OXFORD
INTERNATIONAL
AQA EXAMINATIONS

# INTERNATIONAL A-LEVEL GEOGRAPHY

(9635)

Schemes of work

## Physical geography 2: Water, carbon and life on earth

This scheme of work is not exhaustive or prescriptive; it is designed to suggest activities and resources that you might find useful in your teaching. Any revisions will be published on the website.

# 3.1 Physical geography

## Core topic

## 3.1.1 Water and carbon cycles

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| **Week 1**<br><br>Systems in physical geography: Systems concepts and their applications to the water and carbon cycles inputs-outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium. | Use of key subject specific and technical terminology.<br><br>To identify **connections** and interrelationships between different aspects of geography.<br><br>Constructing and using systems and models.<br><br>Labelling and annotation of diagrams. | An overview of the concept and use of '**models**' by geographers as simplifications of a complex world.<br><br>Understanding of the concept of '**systems frameworks**' as a type of model fundamental to most areas of geographical understanding.<br><br>Students will be able to identify, describe and explain the elements of geographical systems, including:<br><br>• stores/components<br><br>• flows/connections<br><br>• elements | Small group discussions followed by feedback – what models used in geography do students know?<br><br>Students to draw and annotate a model system to show the key elements of a system.<br><br>Students to draw and annotate a diagram of an example of a positive feedback system and a negative feedback system.<br><br>Repeat group discussion to see if students can now think of any more examples of systems in geography. | Introductory presentation on natural systems: **prezi.com/waun8urselvh/water-and-carbon-cycles-as-natural-systems/**<br><br>Website with simple summaries of a number of earth systems: **eo.ucar.edu/kids/green/cycles1.htm**<br><br>A summary of the features of the lithosphere: **nationalgeographic.org/encyclopedia/lithosphere/**<br><br>A summary of the features of the hydrosphere: **nationalgeographic.org/activity/our-hydrosphere/**<br><br>A summary of the features of the cryosphere: **oceanservice.noaa.gov/facts/cryosphere.html** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| | | • attributes<br>• relationships.<br><br>Students will be able to identify, describe and explain common characteristics of systems including:<br><br>• boundaries<br>• inputs<br>• outputs<br>• flows.<br><br>Students will understand systems that are classified as:<br><br>• isolated systems<br>• closed systems<br>• open systems.<br><br>Students will understand systems as being in a state of dynamic equilibrium that includes:<br><br>• positive feedback<br>• negative feedback.<br><br>Students will be able to identify the four major | Students to work in pairs/small groups to think of ways in which the 4 'spheres' are interlinked. To feedback and share ideas.<br><br>Opportunity here for a short research task for interconnections between geographical systems.<br><br>Practice low-tariff exam questions to assess learning – peer assessment opportunity. | More information on the cryosphere: **nsidc.org/cryosphere/**<br><br>A summary of the features of the atmosphere: **nationalgeographic.org/encyclopedia/atmosphere/** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| | | subsystems of the earth:<br>• atmosphere<br>• lithosphere<br>• hydrosphere<br>• biosphere.<br>To understand that these are interlinked as a 'cascading system'. | | |
| **Weeks 1–3**<br><br>**The water cycle**<br>• Global distribution and size of major stores of water – lithosphere, hydrosphere, cryosphere and atmosphere.<br>• Processes driving change in the magnitude of these stores over time and space, including flows and transfers: evaporation, condensation, cloud formation, causes of precipitation and cryospheric processes | Use of key subject specific and technical terminology.<br><br>Opportunities to develop skills such as drawing, labelling and annotating diagrams.<br><br>Opportunity to study soil infiltration rates.<br><br>Online research.<br><br>Construct and interpret line graphs and bar graphs. | Students will understand that on earth water exists in three forms:<br>• solid ice<br>• liquid water<br>• gaseous water vapor.<br>Students will understand the idea of latent heat and energy in the context of evaporation and condensation and how they relate to major atmospheric processes like cloud formation and precipitation.<br><br>Students will understand the distribution of water on earth in terms of: | Brief question and answer/paired discussion – in what 'states' does water exist?<br><br>Construct a diagram to illustrate water-changing state, including latent heat.<br><br>An opportunity to conduct research into each of the major stores of water – in small groups each student given one store to research and return to the group to share and snowball.<br><br>Construct and annotate a range of diagrams to illustrate hydrological cycles, drainage basin hydrological cycles and | An interactive website that summarises the water cycle: **water.usgs.gov/edu/watercycle-kids-adv.html**<br><br>A simple summary of the changing state of water including latent heat: **eo.ucar.edu/kids/sky/water1.htm**<br><br>More detailed information on the properties of water: **physicalgeography.net/fundamentals/8a.html**<br><br>A summary of some of the key themes within the water cycle: **nationalgeographic.org/encyclopedia/water-cycle/**<br><br>A summary of cloud formation: **nationalgeographic.org/encyclopedia/cloud/** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| at hill slope, drainage basin and global scales with reference to varying timescales involved.<br>• Drainage basins as open systems – inputs and outputs, to include precipitation, evapotranspiration and runoff; stores and flows, to include interception, surface, soil water, groundwater and channel storage; stemflow, infiltration overland flow, and channel flow. Concept of water balance.<br>• Run off variation and the flood hydrograph.<br>• Changes in the water cycle over time to include natural variation (including storm events, seasonal changes) and human impact (including farming practices, land use | | • oceanian and fresh water<br>• the limited amount of water economically and physically accessible for human use.<br><br>Students will understand that the Earth's water is distributed between:<br>• oceanic water<br>• cryospheric water<br>• terrestrial water<br>• atmospheric water.<br><br>Students will explore the nature of the dynamic equilibrium between these stores.<br><br>Students will be able to describe and explain the characteristics of each of these stores.<br><br>Students will be able to describe and explain the characteristics and inputs, stores, transfers and outputs of a drainage basin system, including: | slope drainage systems.<br><br>Construct and annotate a model of the soil moisture budget – opportunity to stretch students with thinking skills to identify and analyse factors affecting the SMB.<br><br>Opportunities to study local level case studies of drainage basins, storm hydrographs, etc.<br><br>Opportunities to assess all aspects with a full range of exam style questions. | Information on cloud formation and precipitation:<br>**ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/cld/home.rxml**<br><br>Met Office video clip on precipitation:<br>**youtube.com/watch?v=dQJsJRNJOfI**<br><br>A range of Met Office videos on many aspects of the weather and atmosphere:<br>**youtube.com/playlist?list=PLGVVqeJodR_bqVT3iXTRNQ9gIUjuXIEvK**<br><br>A summary of global water stores:<br>**water.usgs.gov/edu/earthwherewater.html**<br><br>Further information on global water stores:<br>**theglobaleducationproject.org/earth/fresh-water.php**<br><br>A summary of the characteristics of drainage basins:<br>**thebritishgeographer.weebly.com/drainage-basin-feedbacks.html**<br><br>A resource for creating a storm hydrograph:<br>**floodready.co.uk/uploadedfiles/resources/Create_a_Storm_Hydrograph_for_a_Flood_Event_Activity.pdf**<br><br>Search for information on and flow |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| change and water abstraction). | | • precipitation<br>• interception store<br>• throughfall<br>• stemflow<br>• Infiltration<br>• soil storage<br>• vegetation storage<br>• transpiration<br>• infiltration<br>• surface storage<br>• evapotranspiration<br>• overland flow/sheet flow<br>• throughflow<br>• percolation<br>• groundwater store and flow<br>• channel flow<br>• run off.<br><br>Students to be able to describe and explain the global water cycle.<br><br>Students will be able to | | data for gauging stations in the UK – data can be downloaded to create hydrographs:<br><br>**nrfa.ceh.ac.uk/data/search**<br><br>The national river flow archives and UK river and flow regimes: **nrfa.ceh.ac.uk/uk-river-flow-regimes** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| | | describe and explain the water balance to include:<br>• inputs, outputs and stores<br>• river regime<br>• soil moisture budget.<br>Students will be able to describe and explain the characteristics of and human and physical factors affecting a storm and flood hydrograph. To include:<br>• rising limb<br>• peak discharge<br>• lag time<br>• receding limb.<br>To understand specific factors affecting the water cycle, to include:<br>• deforestation<br>• soil drainage<br>• water abstraction. | | |
| **Weeks 4–6**<br><br>**The carbon cycle**<br>• Global distribution and | Interpreting a variety of charts, data, graphs and maps (especially | Students to understand the features of carbon as an element, its versatility and importance as a component | Introductory discussion/question and answer session to establish what students | An article that summarizes many of the key aspects of the carbon cycle:<br><br>**globecarboncycle.unh.edu/Carbon** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| size of major stores of carbon – lithosphere, hydrosphere, cryosphere biosphere, atmosphere.<br>• Factors driving change in the magnitude of these stores over time and space, including flows and transfers at plant, sere and continental scales. Photosynthesis, respiration, decomposition, combustion, burial, compaction, carbon sequestration in oceans and sediments, weathering.<br>• Changes in the carbon cycle over time, to include natural variation (including wild fires, volcanic activity) and human impact (including hydrocarbon fuel extraction and burning, farming | atlas maps).<br><br>To develop extended writing skills to explore issues relating to changes in the carbon cycle.<br><br>Opportunity to create line graphs of amounts of carbon dioxide ($CO_2$) in the atmosphere over time.<br><br>Opportunity to discuss the nature of geographical data and methods of collection of the type of data relevant here, including geographic information systems (GIS).<br><br>Opportunity to analyse and present geographical data employing a variety of graphical techniques and descriptive statistics. (see skills checklist). | of organic and inorganic compounds.<br><br>Students to understand that as geographers the study of $CO_2$ is of most importance currently due to its perceived role in controlling climate.<br><br>Students to understand the origins of the carbon that we study in the carbon cycle.<br><br>Students to be able to describe and explain the global stores of carbon, including:<br>• lithosphere<br>• hydrosphere<br>• cryosphere<br>• biosphere<br>• atmosphere.<br><br>Students to be able to describe and explain the movement of transfer between the carbon stores, studied above, at a range of scales. Including:<br>• plant | know about carbon and its importance and versatility as an element.<br><br>Opportunity for group research activity, with each student given a carbon store to study and then feedback shared with the group.<br><br>Opportunity for students to engage with a range of charts, diagrams, graphs and maps to be able to describe the characteristics of different carbon transfers.<br><br>Opportunity for independent research into natural and human impacts on the carbon cycle. With illustrations of examples from different places around the world.<br><br>Opportunity for students to read around the impacts of changes in the carbon cycle and the possible impacts. Students to categorise the impacts according to: | **CycleBackground.pdf**<br><br>Web page with a diagram summarising the main stores of carbon: **physicalgeography.net/fundamentals/9r.html**<br><br>An interactive multiple choice quiz on the carbon cycle (with links to other reading and resources): **visionlearning.com/en/library/Earth-Science/6/The-Carbon-Cycle/95/quiz**<br><br>The full length lesson on the carbon cycle from TED Ed lessons:<br><br>**ed.ted.com/lessons/the-carbon-cycle-nathaniel-manning**<br><br>'The carbon cycle'<br><br>A summary of changing carbon emissions and sinks since 1750:<br><br>**shrinkthatfootprint.com/carbon-emissions-and-sinks**<br><br>Changes in the carbon cycle over different time scales, including natural cycles: **earthobservatory.nasa.gov/Features/CarbonCycle/page4.php**<br><br>Links between carbon and climate |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| practices, deforestation, land use changes).<br>• The carbon budget and the impact of the carbon cycle upon land, ocean and atmosphere, including global climate. | | • sere<br>• continental.<br>Students to be able to describe and explain the processes involved in these transfers, including:<br>• photosynthesis<br>• respiration<br>• decomposition<br>• combustion<br>• burial<br>• compaction<br>• carbon sequestration<br>• weathering.<br>Students to be able to describe, explain, analyse and comment on factors leading to change in the carbon cycle, including:<br>• wild fires<br>• volcanic activity<br>• hydrocarbon fuel extraction<br>• land use changes. | • human or physical<br>• social, economic, environmental, demographic, political, etc.<br>With an opportunity for students to investigate the possible effects of the disruption of the North Atlantic ocean currents on the climate of NW Europe.<br>The greenhouse effect should be prior knowledge for A-level students – in pairs ask students to produce a diagram and accompanying annotations and text to explain to each other the greenhouse effect. Students to 'peer assess' each other and identify strengths and weaknesses of each other's explanation.<br>Ensure all students have access to a "correct" description and explanation, followed by multimedia or research opportunity to explore the idea of the "enhanced | (links include an interactive carbon budget between 1960 and 2100): **carboncycle.aos.wisc.edu/**<br>Met Office summary of a range of impacts of climate change: **metoffice.gov.uk/climate-guide/climate-change/impacts**<br>Interactive resource on the greenhouse effect, with various articles on climate change: **environment.nationalgeographic.com/environment/global-warming/gw-overview-interactive/**<br>Interactive map of possible impacts of climate change: **environment.nationalgeographic.com/environment/global-warming/gw-impacts-interactive/** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| | | Students to be able to describe and explain, and draw conclusions about the nature of the impacts of carbon cycle, and possible future changes, for:<br>• the land<br>• the oceans<br>• the atmosphere and global climate.<br>Students to be introduced to the idea of "enhance greenhouse effect". | greenhouse effect". | |
| **Week 7**<br><br>**Water, carbon, climate and life on Earth**<br>• The key role of the carbon and water stores and cycles in supporting life on Earth and particular reference to climate. The relationship between the water cycle and carbon cycle in the atmosphere. The role of feedbacks within and between cycles | Comparative graphing techniques.<br>Extended writing to levels descriptors.<br>Collect, analyse and interpret information from a range of secondary sources – including factual, numerical and spatial data.<br>Critical questioning of information, and sources of information. | Students to understand the positive feedback between $CO_2$ led warming leading to higher evaporation rates and a wetter atmosphere.<br>Students to understand the significance of water (water vapour and clouds) and carbon ($CO_2$) as greenhouse gases.<br>Students to understand the dominance of $CO_2$ in controlling the **scale** of the greenhouse effect.<br>Students to understand and | An opportunity for students to construct comparative graphs – to show increases in greenhouse gases and atmospheric temperatures.<br>Students could construct feedback diagrams to illustrate relationships between water and carbon cycles and climate change.<br>Following discussion and reading students to write an extended, prose exam style answer to explain the role of carbon and water in the greenhouse effect. | Website with resources, lesson ideas and interactive activities about a range of issues relating to the role of carbon: **serc.carleton.edu/earthlabs/carbon/index.html**<br>Website with a range of pages exploring links between the water and carbon cycles and climate: **science.nasa.gov/earth-science/oceanography/ocean-earth-system/**<br>Studying the effects of changes in the carbon cycle: **earthobservatory.nasa.gov/Features/CarbonCycle/page5.php** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| and their link to climate change and implications for life on Earth.<br><br>• Human interventions in the carbon cycle designed to influence carbon transfers and mitigate the impacts of climate change. | Evaluating and presenting findings from research. | explain why there is a lag between increased emissions of $CO_2$ and any resulting temperature increase.<br><br>Students to have a clear understanding of the concept of "mitigation".<br><br>All students will be able to identify a range of possible human interventions to reduce or prevent emissions. Differentiation could be used when getting students to identify categories or groupings of strategies/approaches – eg local, regional, national, global etc.<br><br>Students to be able to describe and explain in detail a range of specific strategies that are employed to mitigate greenhouse gas emissions. Possibly including:<br><br>• carbon capture and sequestration (CCS)<br><br>• changing rural land use<br><br>• improved transport practices. | Opportunity for peer assessment.<br><br>Opportunity for group work for students to identify as many mitigation strategies as possible then to categorise. This information once shared could be used to produce a summary mind map.<br><br>An opportunity for a research or individual learning activity for students to explore different mitigation strategies – this learning could be shared with the group in a range of ways including wall display, group/individual presentation, PowerPoint/Prezi presentation, YouTube video, or blog, etc.<br><br>An opportunity to discuss the differing views relating to climate change, and any ethical, moral or socio-political issues arising. Also to be critical of the sources of data. | Video clip of Met Office climate scientist exploring the idea of climate feedbacks: **youtube.com/watch?v=363HhzYzJlA**<br><br>Ted-Ed video exploring the role of clouds in climate change: **youtube.com/watch?v=sDo7saKaEys**<br><br>Video looking at the Human Role in climate change: **youtube.com/watch?v=LdlORWLd_wk**<br><br>Link to the Imperial College centre for carbon capture and storage website: **imperial.ac.uk/carboncaptureandstorage**<br><br>The industry view on carbon capture and storage: **ccsassociation.org/**<br><br>A lengthy 2005 IPCC report on carbon capture and storage, runs to +400 pages, but the "Summary for policymakers" introduces a range of key ideas with accompanying diagrams: **ipcc.ch/pdf/special-reports/srccs/srccs_wholereport.pdf**<br><br>IPCC video clips: |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| | | | | Working group II – fifth assessment report – climate change 2014: impacts, adaptation and vulnerability:<br><br>youtube.com/watch?v=jMIFBJYpSgM<br><br>Working group III – fifth assessment report – climate change 2014: mitigation of climate change:<br><br>youtube.com/watch?v=gDcGz1iVm6U |
| **Weeks 8–9**<br><br>**Case study 1**<br><br>Case study of a tropical rainforest setting to illustrate and analyse key themes in water and carbon cycles and their relationship to environmental change and human activity. | Collect, analyse and interpret a range of qualitative and quantitative data from a range of primary and secondary sources – this could include discursive/creative material when looking at the experiences of people in place. | Students will be able to describe, explain and evaluate a number of themes relating to water and climate in the Amazon tropical rainforest, including:<br><br>• how changes in the water and carbon cycles have changed the tropical rainforest environment<br><br>• the relationships between hydrology, the carbon cycle and the environment<br><br>• how human activity affects the tropical rainforest.<br><br>Students will be able to describe and evaluate a range of strategies employed | Opportunity for individual, paired or group research task, using a range of textual, digital or audiovisual resources. Findings could be shared in traditional classroom approaches or shared through a virtual learning environment (VLE) on a blog for example.<br><br>For a more active learning approach, students could research from the point of view of different stakeholders. Feedback could then take the form of a debate/roleplay or construction of SWOT | Deforestation and carbon cycles in the Amazon rainforest:<br><br>livescience.com/27692-deforestation.html<br><br>livescience.com/34629-amazon-river-carbon-cycle.html<br><br>Presentation exploring the impacts of land use change on the hydrological cycle in the Brazilian Amazon region: youtube.com/watch?v=oztPk2lU_fg<br><br>Exploring the impacts of climate change in the Amazonian tropical rainforest: wwf.org.uk/where_we_work/south_america/amazon/amazon_and_climate_change.cfm<br><br>rainforests.mongabay.com/amazon/ |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| | | in the Amazon tropical rainforest to reduce the effects of climate change. | analysis in groups etc. | **amazon_climate_change.html**<br><br>**rainforest-alliance.org/work/climate**<br><br>Search for information on flow data for gauging stations in the UK – data can be downloaded from the national river flow archive to create hydrographs: **nrfa.ceh.ac.uk/data/search** |
| **Case study 2**<br><br>Case study of a river catchment(s) at a local scale to illustrate and analyse the key themes above, engage with field data and consider the impact of precipitation upon drainage basin stores and transfers and implications for sustainable water supply and/or flooding. | As above, including fieldwork data collection, presentation and analysis techniques, to come to valid conclusions.<br><br>Techniques to evaluate the geographical enquiry process.<br><br>Ideally, a river catchment close to the school should be chosen. If this is impossible, it might be possible to create a 'virtual fieldwork' study of a river elsewhere. Some sources for river study in the UK are | Either students could study a local river using secondary data sources – including online and digital mapping, or students could engage first hand and complete fieldwork to collect primary data, or a combination of both. The aim of such work is to:<br><br>• illustrate how the hydrological system affects channel flow<br><br>• analyse the relationships between inputs and outputs in a local river<br><br>• to understand implications for flooding on a local river.<br><br>If students complete a fieldwork, investigation they will be able to follow through a complete geographical | An opportunity to either create a "virtual fieldwork investigation" or provide students with a range of data relating to a local river for students to investigate and address the themes of the enquiry.<br><br>Alternatively, an opportunity for students to conduct a short fieldwork enquiry of a local river to investigate the main themes of the lesson.<br><br>Students could write up a mini-fieldwork enquiry to act as a case study of a local river.<br><br>(This could feed into the completion of coursework for the non-examination | The National river flow archives and UK river and flow regimes: **nrfa.ceh.ac.uk/uk-river-flow-regimes**<br><br>The field studies council (and other similar organisations) may also provide guidance and resources to help undertake fieldwork. **field-studies-council.org/publications/pubs/understanding-geography-fieldwork-3-the-river-environment.aspx**<br><br>Study of the River Evenlode in Oxfordshire: **geocases1.co.uk/vf1.htm** |

| Specification content<br><br>Week number | Subject specific skills development | Learning outcomes | Suggested learning activities (including ref to differentiation and extension activities) | Resources |
|---|---|---|---|---|
| | provided. | investigation and route to enquiry. | assessment element of the specification). | |

## Quantitative and qualitative skills

Students must engage with a range of quantitative and relevant qualitative skills, within the theme water and carbon cycles. Students must specifically understand simple mass balance, unit conversions and the analysis and presentation of field data.

# GET HELP AND SUPPORT

Visit our website for information, guidance, support and resources at **oxfordaqaexams.org.uk**

You can contact the geography team directly;

E: **geography@oxfordaqaexams.org.uk**

**OXFORD INTERNATIONAL AQA EXAMINATIONS**
LINACRE HOUSE, JORDAN HILL, OXFORD, OX2 8TA
UNITED KINGDOM

enquiries@oxfordaqaexams.org.uk
oxfordaqaexams.org.uk