--|--|
| LO3 Examine and record features of samples Visual observation, light microscope. Electron microscope, X-ray analysis, ultrasound | Atomic structure and the periodic table [D] | C4.1 What are the patterns in the properties of elements? C4.2 How do chemists explain the patterns in the properties of elements? C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements? | Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements). Understand the structure of an atom, and relate this to elements in the periodic table. Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity). |
| LO4 Identify cations and anions in sample Flame test – barium, calcium, copper, lithium, potassium, sodium. Chemical test (cations) – aluminium, copper, iron, lead. Chemical test (anions) – carbonate, chloride, sulphate. Ion chromatography, atomic emission spectrometry. | Atomic structure and the periodic table [D] Chemical reactions [D] Chemical analysis [D] | C4.1 What are the patterns in the properties of elements? C4.2 How do chemists explain the patterns in the properties of elements? C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements? C6.1 Chemicals and why we need them C6.2 Planning, carrying out and controlling a chemical synthesis C7.5 Analysis | Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements). Understand the structure of an atom, and relate this to elements in the periodic table. Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity). Recall alkali's and acids including how they are tested for (eg pH Value, litmus tests and universal indicators) Interpret chemical symbol equations. Understand chemical reactions (eg acid with an alkali to form a salt). Understand neutralisation reactions. Understand exothermic and endothermic reactions. Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield). Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction. Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration. |

Mapping 21st Century Chemistry A J244 to R074 – How scientists use analytical techniques to collect data

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|---|--|---|---|
| LO5 Determine concentration of acid or base Indicators – for acids and base – bromothymol, methyl orange, phenolphthalein pH meter auto-titration | Benefits and risks associated with chemicals [I] Atomic structure and the periodic table [D] Chemical reactions [D] Chemical analysis [D] | C3.3 Why do we need chemicals such as alkalis and chlorine and how do we make them? C4.1 What are the patterns in the properties of elements? C4.2 How do chemists explain the patterns in the properties of elements? C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements? C5.2 What reactions happen in the hydrosphere? C6.1 Chemicals and why we need them C6.2 Planning, carrying out and controlling a chemical synthesis C7.5 Analysis | Understand the benefits and risks associated with chemicals including environmental impact and risks to the environment and human health. Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements). Understand the structure of an atom, and relate this to elements in the periodic table. Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity). Understand that some ions may be identified by precipitation. Recall alkalis and acids including how they are tested for (eg pH Value, litmus tests and universal indicators) Interpret chemical symbol equations. Understand chemical reactions (eg acid with an alkali to form a salt). Understand neutralisation reactions. Understand exothermic and endothermic reactions. Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield). Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction. Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration. |
| LO6 Determine concentration of coloured substances Visual comparison, colorimetry, calibration curves. Wavelength - spectrophotometer | Chemical analysis [D] | C7.5 Analysis | Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration. |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE 21st Century Chemistry

Mapping 21st Century Chemistry A J244 to R075 – How scientific data is used

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|---|---|--|--|
| LO1 Know/understand how scientists obtain scientific info Use/limitations of scientific equipment. Equipment advantages/disadvantages. Collecting samples. Calibration of equipment. | Chemicals and the environment [I] Atomic structure and the periodic table [I] Chemical reactions [I] Chemical analysis [D] | C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution? C4.1 What are the patterns in the properties of elements? C4.2 How do chemists explain the patterns in the properties of elements? C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements? C6.1 Chemicals and why we need them C6.2 Planning, carrying out and controlling a chemical synthesis C7.5 Analysis | Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes. Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements). Understand the structure of an atom, and relate this to elements in the periodic table. Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity). Recall alkali's and acids including how they are tested for (eg pH Value, litmus tests and universal indicators) Interpret chemical symbol equations. Understand chemical reactions (eg acid with an alkali to form a salt). Understand neutralisation reactions. Understand exothermic and endothermic reactions. Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield). Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction. Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration. |

Mapping 21st Century Chemistry A J244 R075 – How scientific data is used

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|---|--|---|--|
| LO2 Analyse and process information | <p>Chemicals and the environment [I]</p> <p>Atomic structure and the periodic table [I]</p> <p>Chemical reactions [I]</p> <p>Chemical analysis [D]</p> | <p>C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution?</p> <p>C4.1 What are the patterns in the properties of elements?</p> <p>C4.2 How do chemists explain the patterns in the properties of elements?</p> <p>C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements?</p> <p>C6.1 Chemicals and why we need them</p> <p>C6.2 Planning, carrying out and controlling a chemical synthesis</p> <p>C7.5 Analysis</p> | <p>Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes.</p> <p>Understand and apply the periodic table.</p> <p>Understand and carry out tests on alkali metals (Group 1 elements).</p> <p>Understand halogens (Group 7 elements).</p> <p>Understand the structure of an atom, and relate this to elements in the periodic table.</p> <p>Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity).</p> <p>Recall alkalis and acids including how they are tested for (eg pH Value, litmus tests and universal indicators)</p> <p>Interpret chemical symbol equations.</p> <p>Understand chemical reactions (eg acid with an alkali to form a salt).</p> <p>Understand neutralisation reactions.</p> <p>Understand exothermic and endothermic reactions.</p> <p>Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield).</p> <p>Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction.</p> <p>Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration.</p> |

Mapping 21st Century Chemistry A J244 to R075 – How scientific data is used

| Keywords | | Theme | 21st Century Chemistry | Theme comments |
|----------|----------------------|--|---|---|
| LO3 | Evaluate information | <p>Chemicals and the environment [I]</p> <p>Atomic structure and the periodic table [I]</p> <p>Chemical reactions [I]</p> <p>Chemical analysis [D]</p> | <p>C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution?</p> <p>C4.1 What are the patterns in the properties of elements?</p> <p>C4.2 How do chemists explain the patterns in the properties of elements?</p> <p>C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements?</p> <p>C6.1 Chemicals and why we need them</p> <p>C6.2 Planning, carrying out and controlling a chemical synthesis</p> <p>C7.5 Analysis</p> | <p>Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes.</p> <p>Understand and apply the periodic table.</p> <p>Understand and carry out tests on alkali metals (Group 1 elements).</p> <p>Understand halogens (Group 7 elements).</p> <p>Understand the structure of an atom, and relate this to elements in the periodic table.</p> <p>Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity).</p> <p>Recall alkali's and acids including how they are tested for (eg pH Value, litmus tests and universal indicators)</p> <p>Interpret chemical symbol equations.</p> <p>Understand chemical reactions (eg acid with an alkali to form a salt).</p> <p>Understand neutralisation reactions.</p> <p>Understand exothermic and endothermic reactions.</p> <p>Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield).</p> <p>Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction.</p> <p>Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration.</p> |

Mapping 21st Century Chemistry A J244 to R075 – How scientific data is used

| Keywords | | Theme | 21st Century Chemistry | Theme comments |
|----------|-----------------------------|--|---|---|
| LO4 | Communicate scientific info | <p>Chemicals and the environment [I]</p> <p>Atomic structure and the periodic table [I]</p> <p>Chemical reactions [I]</p> <p>Chemical analysis [I]</p> | <p>C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution?</p> <p>C4.1 What are the patterns in the properties of elements?</p> <p>C4.2 How do chemists explain the patterns in the properties of elements?</p> <p>C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements?</p> <p>C6.1 Chemicals and why we need them</p> <p>C6.2 Planning, carrying out and controlling a chemical synthesis</p> <p>C7.5 Analysis</p> | <p>Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes.</p> <p>Understand and apply the periodic table.</p> <p>Understand and carry out tests on alkali metals (Group 1 elements).</p> <p>Understand halogens (Group 7 elements).</p> <p>Understand the structure of an atom, and relate this to elements in the periodic table.</p> <p>Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity).</p> <p>Recall alkali's and acids including how they are tested for (eg pH Value, litmus tests and universal indicators)</p> <p>Interpret chemical symbol equations.</p> <p>Understand chemical reactions (eg acid with an alkali to form a salt).</p> <p>Understand neutralisation reactions.</p> <p>Understand exothermic and endothermic reactions.</p> <p>Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield).</p> <p>Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction.</p> <p>Understand and perform qualitative and quantitative analysis used in chemistry including chromatography (ie Rf value) and titration.</p> |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE 21st Century Chemistry

Mapping 21st Century Chemistry A J244 to R076 – Environmental science

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|--|-----------------------------|--|--|
| LO1 Understand stable ecosystems – balanced and biological environment Ecosystem – living organisms and physical environment. Abiotic and biotic components – carbon, nitrogen, water | Chemicals and the Earth [D] | <p>C5.1 What types of chemicals make up the atmosphere?</p> <p>C5.2 What reactions happen in the hydrosphere?</p> <p>C5.3 What types of chemicals make up the Earth's lithosphere?</p> <p>C5.4 How can we extract useful metals from minerals?</p> | <p>Understand the chemical composition of the atmosphere.</p> <p>Recall that the Earth's hydrosphere (oceans, seas, lakes) consists mainly of water and dissolved compound such as salts.</p> <p>Recall that the Earth's lithosphere (outer layer of Earth's crust) is made up a mixture of minerals.</p> <p>Understand how useful minerals are extracted from the Earth (eg ores from rocks).</p> |

Mapping 21st Century Chemistry A J244 to R076 – Environmental science

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|--|--|---|--|
| LO2 Impact of human and nature on environment Human events – agriculture, land use, industrial/domestic emissions, new species, GM organisms Nature – volcano, earthquake, flood, erosion, tsunami Consequences – biodiversity, climate change, sea level, drought, floods, safety, annoyance, unusable land | Chemicals and the environment [D] Chemicals and the Earth [D] Sustainable applications [D] | C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution? C1.2 What chemical reactions produce air pollutants? What happens to these pollutants in the atmosphere? C1.3 What choices can we make personally, locally, nationally or globally to improve air quality? C5.1 What types of chemicals make up the atmosphere? C5.2 What reactions happen in the hydrosphere? C5.3 What types of chemicals make up the Earth's lithosphere? C5.4 How can we extract useful metals from minerals? C7.2 Alcohols, carboxylic acids and esters [I] | Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes. Explain the evolution of photosynthesising organisms and how they remove carbon dioxide from the atmosphere. Understand how chemical reactions produce air pollutants (eg burning fossil fuels, using petrol, diesel and fuel oil) Understand that pollutants do not disappear but go elsewhere (eg on surfaces, cause acid rain, in rain and sea water and are used by plants during photosynthesis). Understand how personal, local and national and global choices can improve air quality (eg use less electricity, remove pollution from industrial processes). Understand the chemical composition of the atmosphere. Recall that the Earth's hydrosphere (oceans, seas, lakes) consists mainly of water and dissolved compound such as salts. Recall that the Earth's lithosphere (outer layer of Earth's crust) is made up a mixture of minerals. Understand how useful minerals are extracted from the Earth (eg ores from rocks). Understand sustainable applications (eg ethanol production from biomass) |
| LO3 Physical conditions in environment – monitoring local and global Global picture - Satellite imaging, weather balloons, seismic sensors, marine sonar Local monitoring – particulate level, concentration of gasses, chemicals, noise, amount of litter | | | |
| LO4 Use standard processes to monitor physical factors in environment Temp, humidity, rainfall, sunlight, UV radiation, wind speed. | | | |

Mapping 21st Century Chemistry A J244 to R076 – Environmental science

| Keywords | Theme | 21st Century Chemistry | Theme comments | |
|----------|--|-----------------------------------|--|--|
| LO5 | Use standard processes to measure degree of pollution | Chemicals and the environment [D] | <p>C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution?</p> <p>C1.2 What chemical reactions produce air pollutants? What happens to these pollutants in the atmosphere?</p> <p>C1.3 What choices can we make personally, locally, nationally or globally to improve air quality?</p> | <p>Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes.</p> <p>Explain the evolution of photosynthesising organisms and how they remove carbon dioxide from the atmosphere.</p> <p>Understand how chemical reactions produce air pollutants (eg burning fossil fuels, using petrol, diesel and fuel oil)</p> <p>Understand that pollutants do not disappear but go elsewhere (eg on surfaces, cause acid rain, in rain and sea water and are used by plants during photosynthesis).</p> <p>Understand how personal, local and national and global choices can improve air quality (eg use less electricity, remove pollution from industrial processes).</p> |

Mapping 21st Century Chemistry A J244 to R076 – Environmental science

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|--|---|--|---|
| LO6 Understand how environment is managed – local and global Conservation of natural resources, habitat protection, control of hazards, control of emission ads waste. Industry regulated | Pollutants [D] Chemicals – benefits and risks [D] Chemicals and the environment [D] Making chemicals [D] | C1.3 What choices can we make personally, locally, nationally or globally to improve air quality? C3.1 What were the origins of minerals in Britain that contribute to our economic wealth? [I] C3.3 Why do we need chemicals such as alkalis and chlorine and how do we make them? C3.4 What can we do to make our use of chemicals safe and sustainable? C5.1 What types of chemicals make up the atmosphere? C5.2 What reactions happen in the hydrosphere? C5.3 What types of chemicals make up the Earth's lithosphere? C5.4 How can we extract useful metals from minerals? C7.1 Green chemistry C7.4 Reversible reactions and equilibria | Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes. Explain the evolution of photosynthesising organisms and how they remove carbon dioxide from the atmosphere. Understand the origins of minerals and their significance to society and economic wealth. [I] Understand the benefits and risks associated with chemicals including environmental impact and risks to the environment and human health. Understand that pollution can sometimes be solved by turning wastes into useful chemicals. Understand the chemical composition of the atmosphere. Recall that the Earth's hydrosphere (oceans, seas, lakes) consists mainly of water and dissolved compound such as salts. Recall that the Earth's lithosphere (outer layer of Earth's crust) is made up a mixture of minerals. Understand how useful minerals are extracted from the Earth (eg ores from rocks). Understand how chemical by-products and waste are handled. Understand the impact on the environment of large scale manufacture of ammonia including the use of fertiliser made from it. |
| LO7 Structure of environmental organisations | | | |
| LO8 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Chemistry

Mapping 21st Century Chemistry A J244 to R077 – The science of fitness and health

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|--|------------------------------|--|--|
| LO1 Understand musculoskeletal system Skull, vertebral column, humerus, radius/ulna, pelvis, femur, tibia/fibula Muscles, tendons Function: supporting, protecting, moving, making blood cells Joints: Hinge, ball and socket, pivot, glide, fixed Antagonistic muscles: biceps/triceps – forces to lift, pull, compress Levers: first order, second order, third order | | | |
| LO2 Understand circulatory system Heart, blood vessels, blood Function: transport of oxygen, defence, heat transfer Performance: pulse and heart rate, blood pressure, ECG | | | |
| LO3 Understand respiratory system Nose, mouth, throat Trachea, bronchi, bronchioles, alveoli Gas exchange: alveoli, capillaries, blood cells Performance: tidal volume, vital capacity (lung volume) | Air pollution and health [I] | C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution? [I] | Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes. |
| LO4 Understand consequences of health and fitness on wellbeing Diet, weight, exercise Unhealthy: smoking, drugs, over/under exercise, under/over eating, unbalanced diet Risks: High BP, high cholesterol, coronary heart disease, stroke Resps: reduced lung capacity, emphysema, type 2 diabetes, arthritis | Salt and health [I] | C3.2 Where does salt come from and why is it so important? [I] | Understand the importance of salt and its production for the food industry and in other applications. |

Mapping 21st Century Chemistry A J244 to R077 – The science of fitness and health

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|---|-------|------------------------|----------------|
| LO5 Create a fitness programme Muscle strength, speed, stamina, flexibility How long and hard: age, gender, health, fitness, skill Warmup Spacing out | | | |
| LO6 Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | | | |
| LO7 Structure of sports/health/fitness organisations | | | |
| LO8 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE 21st Century Chemistry

Mapping 21st Century Chemistry A J244 to R078 – The science of production

| Keywords | Theme | 21st Century Chemistry | Theme comments |
|--|--|---|--|
| LO1 Understand bulk production of chemicals Bulk production of chemicals – ammonia sulphate (fertiliser), sodium hydroxide (soap) Neutralisation reactions: salt + acid = salt + water | <p>Chemicals – benefits and risks [D]</p> <p>Atomic structure and the periodic table [I]</p> <p>Chemical reactions [I]</p> <p>Making chemicals [D]</p> | <p>C3.3 Why do we need chemicals such as alkalis and chlorine and how do we make them?</p> <p>C3.4 What can we do to make our use of chemicals safe and sustainable?</p> <p>C4.1 What are the patterns in the properties of elements?</p> <p>C4.2 How do chemists explain the patterns in the properties of elements?</p> <p>C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements?</p> <p>C6.1 Chemicals and why we need them</p> <p>C6.2 Planning, carrying out and controlling a chemical synthesis</p> <p>C7.1 Green chemistry</p> <p>C7.2 Alcohols, carboxylic acids and esters</p> <p>C7.4 Reversible reactions and equilibria</p> | <p>Understand the benefits and risks associated with chemicals including environmental impact and risks to the environment and human health.</p> <p>Understand why we need chemicals such as alkali's, acids and chlorine.</p> <p>Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements).</p> <p>Understand the structure of an atom, and relate this to elements in the periodic table.</p> <p>Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity).</p> <p>Recall alkali's and acids including how they are tested for (eg pH Value, litmus tests and universal indicators) Interpret chemical symbol equations. Understand chemical reactions (eg acid with an alkali to form a salt). Understand neutralisation reactions. Understand exothermic and endothermic reactions. Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield). Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction.</p> <p>Understand how chemical by-products and waste are handled. Understand alcohols, (carboxylic acid and ester production). Understand sustainable applications (eg ethanol production from biomass)</p> <p>Understand how industrial chemical processes rely on reversible reactions that can reach chemical equilibria. Understand the impact on the environment of large scale manufacture of ammonia including the use of fertiliser made from it.</p> |

Mapping 21st Century Chemistry A J244 to R078 – The science of production

| Keywords | Theme | 21st Century Chemistry | Theme comments | |
|----------|--|--|---|---|
| LO2 | Be able to produce a bulk chemical | Atomic structure and the periodic table [I] | C4.1 What are the patterns in the properties of elements? C4.2 How do chemists explain the patterns in the properties of elements? | Understand and apply the periodic table. Understand and carry out tests on alkali metals (Group 1 elements). Understand halogens (Group 7 elements). Understand the structure of an atom, and relate this to elements in the periodic table. |
| | Indicators to determine neutralisation Yield – from mass of reactants | Chemical reactions [I] | C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements? C6.1 Chemicals and why we need them | Understand the properties of compounds in Group 1 and Group 7 (eg crystal structure, electrical conductivity). |
| | | Making chemicals [D] | C6.2 Planning, carrying out and controlling a chemical synthesis C7.1 Green chemistry C7.2 Alcohols, carboxylic acids and esters | Recall alkali's and acids including how they are tested for (eg pH Value, litmus tests and universal indicators) Interpret chemical symbol equations. Understand chemical reactions (eg acid with an alkali to form a salt). Understand neutralisation reactions. Understand exothermic and endothermic reactions. Identify the stages involved in chemical synthesis of an inorganic compound (eg choosing reaction, risk assessment, working with reactants, using apparatus, purifying product and measuring yield). Use periodic table, calculate relative mass of compound, determine percentage yield and explain rate of reaction. |
| LO3 | Understand factors that affect growth of plants (commercial) | Photosynthesis [D] | C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution? C1.2 What chemical reactions produce air pollutants? What happens to these pollutants in the atmosphere? | Understand how chemical by-products and waste are handled. Understand alcohols, (carboxylic acid and ester production). Understand sustainable applications (eg ethanol production from biomass) |
| | Plant growth factors: temp, water supply, minerals, light, CO ₂ , pests Maximising growth: increased light, fertilisers, pesticides Plant variety selection: quality, yield, hardiness, resistance to disease Genetic improvements | | | Explain the evolution of photosynthesising organisms and how they remove carbon dioxide from the atmosphere. |
| | | | | Understand that pollutants do not disappear but go elsewhere (eg on surfaces, cause acid rain, in rain and sea water and are used by plants during photosynthesis). |
| LO4 | Be able to monitor growth of plant (commercial) | Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | | |

Mapping 21st Century Chemistry A J244 to R078 – The science of production

| Keywords | | Theme | 21st Century Chemistry | Theme comments |
|------------|---|--|---|--|
| LO5 | Understand how products are made from micro-organisms Micro-organisms from waste/other processes: ethanol and CO ₂ by anaerobic respiration of yeast, lactic acid, antibiotics from fermentation. Production requires: food source, oxygen, temp, pH Products: bread, beer, yogurt, antibiotics, lactic acid, ethanol Mycoprotein | Making products from micro-organisms [D] | C7.2 Alcohols, carboxylic acids and esters | Understand alcohols, carboxylic acid and ester production. Understand sustainable applications (eg ethanol production from biomass) |
| LO6 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Chemistry

Mapping Gateway Chemistry B J264 to R074 – How scientists use analytical techniques to collect data

| Keywords | Theme | Gateway Chemistry | Theme comments |
|-------------------------------------|--|--|---|
| LO1 Principles of good lab practice | <p>Chemical reactions [D]</p> <p>Atomic structure and the periodic table [I]</p> <p>Moles, molar mass and chemical experiments [D]</p> | <p>C3a: Rate of reaction (1)</p> <p>C3b: Rate of reaction (2)</p> <p>C3c: Rate of reaction (3)</p> <p>C3d: Reacting masses</p> <p>C3e: Percentage yield and atom economy</p> <p>C3f: Energy</p> <p>C4a: Atomic structure</p> <p>C4b: Ionic bonding</p> <p>C4c: The Periodic Table and covalent bonding</p> <p>C4d: The Group 1 elements</p> <p>C4e: The Group 7 elements</p> <p>C4f: Transition elements</p> <p>C4g: Metal structure and properties</p> <p>C5a: Moles and molar mass</p> <p>C5b: Percentage composition and empirical formula</p> <p>C5c: Quantitative analysis</p> <p>C5d: Titrations</p> <p>C5e: Gas volumes</p> <p>C5f: Equilibria</p> <p>C5g: Strong and weak acids</p> <p>C5h: Ionic equations and precipitation</p> | <p>Understand the laboratory processes involved in measuring rate of reaction.</p> <p>Understand and measure how temperature, pressure and concentration affect reaction rate.</p> <p>Understand and measure how using a catalyst can affect the rate of reaction.</p> <p>Understand and apply principles of atomic masses (eg using periodic table).</p> <p>Understand that percentage yield is a way of comparing actual amount of product made and the amount expected.</p> <p>Understand endothermic and exothermic reactions.</p> <p>Understand atomic structure including the periodic table.</p> <p>Understand ionic bonding including experiments on melting point and conductivity.</p> <p>Understand the periodic table and the classification of elements.</p> <p>Understand and carry out tests (eg flame test) on alkali metals.</p> <p>Understand the physical properties and application of halogens.</p> <p>Recall and deduce whether an element is a transition element – including that transition elements are often coloured.</p> <p>Understand the structure, properties and typical application of metals.</p> <p>Understand the relationship between mass, moles and molar mass of chemical substances.</p> <p>Carry out practical experiments to determine how mass is converted in chemical reactions.</p> <p>Understand everyday quantitative analysis (eg dilution of chemicals and substances, guideline daily amounts (GDA) on food packaging).</p> <p>Understand titration (eg how pH changes in the neutralisation of an alkali with an acid) using pH titration curves.</p> <p>Understand the use of single indicators such as litmus or phenolphthalein.</p> <p>Understand apparatus and experiments to determine gas volume change during the course of a chemical reaction.</p> <p>Understand how industrial chemical processes rely on reversible reactions that can reach chemical equilibria.</p> <p>Understand strong and weak acids including how this is determined from measuring pH value.</p> <p>Understand how precipitation is used to test for ions in a solution.</p> |

Mapping Gateway Chemistry B J264 to R074 – How scientific ideas have an impact on our lives

| Keywords | | Theme | Gateway Chemistry | Theme comments |
|----------|---|--|---|---|
| LO2 | Separate and identify substances in mixture Chromatography, stationary and mobile phases, Rf values, electrophoresis, gas chromatography, mass spectrometer | Batch and continuous chemical processes [D] | C3g: Batch or continuous? | Describe how chemicals are extracted from plant Sources by chromatography. Interpret melting point, boiling point and chromatographic data relating to the purity of a substance |
| LO3 | Examine and record features of samples Visual observation, light microscope. Electron microscope, X-ray analysis, ultrasound | | | |
| LO4 | Identify cations and anions in sample Flame test – barium, calcium, copper, lithium, potassium, sodium. Chemical test (cations) – aluminium, copper, iron, lead. Chemical test (anions) – carbonate, chloride, sulphate. Ion chromatography, atomic emission spectrometry. | Atomic structure and the periodic table [D] | C4a: Atomic structure C4b: Ionic bonding C4c: The Periodic Table and covalent bonding C4d: The Group 1 elements C4e: The Group 7 elements C4f: Transition elements | Understand atomic structure including the periodic table. Understand ionic bonding including experiments on melting point and conductivity. Understand the periodic table and the classification of elements. Understand and carry out tests (eg flame test) on alkali metals. Understand the physical properties and application of halogens. Recall and deduce whether an element is a transition element – including that transition elements are often coloured. |
| LO5 | Determine concentration of acid or base Indicators – for acids and base – bromothymol blue, methyl orange, phenolphthalein pH meter auto-tritration | Acids and Bases [D] Titrations [D] Strong and weak acids [D] | C2f: Acids and bases C5d: Titrations C5g: Strong and weak acids | Understand acids and bases and how they can be tested for using pH value (eg litmus test). Understand titration (eg how pH changes in the neutralisation of an alkali with an acid) using pH titration curves. Understand the use of single indicators such as litmus or phenolphthalein. Understand strong and weak acids including how this is determined from measuring pH value. |
| LO6 | Determine concentration of coloured substances Visual comparison, colorimetry, calibration curves. Wavelength - spectrophotometer | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Chemistry

Mapping Gateway Chemistry B J264 to R075 – How scientific data is used

| Keywords | Theme | Gateway Chemistry | Theme comments |
|---|--|--|--|
| LO1 Know/understand how scientists obtain scientific info Use/limitations of scientific equipment. Equipment advantages/disadvantages. Collecting samples. Calibration of equipment. | Chemical reactions [I] Atomic structure and the periodic table [I] Quantitative analysis [I] | C3a: Rate of reaction (1) C3b: Rate of reaction (2) C3c: Rate of reaction (3) C3d: Reacting masses C3e: Percentage yield and atom economy C3f: Energy C4a: Atomic structure C4b: Ionic bonding C4c: The Periodic Table and covalent bonding C4d: The Group 1 elements C4e: The Group 7 elements C4f: Transition elements C4g: Metal structure and properties C5c: Quantitative analysis | Understand the laboratory processes involved in measuring rate of reaction. Understand and measure how temperature, pressure and concentration affect reaction rate. Understand and measure how using a catalyst can affect the rate of reaction. Understand and apply principles of atomic masses (eg using periodic table). Understand that percentage yield is a way of comparing actual amount of product made and the amount expected. Understand endothermic and exothermic reactions. Understand atomic structure including the periodic table. Understand ionic bonding including experiments on melting point and conductivity. Understand the periodic table and the classification of elements. Understand and carry out tests (eg flame test) on alkali metals. Understand the physical properties and application of halogens. Recall and deduce whether an element is a transition element – including that transition elements are often coloured. Understand the structure, properties and typical application of metals. Understand everyday quantitative analysis (eg dilution of chemicals and substances, guideline daily amounts (GDA) on food packaging). |

Mapping Gateway Chemistry B J264 to R075 – How scientific data is used

| Keywords | Theme | Gateway Chemistry | Theme comments |
|-------------------------------------|------------------------|--|--|
| LO2 Analyse and process information | Chemical reactions [I] | C3a: Rate of reaction (1) C3b: Rate of reaction (2) C3c: Rate of reaction (3) C3d: Reacting masses C3e: Percentage yield and atom economy C3f: Energy | Understand the laboratory processes involved in measuring rate of reaction. Understand and measure how temperature, pressure and concentration affect reaction rate. Understand and measure how using a catalyst can affect the rate of reaction. Understand and apply principles of atomic masses (eg using periodic table). Understand that percentage yield is a way of comparing actual amount of product made and the amount expected. Understand endothermic and exothermic reactions. Understand atomic structure including the periodic table. Understand ionic bonding including experiments on melting point and conductivity. Understand the periodic table and the classification of elements. Understand and carry out tests (eg flame test) on alkali metals. Understand the physical properties and application of halogens. Recall and deduce whether an element is a transition element – including that transition elements are often coloured. Understand the structure, properties and typical application of metals. Understand everyday quantitative analysis (eg dilution of chemicals and substances, guideline daily amounts (GDA) on food packaging). |

Mapping Gateway Chemistry B J264 to R075 – How scientific data is used

| Keywords | Theme | Gateway Chemistry | Theme comments |
|--------------------------|---|---|---|
| LO3 Evaluate information | <p>Chemical reactions [I]</p> <p>Atomic structure and the periodic table [I]</p> <p>Quantitative analysis [I]</p> | <p>C3a: Rate of reaction (1)</p> <p>C3b: Rate of reaction (2)</p> <p>C3c: Rate of reaction (3)</p> <p>C3d: Reacting masses</p> <p>C3e: Percentage yield and atom economy</p> <p>C3f: Energy</p> <p>C4a: Atomic structure</p> <p>C4b: Ionic bonding</p> <p>C4c: The Periodic Table and covalent bonding</p> <p>C4d: The Group 1 elements</p> <p>C4e: The Group 7 elements</p> <p>C4f: Transition elements</p> <p>C4g: Metal structure and properties</p> <p>C5c: Quantitative analysis</p> | <p>Understand the laboratory processes involved in measuring rate of reaction.</p> <p>Understand and measure how temperature, pressure and concentration affect reaction rate.</p> <p>Understand and measure how using a catalyst can affect the rate of reaction.</p> <p>Understand and apply principles of atomic masses (eg using periodic table).</p> <p>Understand that percentage yield is a way of comparing actual amount of product made and the amount expected.</p> <p>Understand endothermic and exothermic reactions.</p> <p>Understand atomic structure including the periodic table.</p> <p>Understand ionic bonding including experiments on melting point and conductivity.</p> <p>Understand the periodic table and the classification of elements.</p> <p>Understand and carry out tests (eg flame test) on alkali metals.</p> <p>Understand the physical properties and application of halogens.</p> <p>Recall and deduce whether an element is a transition element – including that transition elements are often coloured.</p> <p>Understand the structure, properties and typical application of metals.</p> <p>Understand everyday quantitative analysis (eg dilution of chemicals and substances, guideline daily amounts (GDA) on food packaging).</p> |

Mapping Gateway Chemistry B J264 to R075 – How scientific data is used

| Keywords | Theme | Gateway Chemistry | Theme comments |
|---------------------------------|---|---|---|
| LO4 Communicate scientific info | <p>Chemical reactions [I]</p> <p>Atomic structure and the periodic table [I]</p> <p>Quantitative analysis [I]</p> | <p>C3a: Rate of reaction (1)</p> <p>C3b: Rate of reaction (2)</p> <p>C3c: Rate of reaction (3)</p> <p>C3d: Reacting masses</p> <p>C3e: Percentage yield and atom economy</p> <p>C3f: Energy</p> <p>C4a: Atomic structure</p> <p>C4b: Ionic bonding</p> <p>C4c: The Periodic Table and covalent bonding</p> <p>C4d: The Group 1 elements</p> <p>C4e: The Group 7 elements</p> <p>C4f: Transition elements</p> <p>C4g: Metal structure and properties</p> <p>C5c: Quantitative analysis</p> | <p>Understand the laboratory processes involved in measuring rate of reaction.</p> <p>Understand and measure how temperature, pressure and concentration affect reaction rate.</p> <p>Understand and measure how using a catalyst can affect the rate of reaction.</p> <p>Understand and apply principles of atomic masses (eg using periodic table).</p> <p>Understand that percentage yield is a way of comparing actual amount of product made and the amount expected.</p> <p>Understand endothermic and exothermic reactions.</p> <p>Understand atomic structure including the periodic table.</p> <p>Understand ionic bonding including experiments on melting point and conductivity.</p> <p>Understand the periodic table and the classification of elements.</p> <p>Understand and carry out tests (eg flame test) on alkali metals.</p> <p>Understand the physical properties and application of halogens.</p> <p>Recall and deduce whether an element is a transition element – including that transition elements are often coloured.</p> <p>Understand the structure, properties and typical application of metals.</p> <p>Understand everyday quantitative analysis (eg dilution of chemicals and substances, guideline daily amounts (GDA) on food packaging).</p> |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Chemistry

Mapping Gateway Chemistry B J264 to R076 – Environmental science

| Keywords | Theme | Gateway Chemistry | Theme comments |
|--|--|--|--|
| LO1 Understand stable ecosystems – balanced and biological environment Ecosystem – living organisms and physical environment. Abiotic and biotic components – carbon, nitrogen, water | The structure of the Earth [D] | C2a: The structure of the Earth | Understand the structure of the Earth including tectonics and natural features that affect the environment such as volcanoes. |
| LO2 Impact of human and nature on environment Human events – agriculture, land use, industrial/domestic emissions, new species, GM organisms Nature – volcano, earthquake, flood, erosion, tsunami Consequences – biodiversity, climate change, sea level, drought, floods, safety, annoyance, unusable land | Environmental exploitation and pollution [D] The Earth and its natural resources [D] The ozone layer [D] | C1a: Making crude oil useful C1b: Using carbon fuels C1c: Clean air C1e: Designer polymers C1g: Smells [] C2a: The structure of the Earth C2b: Construction materials C2c: Metals and alloys C2d: Making cars [I] C6e: Depletion of the ozone layer | Describe the environmental problems with the exploitation of crude oil. Understand the problems with the finite nature of natural resources such as crude oil. Explain why increasing population and global development has lead to an increase in fossil fuels being burnt including effects such as pollution (eg acid rain, greenhouse effect) Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes. Understand the environmental issues associated with polymers (eg they are not bio-degradable). Recall the debate around the testing of perfumes on animals. [] |

Mapping Gateway Chemistry B J264 to R076 – Environmental science

| | Keywords | Theme | Gateway Chemistry | Theme comments |
|-----|---|-------|-------------------|----------------|
| LO3 | Physical conditions in environment – monitoring local and global Global picture - Satellite imaging, weather balloons, seismic sensors, marine sonar Local monitoring – particulate level, concentration of gasses, chemicals, noise, amount of litter | | | |
| LO4 | Use standard processes to monitor physical factors in environment Temp, humidity, rainfall, sunlight, UV radiation, wind speed. | | | |
| LO5 | Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, pH, microbiological count | | | |

Mapping Gateway Chemistry B J264 to R076 – Environmental science

| Keywords | Theme | Gateway Chemistry | Theme comments |
|---|---|--|---|
| LO6 Understand how environment is managed – local and global Conservation of natural resources, habitat protection, control of hazards, control of emission and waste. Industry regulated | Environmental exploitation and pollution [D] The Earth and its natural resources [D] Sustainable energy [D] | C1a: Making crude oil useful C1b: Using carbon fuels C1c: Clean air C2b: Construction materials C2c: Metals and alloys C2d: Making cars [] C6b: Energy transfers – fuel cells [] | Describe the environmental problems with the exploitation of crude oil. Understand the problems with the finite nature of natural resources such as crude oil. Explain why increasing population and global development has lead to an increase in fossil fuels being burnt including effects such as pollution (eg acid rain, greenhouse effect) Relate common pollutants found in air (eg carbon monoxide, oxides of nitrogen, sulphur dioxide) to the environmental problems it causes. Understand how raw materials such as sand, aggregate, clay and iron ores found in the Earth are used in construction. Understand how metals are extracted from their ores and some of their applications. Understand how the environment affects performance of materials (eg acid rain causes rusting). Understand that natural resources are finite and the significance of good design and recycling. [] Understand how hydrogen can be used in fuel cells including that it does not form a polluting waste product (unlike fossil fuels). |
| LO7 Structure of environmental organisations | | | |
| LO8 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Chemistry

Mapping Gateway Chemistry B J264 to R077 – The science of fitness and health

| Keywords | Theme | Gateway Chemistry | Theme comments |
|--|----------------------------|-----------------------------------|---|
| LO1 Understand musculoskeletal system Skull, vertebral column, humerus, radius/ulna, pelvis, femur, tibia/fibula Muscles, tendons Function: supporting, protecting, moving, making blood cells Joints: Hinge, ball and socket, pivot, glide, fixed Antagonistic muscles: biceps/triceps – forces to lift, pull, compress Levers: first order, second order, third order | | | |
| LO2 Understand circulatory system Heart, blood vessels, blood Function: transport of oxygen, defence, heat transfer Performance: pulse and heart rate, blood pressure, ECG | | | |
| LO3 Understand respiratory system Nose, mouth, throat Trachea, bronchi, bronchioles, alveoli Gas exchange: alveoli, capillaries, blood cells Performance: tidal volume, vital capacity (lung volume) | | | |
| LO4 Understand consequences of health and fitness on wellbeing Diet, weight, exercise Unhealthy: smoking, drugs, over/under exercise, under/over eating, unbalanced diet Risks: High BP, high cholesterol, coronary heart disease, stroke Resps: reduced lung capacity, emphysema, type 2 diabetes, arthritis | Guideline daily amount [I] | C5c: Quantitative analysis | Understand everyday quantitative analysis (eg dilution of chemicals and substances, guideline daily amounts (GDA) on food packaging). |

Mapping Gateway Chemistry B J264 to R077 – The science of fitness and health

| | Keywords | Theme | Gateway Chemistry | Theme comments |
|-----|---|-------|-------------------|----------------|
| LO5 | Create a fitness programme Muscle strength, speed, stamina, flexibility How long and hard: age, gender, health, fitness, skill Warmup Spacing out | | | |
| LO6 | Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | | | |
| LO7 | Structure of sports/health/fitness organisations | | | |
| LO8 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Chemistry

Mapping Gateway Chemistry B J264 to R078 – The science of production

| Keywords | Theme | Gateway Chemistry | Theme comments |
|--|--|--|--|
| LO1 Understand bulk production of chemicals Bulk production of chemicals – ammonia sulphate (fertiliser), sodium hydroxide (soap) Neutralisation reactions: salt + acid = salt + water | Making polymers, food additives and perfumes [D] Making paints, pigments, ammonia, fertilisers and salt [D] | C1d: Making polymers C1e: Designer polymers C2e: Manufacturing chemicals: making ammonia C2g: Fertilisers and crop yields | Understand how polymers are mass produced (eg nylon). Understand the production and applications of designer polymers (eg GORE-TEX). Understand the environmental issues associated with polymers (eg they are not bio-degradable). Recall the process used to manufacture ammonia including its applications such as in fertilisers and nitric acid. Understand industrial processes including rate, percentage yield and cost. Explain how fertilisers are used to increase crop yield. |

Mapping Gateway Chemistry B J264 to R078 – The science of production

| Keywords | Theme | Gateway Chemistry | Theme comments |
|--|---|---|---|
| LO2 Be able to produce a bulk chemical Indicators to determine neutralisation Yield – from mass of reactants | Making chemicals (including yield) [D] Chemical reactions [I] Atomic structure and the periodic table [I] | C2e: Manufacturing chemicals: making ammonia C2g: Fertilisers and crop yields C3a: Rate of reaction (1) C3b: Rate of reaction (2) C3c: Rate of reaction (3) C3d: Reacting masses C3e: Percentage yield and atom economy C3f: Energy C4a: Atomic structure C4b: Ionic bonding C4c: The Periodic Table and covalent bonding C4d: The Group 1 elements C4e: The Group 7 elements C4f: Transition elements C4g: Metal structure and properties | Understand industrial processes including rate, percentage yield and cost. Explain how fertilisers are used to increase crop yield. Understand the laboratory processes involved in measuring rate of reaction. Understand and measure how temperature, pressure and concentration affect reaction rate. Understand and measure how using a catalyst can affect the rate of reaction. Understand and apply principles of atomic masses (eg using periodic table). Understand that percentage yield is a way of comparing actual amount of product made and the amount expected. Understand endothermic and exothermic reactions. Understand atomic structure including the periodic table. Understand ionic bonding including experiments on melting point and conductivity. Understand the periodic table and the classification of elements. Understand and carry out tests (eg flame test) on alkali metals. Understand the physical properties and application of halogens. Recall and deduce whether an element is a transition element – including that transition elements are often coloured. Understand the structure, properties and typical application of metals. |

Mapping Gateway Chemistry B J264 to R078 – The science of production

| Keywords | | Theme | Gateway Chemistry | Theme comments |
|----------|--|--|---|---|
| LO3 | Understand factors that affect growth of plants (commercial) Plant growth factors: temp, water supply, minerals, light, CO ₂ , pests Maximising growth: increased light, fertilisers, pesticides Plant variety selection: quality, yield, hardiness, resistance to disease Genetic improvements | Fertilisers and crop yield [D] | C2g: Fertilisers and crop yields | Explain how fertilisers are used to increase crop yield. |
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Fertilisers and crop yield [D] | C2g: Fertilisers and crop yields | Explain how fertilisers are used to increase crop yield. |
| LO5 | Understand how products are made from micro-organisms Micro-organisms from waste/other processes: ethanol and CO ₂ by anaerobic respiration of yeast, lactic acid, antibiotics from fermentation. Production requires: food source, oxygen, temp, pH Products: bread, beer, yoghurt, antibiotics, lactic acid, ethanol Mycoprotein | Making products from micro-organisms [D] | C6d: Alcohols C6g: Natural fats and oils C6h: Detergents | Understand the manufacture and applications of alcohols/ethanol (eg alcoholic beverages, solvents, fuel for cars) Understand that natural fats and oils are an important raw material for the chemical industry. Understand the chemistry of detergents and solvents. |
| LO6 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Physics J245

R074 How scientists use analytical techniques to collect data

R075 How scientific data is used

R076 Environmental science

R077 The science of fitness and health

R078 The science of production

Gateway Physics J265

R074 How scientists use analytical techniques to collect data

R075 How scientific data is used

R076 Environmental science

R077 The science of fitness and health

R078 The science of production

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE 21st Century Physics

Mapping 21st Century Physics A J245 to R074 – How scientists use analytical techniques to collect data

| | Keywords | Theme | 21st Century Physics | Theme comments |
|-----|---|---|--|---|
| LO1 | Principles of good lab practice | | | |
| LO2 | Separate and identify substances in mixture Chromatography, stationary and mobile phases, Rf values, electrophoresis, gas chromatography, mass spectrometer | | | |
| LO3 | Examine and record features of samples Visual observation, light microscope. Electron microscope, X-ray analysis, ultrasound | Electromagnetic radiation [I] Measuring using refraction and waves [D] | P2.1 What types of electromagnetic radiation are there? What happens when radiation hits an object? P7.2 Light, telescopes and images | Understand different types of electromagnetic radiation (eg X-rays and ultraviolet radiation) Understand how refraction relates to the passage of light through different mediums. Understand how refraction of waves leads to the formation of an image in a convex/concave lens (eg in a microscope). |
| LO4 | Identify cations and anions in sample Flame test – barium, calcium, copper, lithium, potassium, sodium. Chemical test (cations) – aluminium, copper, iron, lead. Chemical test (anions) – carbonate, chloride, sulphate. Ion chromatography, atomic emission spectrometry. | | | |
| LO5 | Determine concentration of acid or base Indicators – for acids and bases – bromothymol, methyl orange, phenolphthalein pH meter auto-tritration | | | |

Mapping 21st Century Physics A J245 to R074 – How scientists use analytical techniques to collect data

| Keywords | Theme | 21st Century Physics | Theme comments |
|--|--|-----------------------------------|---|
| LO6 Determine concentration of coloured substances Visual comparison, colorimetry, calibration curves. Wavelength - spectrophotometer | Measuring using refraction and waves [D] | P7.2 Light, telescopes and images | Understand how refraction relates to the passage of light through different media (as used in spectrophotometry). Understand how refraction of waves leads to the formation of an image in a convex/concave lens (eg in a microscope). |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Physics

Mapping 21st Century Physics A J245 to R075 – How scientific data is used

| | Keywords | Theme | 21st Century Physics | Theme comments |
|-----|---|-------|----------------------|----------------|
| LO1 | Know/understand how scientists obtain scientific info Use/limitations of scientific equipment. Equipment advantages/disadvantages. Collecting samples. Calibration of equipment. | | | |
| LO2 | Analyse and process information | | | |
| LO3 | Evaluate information | | | |
| LO4 | Communicate scientific info | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE 21st Century Physics

Mapping 21st Century Physics A J245 to R076 – Environmental science

| Keywords | Theme | 21st Century Physics | Theme comments |
|--|--|--|--|
| LO1 Understand stable ecosystems – balanced and biological environment Ecosystem – living organisms and physical environment. Abiotic and biotic components – carbon, nitrogen, water | The Earth and how it is changing [D] Protecting the Earth [D] | P1.2 What do we know about the Earth and how it is changing? P2.2 Which types of electromagnetic radiation harm living tissue and why? P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it? | Understand how the Earth is changing (eg continental erosion by the sea) and natural phenomena such as earthquakes. Understand basic tectonics and their relationship to earthquakes, volcanoes and mountain building. Understand how the ozone layer protects living organisms. Understand the evidence relating to global warming and how serious a threat this is to the Earth. Recall that a rise in atmospheric carbon dioxide is as a result of burning fossil fuels and cutting down forests. |

Mapping 21st Century Physics A J245 to R076 – Environmental science

| Keywords | Theme | 21st Century Physics | Theme comments |
|--|--|--|--|
| LO2 Impact of human and nature on environment Human events – agriculture, land use, industrial/domestic emissions, new species, GM organisms Nature – volcano, earthquake, flood, erosion, tsunami Consequences – biodiversity, climate change, sea level, drought, floods, safety, annoyance, unusable land | The Earth and how it is changing [D] Protecting the Earth [D] Generating energy and its effects on the Earth [D] | P1.2 What do we know about the Earth and how it is changing? P2.2 Which types of electromagnetic radiation harm living tissue and why? P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it? P3.1 How much energy do we use? P3.2 How can electricity be generated? P3.3 Which energy sources should we choose? P6.2 How can radioactive materials be used and handled safely, including wastes? | Understand how the Earth is changing (eg continental erosion by the sea) and natural phenomena such as earthquakes. Understand basic tectonics and their relationship to earthquakes, volcanoes and mountain building. Understand how the ozone layer protects living organisms. Understand the evidence relating to global warming and how serious a threat this is to the Earth. Recall that a rise in atmospheric carbon dioxide is as a result of burning fossil fuels and cutting down forests. Understand that the demand for energy is increasing and the issues about the availability of energy sources. Understand that power stations burn fossil fuels and produce carbon dioxide which contributes to global warming and climate change. Suggest ways to reduce energy use in personal or national contexts. |
| LO3 Physical conditions in environment – monitoring local and global Global picture - Satellite imaging, weather balloons, seismic sensors, marine sonar Local monitoring – particulate level, concentration of gasses, chemicals, noise, amount of litter | Satellite communications [] | P2.4 How are electromagnetic waves used in communications? | Understand the effects of the Earth's atmosphere on radio communications. |
| LO4 Use standard processes to monitor physical factors in environment Temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Measuring the Sun's energy [D] | P5.2 What determines the size of the current in an electric circuit and the energy it transfers? P5.3 How do parallel and series circuits work? | Understand how a light dependent resistor (LDR) can be used to measure light intensity. |

Mapping 21st Century Physics A J245 to R076 – Environmental science

| Keywords | | Theme | 21st Century Physics | Theme comments |
|----------|--|--|---|--|
| LO5 | Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, pH, microbiological count | Protecting the Earth [D] | P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it? | Understand the evidence relating to global warming and how serious a threat this is to the Earth. Recall that a rise in atmospheric carbon dioxide is as a result of burning fossil fuels and cutting down forests. |
| LO6 | Understand how environment is managed – local and global Conservation of natural resources, habitat protection, control of hazards, control of emission ads waste. Industry regulated | Protecting the Earth [D] Generating energy and its effects on the Earth [D] | P2.2 Which types of electromagnetic radiation harm living tissue and why? P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it? P3.1 How much energy do we use? P3.2 How can electricity be generated? P3.3 Which energy sources should we choose? P6.2 How can radioactive materials be used and handled safely, including wastes? | Understand how the ozone layer protects living organisms. Understand the evidence relating to global warming and how serious a threat this is to the Earth. Recall that a rise in atmospheric carbon dioxide is as a result of burning fossil fuels and cutting down forests. Understand that the demand for energy is increasing and the issues about the availability of energy sources. Understand that power stations burn fossil fuels and produce carbon dioxide which contributes to global warming and climate change. Suggest ways to reduce energy use in personal or national contexts. Understand that radioactive materials require safe handling, and that nuclear power stations produce radioactive waste. |
| LO7 | Structure of environmental organisations | | | |
| LO8 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE 21st Century Physics

Mapping 21st Century Physics A J245 to R077 – The science of fitness and health

| Keywords | Theme | 21st Century Physics | Theme comments |
|--|--|--|--|
| LO1 Understand musculoskeletal system Skull, vertebral column, humerus, radius/ulna, pelvis, femur, tibia/fibula Muscles, tendons Function: supporting, protecting, moving, making blood cells Joints: Hinge, ball and socket, pivot, glide, fixed Antagonistic muscles: biceps/triceps – forces to lift, pull, compress Levers: first order, second order, third order | Medical analysis [I] Forces, motion, work and power [I] | P2.2 Which types of electromagnetic radiation harm living tissue and why? P4.2 What are forces? | Recall that barriers absorb ionising radiation (eg X-rays) and applications such as visualising bones. Recall that forces arise from an interaction between two objects (eg in human muscles and joints). |
| LO2 Understand circulatory system Heart, blood vessels, blood Function: transport of oxygen, defence, heat transfer Performance: pulse and heart rate, blood pressure, ECG | | | |
| LO3 Understand respiratory system Nose, mouth, throat Trachea, bronchi, bronchioles, alveoli Gas exchange: alveoli, capillaries, blood cells Performance: tidal volume, vital capacity (lung volume) | | | |

Mapping 21st Century Physics A J245 to R077 – The science of fitness and health

| Keywords | Theme | 21st Century Physics | Theme comments |
|---|-------|----------------------|----------------|
| LO4 Understand consequences of health and fitness on wellbeing Diet, weight, exercise Unhealthy: smoking, drugs, over/under exercise, under/over eating, unbalanced diet Risks: High BP, high cholesterol, coronary heart disease, stroke Resps: reduced lung capacity, emphysema, type 2 diabetes, arthritis | | | |
| LO5 Create a fitness programme Muscle strength, speed, stamina, flexibility How long and hard: age, gender, health, fitness, skill Warmup Spacing out | | | |
| LO6 Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | | | |
| LO7 Structure of sports/health/fitness organisations | | | |
| LO8 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

21st Century Physics

Mapping 21st Century Physics A J245 to R078 – The science of production

| | Keywords | Theme | 21st Century Physics | Theme comments |
|-----|---|--|---|---|
| LO1 | Understand bulk production of chemicals Bulk production of chemicals – ammonia sulphate (fertiliser), sodium hydroxide (soap) Neutralisation reactions: salt + acid = salt + water | | | |
| LO2 | Be able to produce a bulk chemical Indicators to determine neutralisation Yield – from mass of reactants | | | |
| LO3 | Understand factors that affect growth of plants (commercial) Plant growth factors: temp, water supply, minerals, light, CO ₂ , pests Maximising growth: increased light, fertilisers, pesticides Plant variety selection: quality, yield, hardiness, resistance to disease Genetic improvements Plant growth factors: temp, water supply, minerals, light, CO ₂ , pests Maximising growth: increased light, fertilisers, pesticides Plant variety selection: quality, yield, hardiness, resistance to disease Genetic improvements | Global warming and crop growth [D] Measuring the Sun's energy [I] | P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it? P5.2 What determines the size of the current in an electric circuit and the energy it transfers? P5.3 How do parallel and series circuits work? | Understand how global warming may result in it being impossible to grow some food crops. Understand how a light dependent resistor (LDR) can be used to measure light intensity. |
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Measuring the Sun's energy [I] | P5.2 What determines the size of the current in an electric circuit and the energy it transfers? P5.3 How do parallel and series circuits work? | Understand how a light dependent resistor (LDR) can be used to measure light intensity. |

Mapping 21st Century Physics A J245 to R078 – The science of production

| Keywords | Theme | 21st Century Physics | Theme comments |
|---|-------|----------------------|----------------|
| LO5 Understand how products are made from micro-organisms Micro-organisms from waste/other processes: ethanol and CO ₂ by anaerobic respiration of yeast, lactic acid, antibiotics from fermentation. Production requires: food source, oxygen, temp, pH Products: bread, beer, yoghurt, antibiotics, lactic acid, ethanol Mycoprotein | | | |
| LO6 Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Physics

Mapping Gateway Physics B J265 to R074 – How scientists use analytical techniques to collect data

| | Keywords | Theme | Gateway Physics | Theme comments |
|-----|---|--|---|--|
| LO1 | Principles of good lab practice | Heat and Energy [I] Electron movement [I] | P1a: Heating houses P1b: Keeping homes warm P4a: Sparks | Understand heat and energy, and how it is calculated. Understand convection, conduction and radiation of energy. Describe static electricity in terms of movement of electrons. |
| LO2 | Separate and identify substances in mixture Chromatography, stationary and mobile phases, Rf values, electrophoresis, gas chromatography, mass spectrometer | | | |
| LO3 | Examine and record features of samples Visual observation, light microscope. Electron microscope, X-ray analysis, ultrasound | Measuring using refraction and waves [D] Diagnostics using ultrasound [D] Measuring using refraction and waves [D] | P1c: A spectrum of waves P1d: Light and lasers P4d: Ultrasound P5h: Optics | Understand waves and wavelength. Understand the limitations of wave-based sensors (eg telescope and microscope). Understand how light and lasers can be used in recording and imaging. Understand how ultrasound can be used for diagnostic purposes. Understand how optics are use to view and examine samples (eg microscope). |
| LO4 | Identify cations and anions in sample Flame test – barium, calcium, copper, lithium, potassium, sodium. Chemical test (cations) – aluminium, copper, iron, lead. Chemical test (anions) – carbonate, chloride, sulphate. Ion chromatography, atomic emission spectrometry. | | | |

Mapping Gateway Physics B J265 to R074 – How scientists use analytical techniques to collect data

| Keywords | | Theme | Gateway Physics | Theme comments |
|----------|--|--|---|---|
| LO5 | Determine concentration of acid or base Indicators – for acids and base – bromothymol blue, methyl orange, phenolphthalein pH meter auto-titration | | | |
| LO6 | Determine concentration of coloured substances Visual comparison, colorimetry, calibration curves. Wavelength - spectrophotometer | Measuring using refraction and waves [D] Measuring using refraction and waves [D] | P1c: A spectrum of waves P1d: Light and lasers P5h: Optics | Understand waves and wavelength. Understand how light and lasers can be used in recording and imaging. Understand how optics are use to view and examine samples (eg microscope). |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Physics

Mapping Gateway Physics B J265 to R075 – How scientific data is used

| Keywords | | Theme | Gateway Physics | Theme comments |
|----------|---|--|--|---|
| LO1 | Know/understand how scientists obtain scientific info Use/limitations of scientific equipment. Equipment advantages/disadvantages. Collecting samples. Calibration of equipment. | | | |
| LO2 | Analyse and process information | Heat and Energy [I] Electron movement [I] | P1a: Heating houses P1b: Keeping homes warm P4a: Sparks | Understand heat and energy, and how it is calculated. Understand convection, conduction and radiation of energy. Describe static electricity in terms of movement of electrons. |
| LO3 | Evaluate information | Heat and Energy [I] Electron movement [I] | P1a: Heating houses P1b: Keeping homes warm P4a: Sparks | Understand heat and energy, and how it is calculated. Understand convection, conduction and radiation of energy. Describe static electricity in terms of movement of electrons. |
| LO4 | Communicate scientific info | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Physics

Mapping Gateway Physics B J265 to R076 – Environmental science

| Keywords | Theme | Gateway Physics | Theme comments |
|--|---|--|---|
| LO1 Understand stable ecosystems – balanced and biological environment Ecosystem – living organisms and physical environment. Abiotic and biotic components – carbon, nitrogen, water | Heat and Energy [] Stable Earth [D] Generating electricity [D] Global warming [D] The Earth and the Solar System [D] Radiation and its uses [] | P1a: Heating houses P1b: Keeping homes warm P1h: Stable Earth P2b: Generating electricity P2d: Fuels for power P2e: Nuclear radiations P2c: Global warming P2f: Exploring our Solar System P2g: Threats to Earth P2h: The Big Bang P4f: Uses of radioisotopes P4h: Fission and fusion | Understand heat and energy, and how it is calculated. Understand convection, conduction and radiation of energy. Understand how waves extracted from nature can be used measure and predict the environment (eg seismic waves can detect earth quakes and possible tsunami). Understand the relationship between environmental pollution (CFCs), the ozone layer and exposure to ultraviolet radiation. Understand sources of fuel for generating power, and the economic and environmental issues associated with them (eg fossil fuels, biomass and nuclear fuels). Understand the environmental issues and benefits associated with nuclear radiation as a source of energy (eg harmful radiation, disposal of waste, not causing global warming) Recall examples of greenhouse gases, reasons for climate change and the difficulties associated with understanding global warming. Explain how the ‘Big Bang’ theory relates to how the Universe (including Earth) was formed, why we want to explore our Solar System and risks to the Earth. Understand how radioisotopes can be used in dating the age of materials (eg rocks). |

Mapping Gateway Physics B J265 to R076 – Environmental science

| Keywords | Theme | Gateway Physics | Theme comments |
|--|--|--|--|
| LO2 Impact of human and nature on environment Human events – agriculture, land use, industrial/domestic emissions, new species, GM organisms Nature – volcano, earthquake, flood, erosion, tsunami Consequences – biodiversity, climate change, sea level, drought, floods, safety, annoyance, unusable land | Wireless signals [I] Stable Earth [D] Generating electricity [D] Global warming [D] Threats to the Earth [D] Energy conversion [D] Radiation [D] | P1g: Wireless signals P1h: Stable Earth P2b: Generating electricity P2d: Fuels for power P2e: Nuclear radiations P2c: Global warming P2g: Threats to Earth P3e: Energy on the move P4e: What is radioactivity? P4f: Uses of radioisotopes P4h: Fission and fusion | Understand how the transmission of wireless signals can depend on the Earth's atmosphere. Understand how waves extracted from nature can be used measure and predict the environment (eg seismic waves can detect earth quakes and possible tsunami). Understand the relationship between environmental pollution (CFCs), the ozone layer and exposure to ultraviolet radiation. Understand sources of fuel for generating power, and the economic and environmental issues associated with them (eg fossil fuels, biomass and nuclear fuels). Understand the environmental issues and benefits associated with nuclear radiation as a source of energy (eg harmful radiation, disposal of waste, not causing global warming) Recall examples of greenhouse gases, reasons for climate change and the difficulties associated with understanding global warming. Understand threats to the earth such as asteroid collision, and strategies for avoiding such catastrophes. Understand how sources of energy can be converted into propulsion (eg fossil fuels used to produce petrol and diesel for a motor vehicle). Recall that bio-fuels and solar energy are an environmentally friendly alternative to using fossil fuels. Describe how electricity can be used for road transport and its environmental effects. Understand the benefits and dangers associated with radiation including managing radioactive waste. |

Mapping Gateway Physics B J265 to R076 – Environmental science

| Keywords | | Theme | Gateway Physics | Theme comments |
|----------|---|---|---|---|
| LO3 | Physical conditions in environment – monitoring local and global Global picture - Satellite imaging, weather balloons, seismic sensors, marine sonar Local monitoring – particulate level, concentration of gasses, chemicals, noise, amount of litter | Measuring using waves [D] Waves and the atmosphere [I] Stable Earth [D] Satellites and waves [D] | P1c: A spectrum of waves P1d: Light and lasers P1e: Cooking and communicating using waves P1g: Wireless signals P1h: Stable Earth P5a: Satellites, gravity and circular motion P5e: Satellite communication P5f: Nature of waves | Understand waves and wavelength. Understand the limitations of wave-based sensors (eg telescope and microscope). Understand how light and lasers can be used in recording and imaging. Understand how emission and absorption of infrared radiation is affected by properties of the surface of an object (eg surface temperature) Understand how the transmission of wireless signals can depend on the Earth's atmosphere. Understand how waves extracted from nature can be used measure and predict the environment (eg seismic waves can detect earth quakes and possible tsunami). Understand how man-made satellites can be used for scientific research and imaging of the Earth. |
| LO4 | Use standard processes to monitor physical factors in environment Temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Heat and Energy [I] Measuring the Sun's energy [D] | P1a: Heating houses P1b: Keeping homes warm P1d: Light and lasers P1e: Cooking and communicating using waves P2a: Collecting energy from the Sun | Understand heat and energy, and how it is calculated. Understand convection, conduction and radiation of energy. Understand how light and lasers can be used in recording and imaging. Understand how emission and absorption of infrared radiation is affected by properties of the surface of an object (eg surface temperature). Understand how energy from the Sun can be measured using a photocell. |

Mapping Gateway Physics B J265 to R076 – Environmental science

| Keywords | | Theme | Gateway Physics | Theme comments |
|----------|--|--|---|--|
| LO5 | Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, Ph, microbiological count | Heat and Energy [I] | P1d: Light and lasers P1e: Cooking and communicating using waves | Understand how light and lasers can be used in recording and imaging. Understand how emission and absorption of infrared radiation is affected by properties of the surface of an object (eg surface temperature). |
| LO6 | Understand how environment is managed – local and global Conservation of natural resources, habitat protection, control of hazards, control of emission ads waste. Industry regulated | Heat and Energy [I] Measuring the Sun's energy [I] Generating electricity [D] Electrostatics [I] Radiation [D] | P1b: Keeping homes warm P2a: Collecting energy from the Sun P2b: Generating electricity P2c: Global warming P2d: Fuels for power P2e: Nuclear radiations P4b: Uses of electrostatics P4e: What is radioactivity? P4h: Fission and fusion | Understand convection, conduction and radiation of energy. Understand how energy from the Sun can be measured using a photocell. Understand sources of fuel for generating power, and the economic and environmental issues associated with them (eg fossil fuels, biomass and nuclear fuels). Understand the environmental issues and benefits associated with nuclear radiation as a source of energy (eg harmful radiation, disposal of waste, not causing global warming) Understand how electrostatic precipitators can be used to remove smoke particles from chimneys. Understand the benefits and dangers associated with radiation including managing radioactive waste. |
| LO7 | Structure of environmental organisations | | | |
| LO8 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Physics

Mapping Gateway Physics B J265 to R077 – The science of fitness and health

| Keywords | Theme | Gateway Physics | Theme comments |
|--|--|---|---|
| LO1 Understand musculoskeletal system Skull, vertebral column, humerus, radius/ulna, pelvis, femur, tibia/fibula Muscles, tendons Function: supporting, protecting, moving, making blood cells Joints: Hinge, ball and socket, pivot, glide, fixed Antagonistic muscles: biceps/triceps – forces to lift, pull, compress Levers: first order, second order, third order | Forces, motion, work and power [I] Medical analysis [I] Motion [I] | P3c: Forces and motion P3d: Work and power P4g: Treatment P5b: Vectors and equations of motion P5d: Action and reaction | Understand forces and motion (eg in relation to muscles and joints in the human body). Understand the relationship between work and power (eg when lifting a weight) Understand how radiation (eg X-Rays) can be used in analysis and treatment. Describe the difference between vector and scalar quantities (eg in relation to muscle and skeletal joint forces and motion). Recall that the range of a ball struck in sport depends on launch angle. |
| LO2 Understand circulatory system Heart, blood vessels, blood Function: transport of oxygen, defence, heat transfer Performance: pulse and heart rate, blood pressure, ECG | Medical electrostatics [I] | P4b: Uses of electrostatics | Understand how static electricity can be used for restarting the heart using a defibrillator. |
| LO3 Understand respiratory system Nose, mouth, throat Trachea, bronchi, bronchioles, alveoli Gas exchange: alveoli, capillaries, blood cells Performance: tidal volume, vital capacity (lung volume) | | | |

Mapping Gateway Physics B J265 to R077 – The science of fitness and health

| | Keywords | Theme | Gateway Physics | Theme comments |
|-----|--|------------------------------------|---|---|
| LO4 | Understand consequences of health and fitness on wellbeing Diet, weight, exercise Unhealthy: smoking, drugs, over/under exercise, under/over eating, unbalanced diet Risks: High BP, high cholesterol, coronary heart disease, stroke Resps: reduced lung capacity, emphysema, type 2 diabetes, arthritis | | | |
| LO5 | Create a fitness programme Muscle strength, speed, stamina, flexibility How long and hard: age, gender, health, fitness, skill Warmup Spacing out | Forces, motion, work and power [I] | P3c: Forces and motion P3d: Work and power | Understand forces and motion (eg in relation to muscles and joints in the human body). Understand the relationship between work and power (eg when lifting a weight) |
| LO6 | Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | Measuring body temperature [D] | P1f: Data transmission | Understand how infrared sensors can be used to measure body temperature. |
| LO7 | Structure of sports/health/fitness organisations | | | |
| LO8 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Gateway Physics

Mapping Gateway Physics B J265 to R078 – The science of production

| | Keywords | Theme | Gateway Physics | Theme comments |
|-----|---|--|-------------------------------------|---|
| LO1 | Understand bulk production of chemicals Bulk production of chemicals – ammonia sulphate (fertiliser), sodium hydroxide (soap) Neutralisation reactions: salt + acid = salt + water | | | |
| LO2 | Be able to produce a bulk chemical Indicators to determine neutralisation Yield – from mass of reactants | | | |
| LO3 | Understand factors that affect growth of plants (commercial) Plant growth factors: temp, water supply, minerals, light, CO ₂ , pests Maximising growth: increased light, fertilisers, pesticides Plant variety selection: quality, yield, hardiness, resistance to disease Genetic improvements | Measuring the Sun's energy [<input type="checkbox"/>] | P2a: Collecting energy from the Sun | Understand how energy from the Sun can be measured using a photocell. |
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Measuring the Sun's energy [<input type="checkbox"/>] | P2a: Collecting energy from the Sun | Understand how energy from the Sun can be measured using a photocell. |

Mapping Gateway Physics B J265 to R078 – The science of production

| Keywords | | Theme | Gateway Physics | Theme comments |
|----------|--|-------|-----------------|----------------|
| LO5 | Understand how products are made from micro-organisms Micro-organisms from waste/other processes: ethanol and CO ₂ by anaerobic respiration of yeast, lactic acid, antibiotics from fermentation. Production requires: food source, oxygen, temp, pH Products: bread, beer, yoghurt, antibiotics, lactic acid, ethanol Mycoprotein | | | |
| LO6 | Research career opportunities | | | |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

Cambridge National in ICT J800

R074 How scientists use analytical techniques to collect data

R075 How scientific data is used

R076 Environmental science

R077 The science of fitness and health

R078 The science of production

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

ICT

ICT to R074 – How scientists use analytical techniques to collect data (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | Theme | ICT | Theme comments |
|---|--|--|---|
| LO1 Principles of good lab practice Measuring, collecting data, sampling, repeatability and reproducibility, interpret data, report on data, evaluate and validate results | Use ICT to gather and interpret data using spreadsheets. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to handle and represent scientific data (eg spreadsheets and plotting graphs) |
| LO2 Separate and identify substances in mixture Quantitative analysis – area under peaks | Undertake quantitative analysis of scientific data using spreadsheets. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to handle, perform quantitative analysis, and represent scientific data (eg spreadsheets and plotting graphs) |
| LO3 Examine and record features of samples Calculating magnification and scale | | | |
| LO4 Identify cations and anions in sample | | | |

ICT to R074 – How scientists use analytical techniques to collect data (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | | Theme | ICT | Theme comments |
|----------|---|--|--|--|
| LO5 | Determine concentration of acid or base Choice of measuring equipment. | | | |
| LO6 | Determine concentration of coloured substances Visual comparison. Plot and use calibrated curves | Enter data and plot curves using spreadsheets. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to handle and represent scientific data in the form of graphs (eg spreadsheets and graph plotting) |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

ICT

ICT to R075 – How scientific data is used (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| | Keywords | Theme | ICT | Theme comments |
|-----|--|---|--|---|
| LO1 | Know/understand how scientists obtain scientific info Identify control variables. Solve problems using multiple techniques. Collecting samples [I] Calibration [I] | | | |
| LO2 | Analyse and process information Calculate mean, range, % error for data. Identify outliers and unexpected values. Measure uncertainty from systematic/random errors. Qualitative techniques? Quantitative techs for Rf value – concentration, scaling images, calibration graphs | Perform scientific calculations using spreadsheets. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to perform scientific calculations and represent data (eg using spreadsheets) |

ICT to R075 – How scientific data is used (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | | Theme | ICT | Theme comments |
|----------|---|--|---|---|
| LO3 | Evaluate information Draw conclusions from data. Repeatability/ reproducibility Comparison with other information. Use secondary data for support | Evaluate scientific data using internet searching. Evaluate scientific data using spreadsheets. | R001 (M) LO 1: Understand how ICT can be used to meet business needs R002 (M) LO 1: Be able to use techniques to search for, store and share information R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to search for and present information about scientific data. Use ICT to evaluate scientific data (eg using spreadsheets) |
| LO4 | Communicate scientific info Maths symbols and conventions. Communicate – diagrams, flow charts, pictures, tables. | Use ICT to communicate scientific data. Use advanced ICT methods to present scientific data. | R002 (M) LO 3: Be able to select and use software to communicate information for a business purpose LO 4: Be able to use software tools to format information R007 (C) LO 1: Be able to prepare for the production of dynamic products LO 2: Be able to create dynamic products LO 3: Be able to test functionality of dynamic products | Use ICT to communicate scientific data. Use advanced ICT presentation techniques to communicate scientific data. |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

ICT

ICT to R076 – Environmental science (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | | Theme | ICT | Theme comments |
|----------|---|--|--|---|
| LO1 | Understand stable ecosystems – balanced and biological environment | | | |
| LO2 | Impact of human and nature on environment | | | |
| LO3 | Physical conditions in environment – monitoring local and global Measuring values of - particulate level, concentration of gasses, chemicals, noise, amount of litter | | | |
| LO4 | Use standard processes to monitor physical factors in environment Measuring values of - temp, humidity, rainfall, sunlight, UV radiation, wind speed. | Use ICT to monitor, record and present environmental data. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to monitor, record and present environmental data (eg using data loggers and spreadsheets to record temperature, humidity, sunlight, UV etc.) |

ICT to R076 – Environmental science (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | | Theme | ICT | Theme comments |
|----------|--|--|--|---|
| LO5 | Use standard processes to measure degree of pollution Pollution measurement. Direct: particulates, CO, CO ₂ , NO _x , nitrates, phosphates. Indirect: oxygen, pH, microbiological count | Use ICT to monitor, record and present pollution data. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to monitor, record and present pollution data (eg using data loggers and spreadsheets to record particulates, CO, CO ₂ , NO _x etc.) |
| LO6 | Understand how environment is managed – local and global | | | |
| LO7 | Structure of environmental organisations | Use ICT to research the structure of organisations. | R001 (M) LO 1: Understand how ICT can be used to meet business needs R002 (M) LO 1: Be able to use techniques to search for, store and share information | Use ICT to search for and research the structure of organisations. |
| LO8 | Research career opportunities | Use ICT to research career opportunities. | R001 (M) LO 1: Understand how ICT can be used to meet business needs R002 (M) LO 1: Be able to use techniques to search for, store and share information | Use ICT to search for and research career opportunities. |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

ICT

ICT to R077 – The science of fitness and health (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | Theme | ICT | Theme comments |
|--|--|--|---|
| LO1 Understand musculoskeletal system Hinges. Levers – 1st, 2nd and 3rd order Forces to lift, pull and compress | | | |
| LO2 Understand circulatory system Flow rates Heat transfer Measuring performance: pulse and heart rate, blood pressure, ECG | | | |
| LO3 Understand respiratory system Measuring performance: tidal volume, vital capacity (lung volume) | | | |
| LO4 Understand consequences of health and fitness on wellbeing | | | |
| LO5 Create a fitness programme Determine goals and targets for: Muscle strength, speed, stamina, flexibility Measuring Planning | Use ICT to create a fitness programme. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to assist with creating a fitness programme (eg using a spreadsheet to set target data for heart rate, VO ₂ , muscle strength and speed etc.). |

ICT to R077 – The science of fitness and health (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | | Theme | ICT | Theme comments |
|----------|---|--|--|--|
| LO6 | Measure a person's fitness Data measurement: Resting heart rate and pulse, cardiovascular endurance (VO ₂), speed test, flexibility test, anthropometrics Collect data: BP, lung function, cholesterol, glucose test | Use ICT (spreadsheet) to record and present a person's fitness data. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to record, analyse and present a person's fitness data (eg using a spreadsheet to record heart rate, VO ₂ , speed and flexibility test data, lung capacity etc.). |
| LO7 | Structure of sports/health/fitness organisations | Use ICT to research the structure of organisations. | R001 (M) LO 1: Understand how ICT can be used to meet business needs R002 (M) LO 1: Be able to use techniques to search for, store and share information | Use ICT to search for and research the structure of organisations. |
| LO8 | Research career opportunities | Use ICT to research career opportunities. | R001 (M) LO 1: Understand how ICT can be used to meet business needs R002 (M) LO 1: Be able to use techniques to search for, store and share information | Use ICT to search for and research career opportunities. |

CAMBRIDGE NATIONAL IN SCIENCE IN THE WORKPLACE

ICT

ICT to R078 – The science of production (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | | Theme | ICT | Theme comments |
|----------|--|---|--|--|
| LO1 | Understand bulk production of chemicals | | | |
| LO2 | Be able to produce a bulk chemical Measure volumes Yield by mass, theoretical yield, percentage yield. Evaluate percentage yield obtained | Use ICT to record, analyse and present bulk chemical production data. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to record, analyse and present bulk chemical production data (eg using a spreadsheet to record chemical masses, reactions and percentage yield etc.) |
| LO3 | Understand factors that affect growth of plants (commercial) | | | |
| LO4 | Be able to monitor growth of plant (commercial) Methods to monitor plant growth: Height, stem diameter, fresh mass, dry mass, leaf area, appearance | Use ICT to record, analyse and present plant growth data. | R002 (M) LO 2: Be able to select and use software to handle data R003 (B) LO 1: Be able to create and populate spreadsheets to meet user requirements LO 2: Be able to select and use spreadsheet functions to meet user requirements LO 3: Be able to use spreadsheet models to present information to support decision making | Use ICT to record, analyse and present plant growth data (eg using a spreadsheet to record stem height, stem diameter and wet/dry mass etc.) |

ICT to R078 – The science of production (Key to strand: M=mandatory/B=business/C=creative/T=technical)

| Keywords | | Theme | ICT | Theme comments |
|----------|--|---|---|--|
| LO5 | Understand how products are made from micro-organisms Units of temperature, oxygen, pH, food quantity [1] | | | |
| LO6 | Research career opportunities | Use ICT to research career opportunities. | R001 (M) LO 1: Understand how ICT can be used to meet business needs R002 (M) LO 1: Be able to use techniques to search for, store and share information | Use ICT to search for and research career opportunities. |

Contact us

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OCR Resources: *the small print*

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