



Topic Studied – Water and Carbon Cycle

Week	Specification Point	Key Questions	Pre-Lesson Work	Set Homework	Independent Work Further Reading
1	<p>Water and carbon cycles as natural systems</p> <p>Systems in physical geography: systems concepts and their application to the water and carbon cycles inputs - outputs, energy, stores/components, flows/transfers, positive/negative feedback, dynamic equilibrium.</p>	<p>How does the water cycle function as an open system with inputs, outputs, stores, and transfers?</p> <p>What role do feedback mechanisms play in maintaining or disrupting equilibrium in the water cycle?</p> <p>In what ways can the water cycle reach a dynamic equilibrium, and how is this balance affected by natural and human factors?</p>	<p>Draw a labelled diagram showing the water cycle as an open system with at least three inputs, outputs, stores, and flows.</p> <p>Write a short paragraph explaining what is meant by 'dynamic equilibrium' and how it applies to either the water or carbon cycle.</p> <p>Find and summarise one example of positive feedback in the carbon cycle in no more than three bullet points.</p>	<p>Answer the following questions based on your understanding of the water cycle as a natural system:</p> <p>Identify and describe two inputs, two outputs, two stores, and two flows in the water cycle. <i>(Use labelled diagrams if helpful.)</i></p> <p>Explain one example of positive or negative feedback within the water cycle. <i>(E.g. melting ice increasing evaporation.)</i></p> <p>Evaluate how human activities (such as deforestation or urbanisation) can disrupt the dynamic equilibrium of the water cycle. <i>(Write a short paragraph - around 100-150 words.)</i></p>	<p>Read the Met Office's "The Water Cycle" overview. Then write five bullet points on how solar energy drives evaporation, condensation, precipitation, and flows like infiltration and runoff. https://weather.metoffice.gov.uk/learn-about/weather/how-weather-works/water-cycle</p> <p>Read the MetLink article "The Changing Water Cycle." Identify one positive feedback mechanism (e.g., water-vapour feedback). Identify one negative feedback (e.g., increased cloud cover reducing solar heating). Write two sentences explaining each. https://www.metlink.org/resource/the-changing-water-cycle/</p>
2	<p>3.1.1.2 The water cycle</p> <p>Global distribution and size of major stores of water - lithosphere, hydrosphere,</p>	<p>How does the volume of water in each major store (e.g. oceans vs. ice sheets) compare, and why?</p>	<p>Create a labelled diagram showing the four major water stores (lithosphere, hydrosphere, cryosphere, atmosphere). For each store, include:</p> <ul style="list-style-type: none"> - One example location (e.g., "Antarctica" for cryosphere) 	<p>Write a short paragraph explaining why most of Earth's water is stored in the hydrosphere.</p> <p>Summarise in two bullet points how atmospheric water, though small in</p>	<p>Read the IPCC AR6 Working Group I - Chapter 8 Summary, and note two trends in cryosphere loss: https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-8/</p> <p>Summarise each section into 1-2 bullet points: https://www2.who.edu/site/globalwatercycle/</p>

	cryosphere and atmosphere.	What patterns can be observed in the global distribution of cryospheric water, and how are these changing?	<ul style="list-style-type: none"> - The main form of water (solid, liquid, gas) - A short note about its importance in the global water cycle (1 sentence each) <p>Write a short explanation (3-4 sentences) of why so little of Earth's water is available for human use, even though water covers most of the planet. Include references to freshwater stores.</p>	volume, significantly affects climate systems.	
3	3.1.1.2 The water cycle 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 at hill slope, drainage basin and global scales with reference to varying timescales involved.	How and why do evaporation and condensation rates vary globally? What processes affect cryospheric change at hillside, basin, and global scales?	Read this Met Office explanation of cloud formation and write three bullet points: https://weather.metoffice.gov.uk/learn-about/weather/types-of-weather/clouds/what-are-clouds-and-how-do-they-form Define sublimation and explain its role in cryospheric change (two sentences).	Write a 100-150 word explanation of how cloud formation is influenced by rising air, cooling temperatures, and the presence of condensation nuclei. Include reference to at least one type of cloud formation process (e.g. convectional, frontal, or orographic). Write a paragraph explaining why polar cryospheric processes often occur over longer timescales.	Read the Met Office blog "Water security and the global water cycle" (Feb 2023), and write three bullet points explaining how solar energy and atmospheric transport interact to cause evaporation, condensation, and precipitation patterns. https://www.metoffice.gov.uk/blog/2023/water-security-and-the-global-water-cycle Read the Wikipedia entry for "Water vapour" and note two key properties (e.g. greenhouse effect, residence time). Then explain in a short paragraph how atmospheric water vapour contributes to precipitation and weather patterns. https://en.wikipedia.org/wiki/Water_vapor
4	3.1.1.2 The water cycle Drainage basins as open systems - inputs and outputs, to include precipitation, evapo-transpiration	In what ways does interception and infiltration influence the water balance in a UK drainage basin?	Draw a drainage basin system and label: precipitation, interception, infiltration, runoff, groundwater, channel flow.	Define stemflow and explain its importance in forested basins such as those in Cumbria.	Read the Cool Geography page "Drainage Basins as open systems" and write three bullet points explaining how inputs, stores, flows, and outputs function together in a drainage basin, using UK-specific examples. https://www.coolgeography.co.uk/advanced/Drainage_Basins.php Read the GOV.UK PDF "A systems-based approach to catchment water management" and write a short paragraph describing how environmental services (like flood regulation and water

	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.	Why are drainage basins considered open systems?			quality) are integrated into catchment planning, and why considering the entire system is essential. https://assets.publishing.service.gov.uk/media/6093c7208fa8f548b0a95ef3/A_systems-based_approach_to_catchment_water_management_-_report.pdf
5	3.1.1.2 The water cycle Runoff variation and the flood hydrograph. Changes in the water cycle over time to include natural variation including storm events, seasonal changes and human impact including farming practices, land use change and water abstraction.	How do storm characteristics influence runoff in a river catchment? What catchment features shape the flood hydrograph?	Use this Cool Geography guide to identify three physical and three human factors affecting the hydrograph: https://www.coolgeography.co.uk/advanced/Hydrographs_Regimes.php#:~:text=Long%20steady%20prolonged%20rainfall%20will,time%20and%20high%20peak%20discharge. Draw and label a storm hydrograph: rising limb, peak discharge, lag time, recession limb.	Analyse a sample hydrograph and explain which basin features cause each phase. Compare seasonal hydrograph shapes for a UK basin using rainfall and temperature clues.	Read the Environment Agency-CEH technical report "Estimating flood peaks and hydrographs for small catchments". https://assets.publishing.service.gov.uk/media/65fd4a8065ca2f00117da85d/Estimating_flood_peaks_and_hydrographs_for_small_catchments_-_R6_-_Estimating_design_hydrographs.pdf assets.publishing.service.gov.uk/3assets.publishing.service.gov.uk/3 Then, in three bullet points, explain: <ol style="list-style-type: none"> 1. One method used to estimate flood hydrograph shapes in small catchments. 2. How hydrograph shape helps in understanding flood risk (e.g. rise and recession). 3. One limitation of using standard estimation methods in urban or forested catchments.
6	3.1.1.6 Case studies Case study of a river catchment(s) at a local scale to illustrate and analyse the key themes above, engage with field data and	How do rainfall and land use affect the River Eden's stores and flows? What are the implications for sustainable water	Explore the following website: https://edenriverstrust.org.uk/secondary-schools/explore-the-eden-geography-of-the-eden-catchment/ Identify two main land uses in the Eden catchment and describe how they affect runoff or infiltration.	Produce a report at least one side of A4 on Storm Desmond and the Carlisle floods of December 2015.	Read and make notes on the following: https://www.cumbria.gov.uk/eLibrary/Content/Internet/536/6181/42494151257.pdf

consider the impact of precipitation upon drainage basin stores and transfers and implications for sustainable water supply and/or flooding.

management and flood risk?

Year 12



Topic Studied – Water and Carbon Cycle, Climate Change, Life on Earth

Subject

Week	Specification Point	Key Questions	Pre-Lesson Work	Set Homework	Independent Work Further Reading
1	<p>3.1.1.3 The Carbon Cycle</p> <p>Global distribution, and size of major stores of carbon - lithosphere, hydrosphere, cryosphere biosphere, atmosphere.</p> <p>Factors driving change in the magnitude of these stores over time and space , including flows and transfers at plant, sere and</p>	<p>What are the characteristics of carbon stores?</p> <p>What are the main transfers of carbon?</p> <p>What are the main factors leading to change in the carbon cycle?</p>	<p>Research carbon as an element and write a paragraph explaining why it is important and how it is versatile.</p> <p>Research the stores of carbon and write a short description of each one.</p> <p>Go over the greenhouse effect. Draw a diagram to represent how it works and what the enhanced greenhouse effect is.</p>	<p>Research the fast carbon cycle and the slow carbon cycle. Write a paragraph explaining what each one is.</p> <p>Watch the following videos and make notes:</p> <p>Carbon... SO SIMPLE: Crash Course Biology #1</p> <p>Carbon - Periodic Table of Videos</p>	<p>Read the following article:</p> <p>Microsoft Word - CarbonBackgroundMaterials19-2009 Web.doc - An Introduction to the Global Carbon Cycle - University of New Hampshire</p> <p>Read the following article:</p> <p>Global Carbon Emissions and Sinks Since 1750 Shrink That Footprint by Lindsay Wilson</p> <p>Read the following article:</p> <p>Effects of climate change - Met Office</p>

	<p>continental scales. Photosynthesis, respiration, decomposition, combustion, carbon sequestration in oceans and sediments, weathering.</p>				
2	<p>3.1.1.3 The Carbon Cycle</p> <p>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 practices, deforestation, land use changes).</p>	<p>How do natural processes such as wildfires and volcanic activity contribute to short-term and long-term variations in the carbon cycle?</p> <p>In what ways have human activities altered the stores and fluxes of carbon in recent times?</p> <p>What are the relative significance and interactions of natural and</p>	<p>Research one example of a natural variation in the carbon cycle and one example of a human impact on the carbon cycle. Try to find examples from different parts of the world.</p> <p>Create a glossary for the following terms:</p> <ul style="list-style-type: none"> • Lithosphere • Hydrosphere • Cryosphere • Biosphere • Atmosphere • Plant • Sere • Continental. • Photosynthesis • Respiration • Decomposition • Combustion • Burial • Compaction • Carbon sequestration • Weathering. • Wildfires 	<p>Assess the extent to which there are inter-relationships between processes in the water cycle and factors driving change in the carbon cycle.</p> <p>[20 marks]</p>	<p>Watch the following video and complete the 'Think' tasks and read through the resources in the 'Dig Deeper' section:</p> <p>'The carbon cycle' full length by Nathan Manning</p>

		<p>human factors in driving changes in the carbon cycle over time?</p>	<ul style="list-style-type: none"> • Volcanic activity • Hydrocarbon fuel extraction • Land use changes. • the land • the oceans • the atmosphere and global climate. 		
3	<p>3.1.1.3 The Carbon Cycle</p> <p>The carbon budget and the impact of the carbon cycle upon land, ocean and atmosphere, including global climate.</p>	<p>What is the global carbon budget, and how does it help us understand the balance between carbon inputs and outputs in the atmosphere, oceans, and land?</p> <p>How does the carbon cycle influence climate systems and processes, including the greenhouse effect and global temperature change?</p> <p>In what ways do changes in the carbon cycle affect ecosystems on land and in the oceans, such as soil health, ocean</p>	<p>Create a glossary for the following key terms:</p> <ul style="list-style-type: none"> • Carbon budget • Carbon sink • Carbon source • Ocean acidification • Greenhouse effect • Sequestration <p>Read through this page and make notes:</p> <p>https://www.coolgeography.co.uk/advanced/Carbon_Budget.php</p>	<p>Choose one real-world example of how the carbon cycle affects either land, ocean, or atmosphere:</p> <ul style="list-style-type: none"> -Amazon rainforest carbon sink -Coral reef bleaching linked to CO₂ rise -Arctic permafrost thaw releasing methane <p>Write 150–200 words explaining:</p> <p>What is happening?</p> <p>What role the carbon budget plays.</p> <p>What consequences there are for ecosystems and climate.</p> <p>Create a diagram showing three major carbon stores (land, ocean, atmosphere) and arrows indicating carbon transfers between them.</p>	<p>Read the following report: https://arxiv.org/pdf/2412.09226</p> <p>Read the following report: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021RG000736?utm_source</p> <p>Read the following report: https://www.theccc.org.uk/publication/the-seventh-carbon-budget/</p>

		acidification, and biodiversity?			
4	<p>3.1.1.3 The Carbon Cycle</p> <p>The key role of the carbon and water stores and cycles in supporting life on Earth with particular reference to climate. The relationship between the water cycle and carbon cycle in the atmosphere. The role of feedbacks within and between cycles and their link to climate change and implications for life on Earth .</p>	<p>How do the carbon and water cycles interact to regulate Earth's climate and support life?</p> <p>What are the main feedback mechanisms within and between the carbon and water cycles, and how do they influence climate change?</p> <p>In what ways could changes to the carbon and water cycles have implications</p>	<p>Define the following key terms in your own words (1-2 sentences each):</p> <ul style="list-style-type: none"> • Positive feedback • Negative feedback • Evapotranspiration • Carbon sequestration • Albedo effect • Climate regulation <p>Research the following:</p> <ul style="list-style-type: none"> • One way the water cycle affects the carbon cycle. • One way the carbon cycle affects the water cycle. • One example of a feedback process that links them to climate change. <p>Write a paragraph answering:</p>	<p>Answer the following exam questions:</p> <p>Explain the concept of negative feedback within the carbon cycle. [4 marks]</p> <p>Outline the relationship between the water cycle and the carbon cycle in the atmosphere. [4 marks]</p> <p>Outline the process of decomposition in the carbon cycle. [4 marks]</p>	<p>Video clip of Met Office climate scientist exploring the idea of climate feedbacks (9 mins): ‘Climate feedback’ by Ben Booth (2009)</p> <p>Studying the effects of changes in the carbon cycle</p> <p>Met Office climate scientist explores the idea of climate feedbacks</p> <p>Ted-Ed video exploring the role of clouds in climate change: ‘Cloudy climate change’ by Jasper Kirkby (2014)</p> <p>Video looking at the Human Role in climate change (11 mins): ‘Human role in climate change’ Richard Alley (2008)</p> <p>Carbon capture and sequestration in the USA</p>

		for ecosystems and human societies?	"Why are the water and carbon cycles essential for life on Earth?"		
5	3.1.1.3 The Carbon Cycle Human interventions in the carbon cycle designed to influence carbon transfers and mitigate the impacts of climate change.	What strategies have humans developed to manage and modify carbon transfers within the carbon cycle? How effective are different human interventions in reducing atmospheric carbon and mitigating the impacts of climate change? What are the environmental, economic, and social implications of large-scale carbon management strategies?	Use a reliable website to find one example of each of the following: -A nature-based solution (e.g., forest restoration) -A technological solution (e.g., direct air capture) For each, write 2-3 bullet points explaining: -What it involves -Where it has been implemented -Its goal for reducing carbon in the atmosphere	Is climate change mitigation <i>actually</i> possible? Why are some people sceptical of mitigation strategies? Answer these questions using evidence. Use the following articles to help you: https://www.sciencedirect.com/science/article/pii/S2214629623004504 https://commonwealthbeacon.org/environment/in-the-face-of-climate-change-mitigation-is-no-longer-enough/	Link to the Imperial College Centre for Carbon Capture and Storage website 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: Carbon dioxide capture and storage report The UNEP website for Climate Change Mitigation, with links to different sectors including Agriculture and Transport: IPCC video clips: Working Group II - Fifth Assessment Report - Climate change 2014: Impacts, Adaptation and Vulnerability: Climate Change: Impacts, Adaptation and Vulnerability (2014) Working Group III - Fifth Assessment Report - Climate change 2014: Mitigation of climate change: Climate change: Mitigation of climate change (2014)
6	3.1.1.6 Case studies Case study of a tropical rainforest setting to illustrate and analyse key themes in water and carbon cycles and their	How do the water and carbon cycles operate within a tropical rainforest ecosystem, and what roles do they play in supporting biodiversity	https://www.coolgeography.co.uk/advanced/Tropical_rainforest_casestudy.php Use the link to create a fact-file on the Amazon rainforest. As well as basic information, include how	Plan an answer to the both questions. Fully write out an answer to at least one of them, if not both! Evaluate the potential impact of changes in the carbon budget on a tropical rainforest that you have studied. [20 marks] 'Human activity has a significant impact on flows of water in tropical rainforests.'	Deforestation and carbon cycles in the Amazon rainforest: Deforestation: facts, causes & effects Amazon river breathes carbon dioxide from rain forest Simple introductory video clip about the Amazon rainforest and water and carbon

	<p>relationship to environmental change and human activity.</p>	<p>and climate regulation?</p> <p>In what ways have human activities, such as deforestation and land-use change, disrupted the water and carbon cycles in this tropical rainforest setting?</p> <p>What are the consequences of changes in the rainforest's water and carbon cycles for local and global environments, and how might these be managed or mitigated?</p>	<p>water moves through the Amazon ecosystem and how carbon is stored and cycled.</p> <p>How has the Amazon changed in the last 30 years or so? Find statistics about the deforestation that has taken place and the impact of this.</p> <p>Find at least one specific scheme being implemented in the Amazon rainforest to manage it sustainably.</p>	<p>With reference to a tropical rainforest you have studied, to what extent do you agree with this view? [20 marks]</p>	<p>Presentation exploring the impacts of land use change on the hydrological cycle in the Brazilian Amazon region: ‘The Hydrological cycle’ by Woods Hole Research Centre (2014)</p> <p>Exploring the impacts of climate change in the Amazonian tropical rainforest:</p> <p>Amazon and climate change</p> <p>Understanding climate change impacts on the Amazon rainforest</p> <p>Climate change and the Amazon rainforest</p> <p>Addressing climate change</p>
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Year 12

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Topic Studied

Week	Specification Point	Key Questions	Pre-Lesson Work	Set Homework	Independent Work Further Reading
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Topic Studied

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