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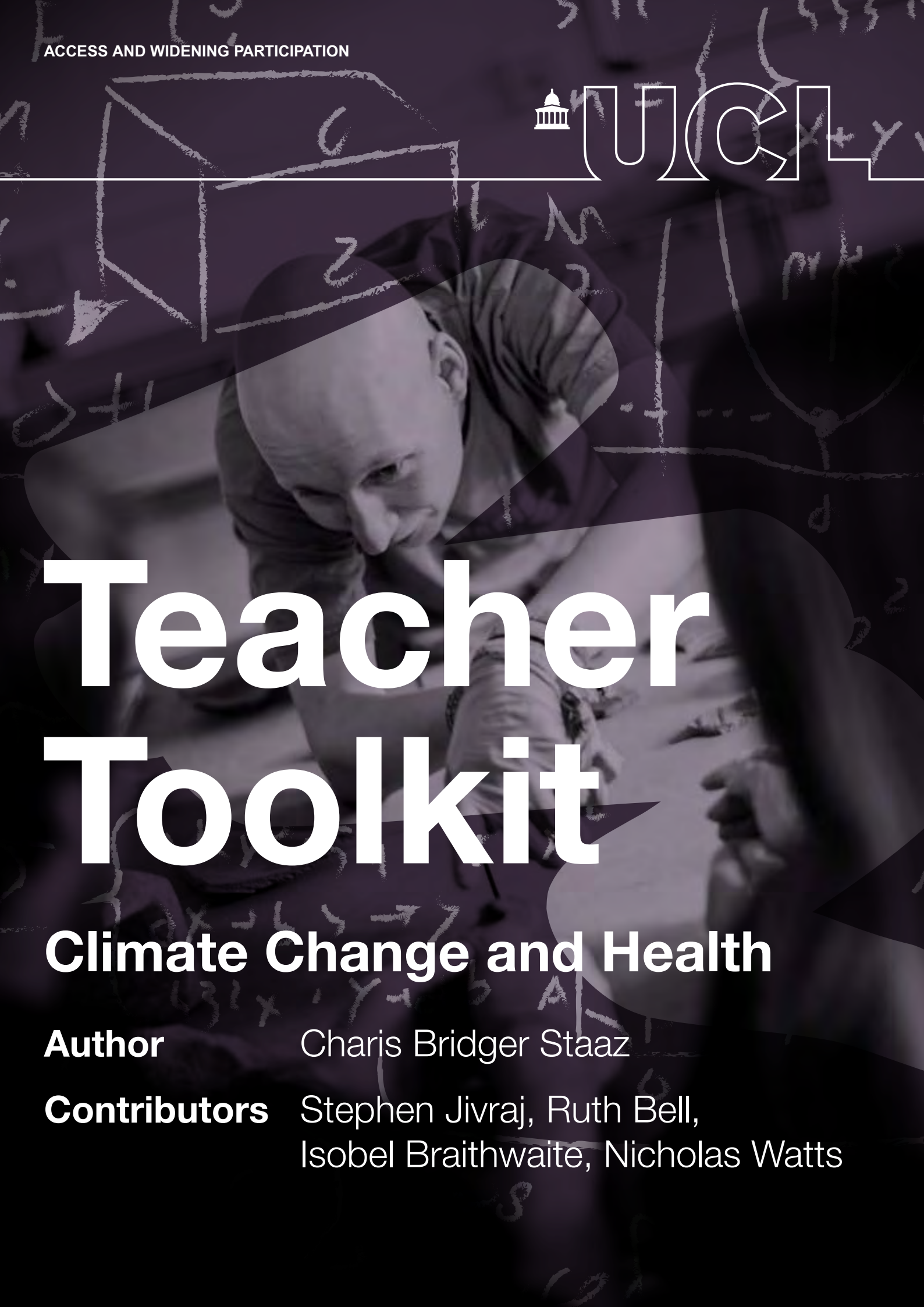

Teacher Toolkit

Climate Change and Health

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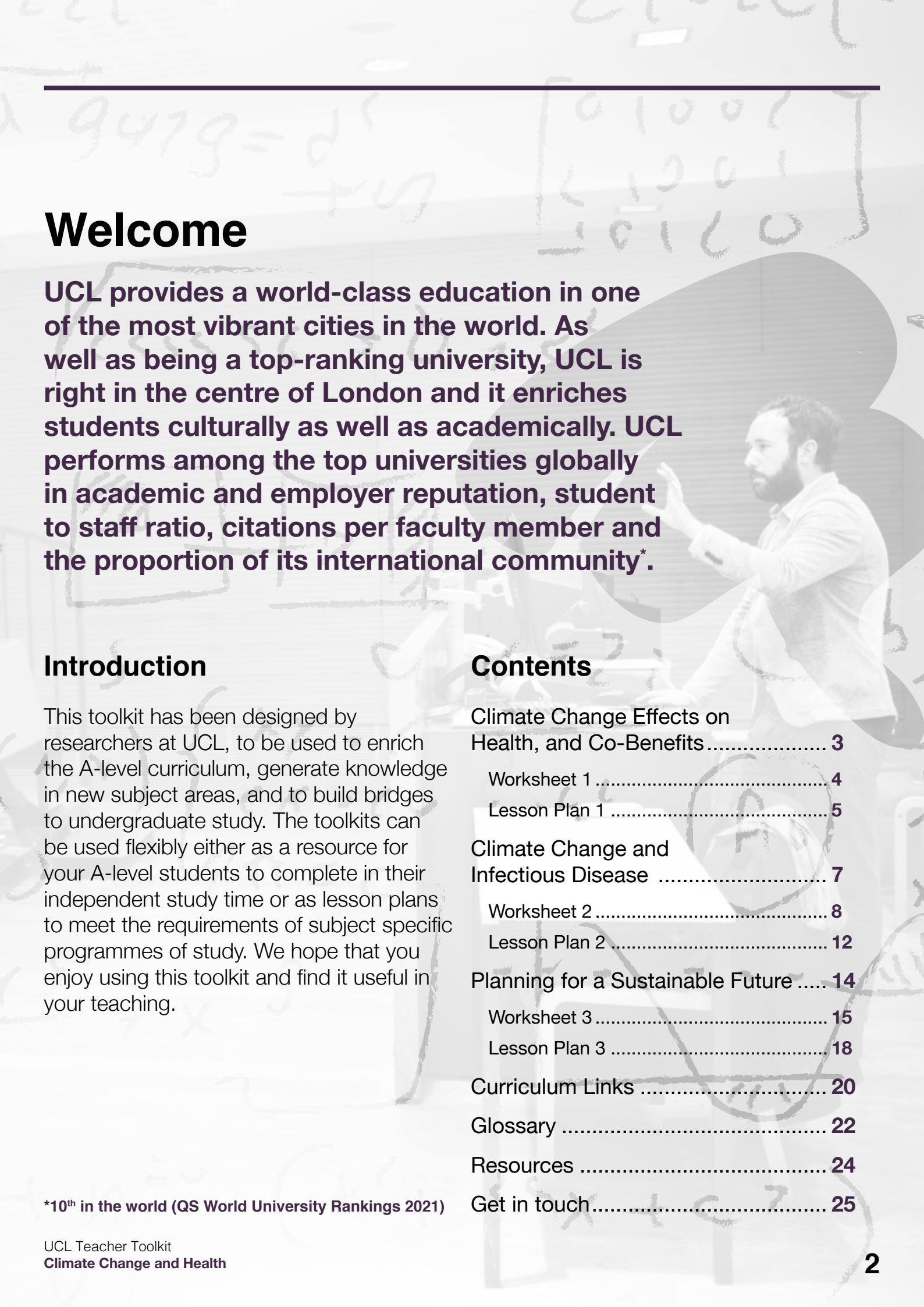
Welcome

UCL provides a world-class education in one of the most vibrant cities in the world. As well as being a top-ranking university, UCL is right in the centre of London and it enriches students culturally as well as academically. UCL performs among the top universities globally in academic and employer reputation, student to staff ratio, citations per faculty member and the proportion of its international community*.



Introduction

This toolkit has been designed by researchers at UCL, to be used to enrich the A-level curriculum, generate knowledge in new subject areas, and to build bridges to undergraduate study. The toolkits can be used flexibly either as a resource for your A-level students to complete in their independent study time or as lesson plans to meet the requirements of subject specific programmes of study. We hope that you enjoy using this toolkit and find it useful in your teaching.

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***10th in the world (QS World University Rankings 2021)**

Topic 1:

Climate Change Effects on Health, and Co-Benefits

Worksheet 1

Climate Change Effects on Health, and Co-Benefits

Direct and indirect effects of climate change

Direct Effects of climate change are those that are felt immediately as a result of climate change. For example, the impacts on health from temperature increases, weather extremes, increases in sea levels, change and distribution of water- and food-borne diseases.

Indirect Effects of climate change are those that are not felt immediately. They include changes to agriculture and employment, mass migration, civil unrest and wider social and economic instability.

Mitigation and adaptation

Mitigation of climate change are primary prevention efforts that aim to slow down or reverse the rate or climate change.

Adaptation to climate change is secondary and tertiary efforts that aim to prepare for the impacts of climate change.

Co-Benefits

Co-benefits are opportunities to take action on climate change that not only reduce the impact of climate change, but also positively benefit human health either directly or indirectly. For example, increasing cycling infrastructure would reduce pollution and increase physical activity.

Activity 1

In groups, use the resources provided and any others you find, to research into one of the below areas:

- Direct Effects of Climate Change
- Indirect Effects of Climate Change
- Mitigation of Climate Change
- Adaption of Climate Change
- Co-Benefits

In your groups create a presentation to feedback to the rest of the class. Try to address each of the relevant discussion points below whilst planning your presentation.

Resources

"Climate Change: The Public Health Response"

➤ ncbi.nlm.nih.gov/pmc/articles/PMC2253589/pdf/0980435.pdf

Climate Change and Health Impacts Infographic

➤ bmj.com/content/351/bmj.h6316/infographic

WHO: Climate Change and Human Health

➤ who.int/globalchange/mediacentre/news/cop23-23-key-messages/en/

The BMJ: Climate Change

➤ bmj.com/campaign/climate-change

Discussion Points

1. What is the evidence that climate change is occurring?
2. What are the direct and indirect health effects of climate change likely to be in high income countries and in low income countries?
3. Differentiate between primary, secondary and tertiary prevention. How do these terms map on to the terms mitigation and adaptation?
4. What health co-benefits might there be there be from steps taken to address climate change?
5. What can be learned from past health education efforts as people now attempt to educate the public about climate change?
6. What will be the main challenges to addressing the health effects of climate change?
7. How can the health system lessen its own contributions to climate change?

Lesson plan 1

Climate Change Effects on Health, and Co-Benefits

Key words and concepts

- Climate Change
- Global Health
- Direct Effects
- Indirect Effects
- Mitigation and Adaptation
- Co-Benefits

What you'll need for this lesson

- ☑ Worksheet 1 (page 4)
- ☑ Article *"Climate Change: The Public Health Response"* doi: 10.2105/AJPH.2007.119362 (see page 4 for URL)
- ☑ Further resources within worksheet

Learning context

This session aims to consolidate understanding of climate change and introduces students to the impacts climate change has on health, and the ways we can manage these impacts.

Learning objectives

- Able to explain the basics of climate science and how climate change affects key determinants of health.
- Able to describe the difference between direct and indirect health effects of climate change.
- Able to describe the difference between mitigation and adaptation of climate change.

Time (min)	Learning opportunities / activities / differentiation	
5	Students are asked to write a brief explanation of what climate change is, and the important processes involved. Students should list ways in which they think climate change may be related to health. Answers are fed back either in small group discussions or in a class discussion. You may want to use The Lancet Countdown on Health and Climate Change video to encourage discussion: ➤ youtube.com/watch?v=9Nw5zhsSgHQ	Start
30	Either in groups, as a class, or individually, students should read the first two sections of article "Climate Change: The Public Health Response" – you may wish to split reading between students or groups. Suggested sections: – Introduction – Public health perspectives on climate change Students split into five groups. Using the resources provided in worksheet 1, each group should research one of the following topics: – Direct effects of climate change – Indirect Effects of Climate Change – Mitigating climate change – Adapting to Climate Change – Co-benefits Each group should prepare a 5 minute presentation on their topic to feedback to the class. This presentation may be in the format of a power point, poster presentation, or a simple spoken presentation. Students should be encouraged to address the questions relevant to their presentation topic that are included in the worksheet.	Learning focus
25	Students present their work to the rest of the group. Students should take notes on each other's presentation, to help answer the discussion points not covered in their own presentation. Each group is encouraged to ask a question at the end of another group's presentation – you may wish to nominate the group that will ask questions at the end of the presentation to allow them to think of questions throughout.	Wrap-up

Topic 2:

Climate Change and Infectious Disease

Worksheet 2

Climate Change and Infectious Disease

Activity 1

Read the information and graphics on pages 8–10 (also available at the link below), and consider:

1. What mechanisms can you think of by which climate change, and associated environmental changes, could impact infectious diseases?
2. Which types of infectious disease are likely to be affected, and why?

climatenexus.org/climate-issues/health/climate-change-and-vector-borne-diseases/

Dengue Fever

Dengue fever is a virus spread by mosquitos. Symptoms include nausea, rashes and aches and pains.

The mosquito vectors of the dengue virus (Aedes mosquitoes) are strongly affected by temperature.

Temperature (and therefore climate) affects their growth, survival, and feeding behavior.

Malaria

Malaria is caused by the Plasmodium protozoa (see glossary) that is also spread by mosquitos, and causes a fever, headaches, muscle pain and diarrhoea – in some cases malaria may be fatal.

Warmer temperatures, higher humidity and more places where water can collect generally favour malaria transmission. There is evidence that in some sites in the highlands of East Africa, a warming trend has improved conditions for mosquitoes, increasing the probability of malaria transmission and epidemics in highland areas.

Environmental suitability for the mosquitos that carry malaria has increased by ~21% in the 2010s compared with a 1950s baseline.

Lyme Disease

Lyme disease is a bacterial infection that is spread by ticks. Initial symptoms include a “bulls eye” rash, but symptoms such as fatigue, heart palpitations and neurological symptoms may continue to develop. More severe symptoms may develop if left untreated.

Increasing temperatures in many areas due to climate change have increased cases of Lyme Disease as accelerated and prolonged the tick’s developmental cycle, increased egg production, increased population density of the ticks and increased the areas they are able to inhabit.

Watch this video on ticks and climate change:

youtube.com/watch?v=E8uxJ-qqa4E

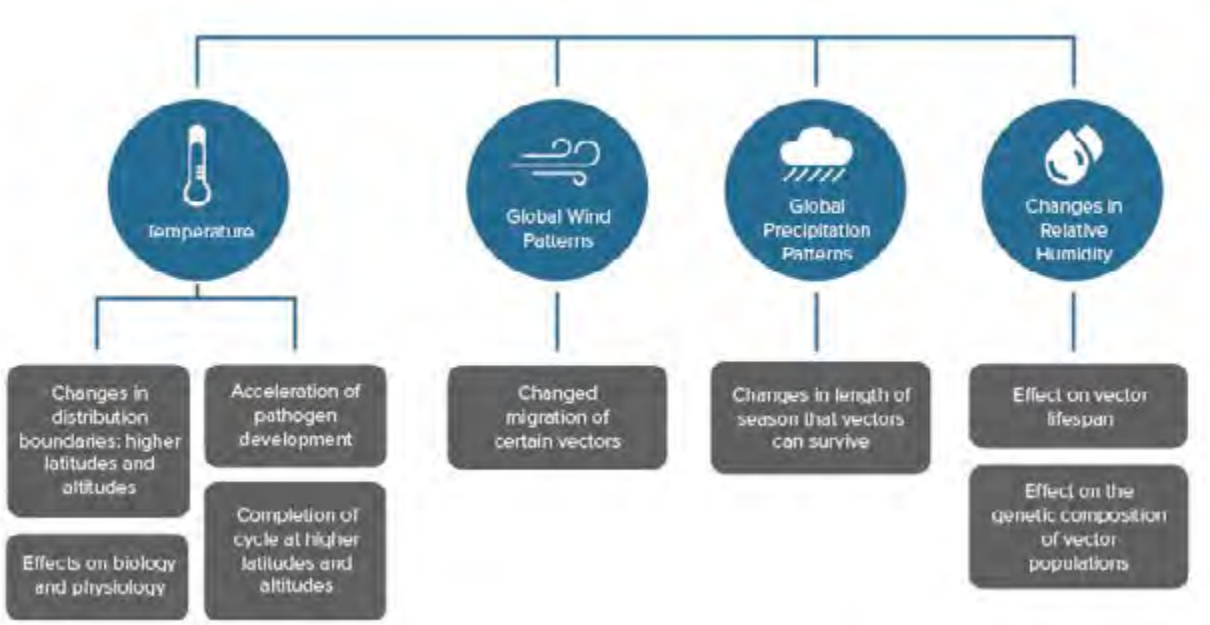
Diarrhoeal disease

Viruses and bacteria transmitted through water and contaminated food can cause severe diarrhoea, particularly affecting young children. This can be fatal, and can also lead to chronic under-nutrition and stunting especially in children.

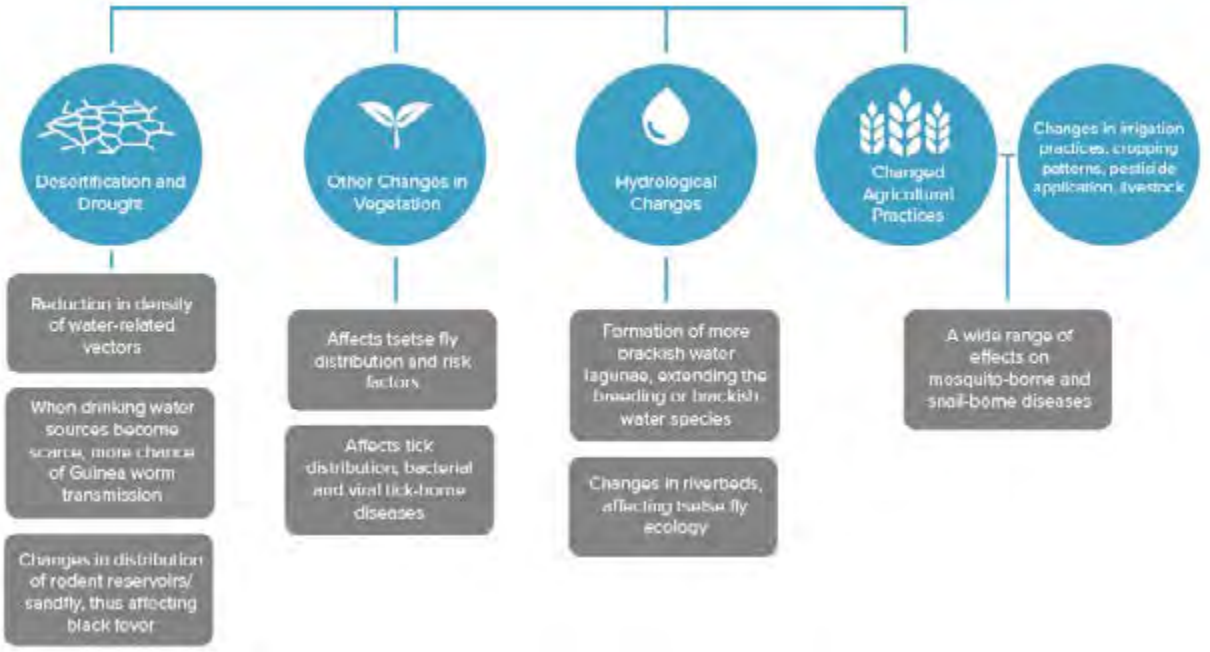
Higher temperatures and both flooding and drought can all facilitate transmission of water- and food-borne diseases. For example, ‘risk of infection by Vibrio bacteria, such as Vibrio cholera which causes cholera, is affected by temperature & precipitation.

Campylobacter, Salmonella and other food born diseases can replicate faster at warmer temperatures. WHO estimates climate change will cause an additional 48,000 deaths due to diarrhoea annually by 2030.

Direct effects of climate change on vector-borne diseases



Indirect effects of climate change on vector-borne diseases



Images sourced from climatenexus.org

Extreme weather events

Since the 1960s, the incidence of extreme weather events has more than tripled. Events such as storms have increased in severity. There are a number of adverse health impacts from such events:

- Drowning, injuries and hypothermia
- Contaminated water supplies, damage to infrastructure
- Increased risk of water-borne, food-borne and vector-borne diseases
- Damage to homes and health services (as well as other infrastructure), difficulties accessing care
- Mental health impacts

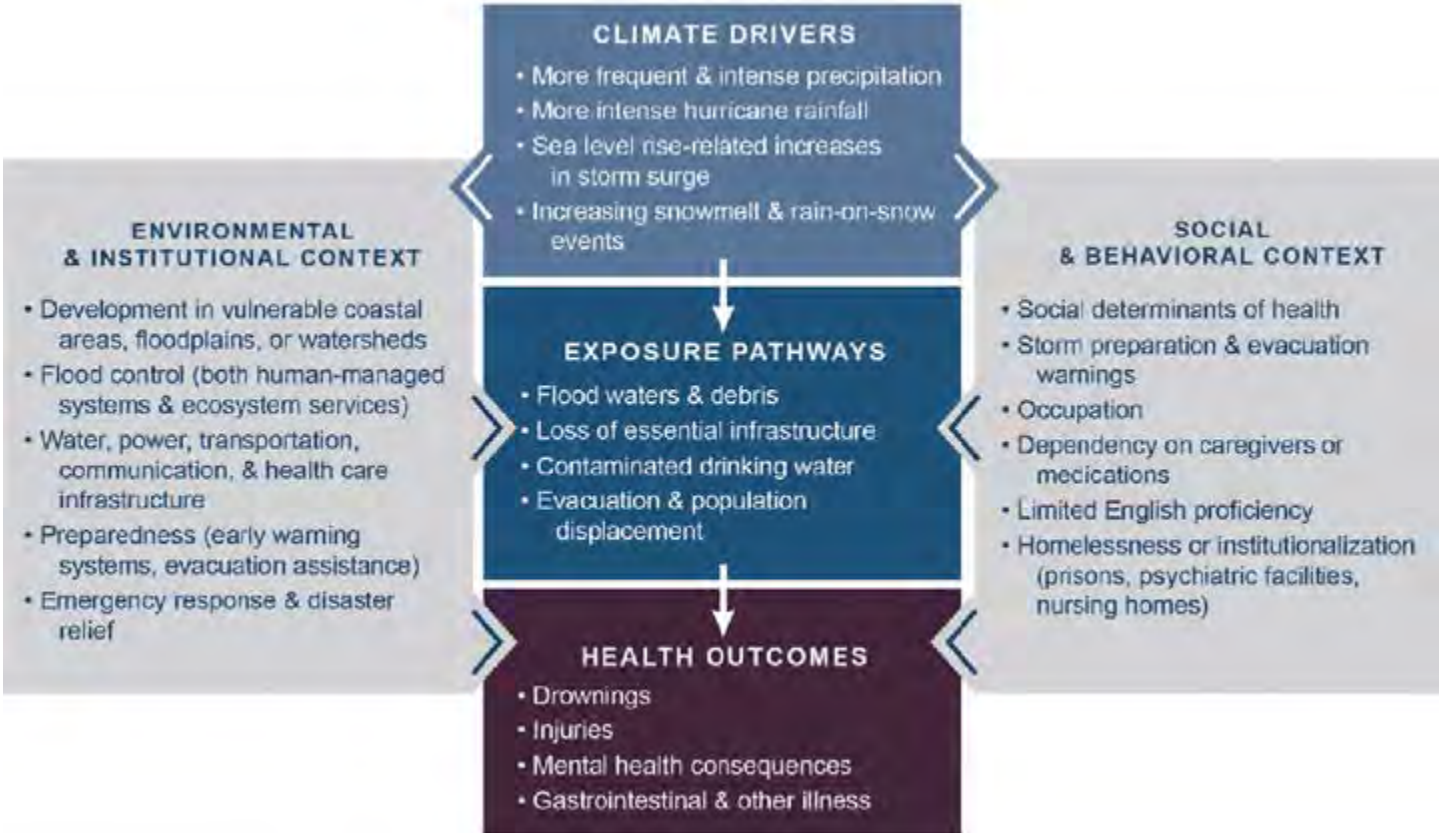


Diagram taken from

semanticscholar.org/paper/Ch.-6%3A-Climate-Impacts-on-Water-Related-Illness-Trtanj-Jantarasami/e04b12807be995ab285bb4559d564655131415b3

Activity 2

You are senior officials in Malawi, responsible for public health strategy.

- The Government have asked you to work out what Malawi should do to become more resilient and reduce the current and future impact of climate change on infectious diseases in the country.
- Thinking about the diseases and mechanisms covered, outline how you would undertake this project and develop your recommendations for the government.
- Create a short presentation on your recommendations, explaining the conclusions you have come to.

Some helpful sites to visit for this activity include:

- unfccc.int/topics/adaptation-and-resilience/the-big-picture/what-do-adaptation-to-climate-change-and-climate-resilience-mean
- who.int/publications/i/item/who-guidance-to-protect-health-from-climate-change-through-health-adaptation-planning

Basic information and demographics

- GDP per capita: $338.5USD/capita/year
- 11% of 15-24 year olds in 2010 had completed primary school
- Life expectancy at birth is 63.7 years (2018)
- Total fertility rate 4.4 children/woman in 2015/16
- Estimated population 17.5 million, expected to double by 2038

Hygiene and infrastructure

- One in three people (5.6m) do not have clean water
- 9.6 million people do not have access to a decent toilet
- 11.4% of the population have access to electricity

Politics and economics

- Stable governments since independence in 1964
- Landlocked; borders with Mozambique, Zambia and Tanzania
- Economy heavily dependent on agriculture, employing nearly 80% of the population, and it is vulnerable to climatic shocks

Things to consider

1. What level of education does the population have? How might this effect an outbreak?
2. How aware are the public and health providers about risks?
3. What prevention is already in place? What prevention might be needed? (e.g. climate change mitigation, addressing disease risk factors, vaccination)
4. What treatment is available? How accessible is it?
5. How strong is the health system? How might it need to be improved?
6. How well equipped is the health system for an outbreak? How would you monitor an outbreak?
7. What do you think the economic impacts will be? How can they be anticipated and prepared for?
8. What wider climate change adaptation might be needed?

Lesson plan 2

Climate Change and Infectious Disease

Key words and concepts

- Infectious Disease
- Climate Change
- Vectors
- Resilience
- Interventions

Learning context

This session aims to introduce students to the impacts of climate change on infectious disease, and how countries may build resilience to climate change.

Learning objectives

- Able to describe mechanisms through which impacts of climate change can affect the burden of infectious diseases.
- Able to evaluate the role and importance of a range of approaches to reducing the impact of climate change on infectious diseases.

What you'll need for this lesson

- ☑ Worksheet 2 (pages 8–11)
- ☑ Video *"Global Temperature Anomalies from 1880 to 2019"* by NASA:
  - ➤ svs.gsfc.nasa.gov/4787
- ☑ Video on Lyme Disease:
  - ➤ youtube.com/watch?v=E8uxJ-qqa4E
- ☑ Infographics available at:
  - ➤ climatenexus.org/climate-issues/health/climate-change-and-vector-borne-diseases/
- ☑ Climate Change and Resilience at:
  - ➤ unfccc.int/topics/adaptation-and-resilience/ the-big-picture/what-do-adaptation-to-climate-change-and-climate-resilience-mean
- ☑ Climate and risk of diseases:
  - ➤ climatenexus.org/climate-issues/health/climate-change-and-vector-borne-diseases/

Time (min)	Learning opportunities / activities / differentiation	
5	Show students the video “Global Temperature Anomalies from 1880 to 2019 “ from NASA to demonstrate global increases in temperature: ➤ svs.gsfc.nasa.gov/4787 Students should discuss how climate change may impact burden of infectious disease.	Start
15	In groups, review how climate change may increase prevalence of infectious diseases. Students should use material provided on the worksheet and the infographics available at climatenexus.org. Individually, students should write short answers to the each of the questions in Activity 1. Students may wish to draw a diagram to help answer the first question.	Learning focus
20	In groups, students should complete the scenario based Activity 2. Students should imagine they are senior officials in Malawi, and design a public health strategy to address the health effects of climate change. Students should prepare to talk for 3-5 minutes about their strategy and present this to the rest of the class.	
20	Students present back their policies and recommendations – as a class discuss what would are the most important measures to take, and difficulties that might exist in implementing them. Students should reflect on the session and write a short paragraph highlighting what they think are the most important measures that could be introduced to prevent the impact of climate change on infectious disease and why. This can be set as a homework activity or an end of class reflection activity.	Wrap-up

Topic 3:

Planning for a Sustainable Future

Worksheet 3

Planning for a Sustainable Future

Reaching the triple-win

Our society is engaged in production and consumption patterns that are harmful for our society, economy, environment and ultimately to our health and well-being.

The EU-funded project INHERIT (inherit.eu) examined how to change conditions and behaviour in ways that can improve health, health equity and support sustainable development. Watch this video about INHERIT to get a better understanding of the project:

➤ inherit.eu/future-scenarios/

INHERIT's work covers three main areas that relate to lifestyles and behaviour, each of which have more specific focuses embedded:

- Living: green spaces and energy efficient housing
- Moving: active transport
- Consuming: consumption trends and waste in the food and beverages context

Within each of these main areas, INHERIT aims at identifying policies, interventions and innovation to enable a 'triple-win':

1. reduce environmental impacts;
2. improve health;
3. and increase health equity.

Example – reducing pollution levels

1. **Reducing Environmental Impacts** – these are policies that address harmful elements of our environment, and ensure we can achieve sustainability goals. Reducing pollution levels (such as carbon dioxide) in cities will reduce the harmful impact of pollutants in our environment that contribute to global warming.
2. **Improving Health** – these are policies that increase health or well-being. By improving air quality in cities, we will improve outcomes for conditions that are made worse by high levels of pollution, such as asthma.
3. **Increasing Equity** – these are policies that aim to make society fairer and reduce inequalities in our health. High levels of pollution are more often found in more deprived areas, or in developing countries. By reducing the pollution levels, we will reduce differences in health between those living in more and less deprived areas.

Activity 1

- What kind of policy do you think would effectively reduce pollution levels in a city?
- Which of the three INHERIT areas (living, moving or consuming) do you think the policy would fall into?
- Do you think there would be any other benefits of a policy that aims to reduce pollution?

Future scenarios

Achieving positive change and identifying necessary actions sometimes requires a 'fast forwarding into future thinking'. Our four future scenarios, **'My life between realities'**, **'Less is more to me'**, **'One for all, all for one'** and **'Our circular community'** allow us to explore how we may achieve a triple win in the future.

They differ in the way society is organised (individualistically versus collectively) and in the driving sector (public versus private). The INHERIT 2040 scenarios represent positive future visions for making healthier, more equitable and more sustainable European societies by 2040 a reality.

My life between realities (Individualistic; Private)
"Everything is digital, connected and personalised"

Less is more to me (Individualistic; Public)
"Less material ownership and tendency towards sufficiency"

One for all, all for one (Collective; Public)
"Everybody plays an important role in the local context"

Our circular community (Collective; Private)
"Co-creation, citizen sciences and the circular economy"

Activity 2

Watch the four videos of each scenario:

➤ inherit.eu/future-scenarios/

and discuss which elements of the four scenarios you think are most compelling to create a more sustainable future in Europe.

Activity 3 – Designing a sustainable future

In groups, imagine you are a mayor in a city or municipal government. Propose one or more policy interventions to achieve a 'triple win' by 2030 i.e. **improving health, the environment and reducing inequalities**. The setting is a city or municipal area in any high, middle or low income country of your choice. For each policy intervention, fill in the policy template on page 17.

Examples of policy interventions

- **Living**: increase availability of green space in urban areas
- **Moving**: fossil fuel free transportation
- **Consuming**: public access for healthier more sustainable food

You may wish to look at successful examples of triple-win policies for more inspiration:

➤ inherit.eu/triple-win-cases/

Activity 3 – Designing a sustainable future (cont.)

Name of Policy	Country/location of Policy
Type of policy intervention? Which area does the policy focus on (Living, Moving or Consuming)?	
What are the aims of the policy intervention and how will they be achieved?	
Explain how the policy would achieve environmental sustainability	
Explain how the policy would increase health and well-being.	
Explain how the policy would reduce inequalities and/or make society fairer.	
Who are the key partners involved (other government bodies, companies, citizen groups)	
Does the policy intervention have any potentially adverse consequences/risks?	
What are the potential challenges to implementing the policy intervention and how can they be addressed?	
Has this policy or parts of it already been applied somewhere? If so, give examples.	

Lesson plan 3

Planning for a Sustainable Future

Key words and concepts

- Triple Win
- INHERIT
- Policy
- Sustainable Development Goals
- Climate Change
- Population Health

What you'll need for this lesson

- ☑ Worksheet 3 (pages 15–17)
- ☑ *INHERIT* future scenario videos:
  - ➤ inherit.eu/future-scenarios/
- ☑ Access to Triple-Win case studies:
  - ➤ inherit.eu/triple-win-cases/

Learning context

This session introduces students to the INHERIT project, and ways to think about building sustainable futures, for both environmental and health outcomes.

Learning objectives

- Able to describe the UN sustainable development goals, and what is meant by a "triple win".
- Able to design a policy intervention that would increase health and well-being.

Time (min)	Learning opportunities / activities / differentiation	
5	Watch the “INHERIT introduction” video on achieving a sustainable Europe by 2040: ➤ inherit.eu/future-scenarios/ In groups, students are asked to discuss and take notes on what factors they think are most important to achieve a sustainable future? What things would they prioritise?	Start
10	Students review material on INHERIT and what is meant by a triple win. Using the example provided, students should provide short written answers to each of the questions in activity one.	Learning focus
15	As a class, students should watch the four videos on each of the scenarios, and read the information provided. As a class or in groups, discuss the pros and cons of each scenario, and which of the future scenario is preferred.	
20	In groups, students should consider their own policies that may help achieve a “Triple Win” and complete the policy template. Students should use the “Triple-Win” case studies to help them think of policies. You may wish to encourage students to think of more than one policy, in each of the “living”, “moving” and “consuming” categories.	
10	Each group should pair up with one other group and feedback the policy they created. Students should think about strengths of each policy, which ones they think would be most effective, and any improvements. Leave the last 5 minutes to share some of the different policies that were created as a class, by asking students to explain the policy of the group they were paired with.	Wrap-up

Curriculum links

Below is a list of areas taken from the A-level curriculum that directly relate to content covered in this toolkit.

Subject area:

Geography (AQA)

3.2.4 Population and the environment

This optional section of our specification has been designed to explore the relationships between key aspects of physical geography and population numbers, population health and well-being, levels of economic development and the role and impact of the natural environment.

Engaging with these themes at different scales fosters opportunities for students to contemplate the reciprocating relationships between the physical environment and human populations and the relationships between people in their local, national and international communities.

Study of this section offers the opportunity to exercise and develop observation skills, measurement and geospatial mapping skills, together with data manipulation and statistical skills, including those associated with and arising from fieldwork.

3.2.4.3 Environment, health and well-being – patterns of health

Global patterns of health, mortality and morbidity. Economic and social development and the epidemiological transition.

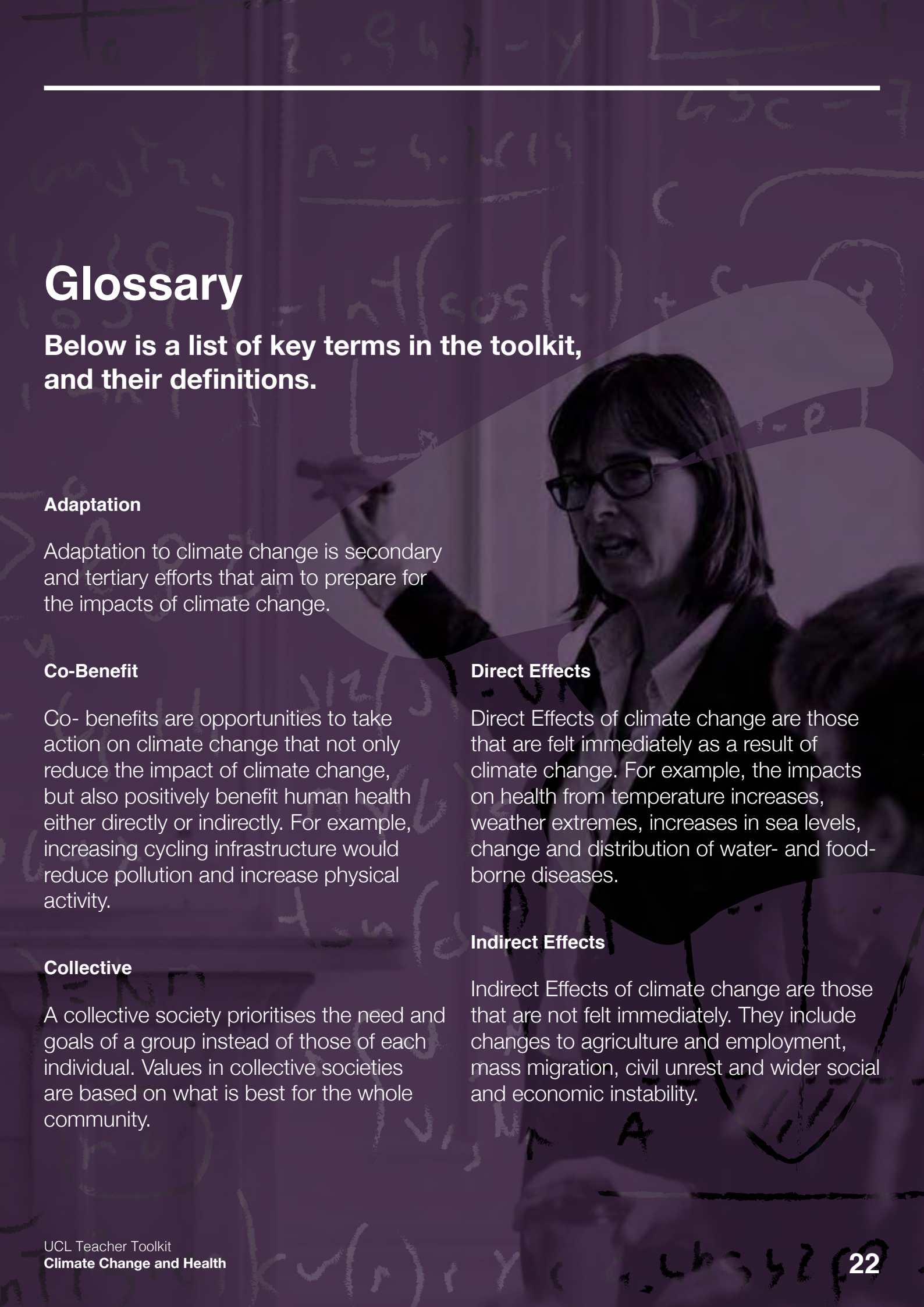
3.2.4.3 Environment, health and well-being – Climate/ environment and health

The relationship between environment variables e.g. climate, topography (drainage) and incidence of disease. Air quality and health. Water quality and health.

3.2.4.3 Environment, health and well-being – Prevalence of communicable diseases	The global prevalence, distribution, seasonal incidence of one specified biologically transmitted disease, e.g. malaria; its links to physical and socio-economic environments including impacts of environmental variables on transmission vectors. Impact on health and well-being. Management and mitigation strategies.
3.2.4.3 Environment, health and well-being – Prevalence of NCDS	The global prevalence and distribution of one specified non-communicable disease, e.g. a specific type of cancer, coronary heart disease, asthma; its links to physical and socio-economic environment including impacts of lifestyles. Impact on health and well-being. Management and mitigation strategies.
3.2.4.3 Environment, health and well-being – International Agencies	Role of international agencies and NGOs in promoting health and combating disease at the global scale.
3.2.4.6 Global population futures	Health impacts of global environmental change: ozone depletion – skin cancer, cataracts; climate change – thermal stress, emergent and changing distribution of vector borne diseases, agricultural productivity and nutritional standards. Prospects for the global population. Projected distributions. Critical appraisal of future population environment relationships.
Case study	Case study of a specified local area to illustrate and analyse the relationship between place and health related to its physical environment, socio-economic character and the experience and attitudes of its populations.

Glossary

Below is a list of key terms in the toolkit, and their definitions.



Adaptation

Adaptation to climate change is secondary and tertiary efforts that aim to prepare for the impacts of climate change.

Co-Benefit

Co- benefits are opportunities to take action on climate change that not only reduce the impact of climate change, but also positively benefit human health either directly or indirectly. For example, increasing cycling infrastructure would reduce pollution and increase physical activity.

Collective

A collective society prioritises the need and goals of a group instead of those of each individual. Values in collective societies are based on what is best for the whole community.

Direct Effects

Direct Effects of climate change are those that are felt immediately as a result of climate change. For example, the impacts on health from temperature increases, weather extremes, increases in sea levels, change and distribution of water- and food-borne diseases.

Indirect Effects

Indirect Effects of climate change are those that are not felt immediately. They include changes to agriculture and employment, mass migration, civil unrest and wider social and economic instability.

Individualistic

An individualistic society prioritises the needs of the individual instead of the whole group, and views people as autonomous and independent.

Mitigation

Mitigation of climate change are primary prevention efforts that aim to slow down or reverse the rate or climate change.

Protozoa

Single-celled organisms which feed on organic matter such as other microorganisms or organic materials.

Resilience

Resilience in the context of climate change is the ability to anticipate, prepare and respond to impacts of climate change.

Sustainable Development Goals

Sustainable development goals (SDG's) are 17 goals outlined by the United Nations that define a sustainable future. The SDG's tackles a number of global challenges including poverty and climate change.

Triple Win

A triple win is a scenario or policy that simultaneously improves the environment, health and health equity.

Vectors

A vector is a living organism that carries a pathogen that can be transmitted to humans. An example of mosquitos, which are vectors for the malaria pathogen.

Resources

See below some useful resources linked to this subject area.

The Lancet Countdown

The Lancet Countdown of Health and Climate Change – provides yearly reports and up to date information on the current situation relating to impacts of climate change and health. Multiple resources available at their website, including videos and animations.

➤ lancetcountdown.org

INHERIT

INHERIT is a research initiative that encourages sustainable lifestyle changes and formulates sustainable scenarios for our future. INHERIT outlines different policies, practices and innovations that address health inequality and environmental stressors of health. There are a number of different infographics, videos and interactive maps detailing their work on their website, as well as links to publications.

➤ inherit.eu

Climate Change and Public Health: From Threat to Opportunity

Recorded lecture by Dr Nick Watts on Climate Change and Public Health.

➤ climateseries.com/home-blog/51-dr-nick-watts-climate-health

Gap Minder

Website providing information on global development, has a number of teaching resources and allows you to access and manipulate data.

➤ gapminder.org

Other useful resources are provided in the lesson plans and worksheets.

Get in touch

UCL Institute of Epidemiology and Health Care

There are a number of different ways you can engage with UCL further. We host a number of school visits to UCL over the year, which include taster sessions of university lectures. We also run summer schools and summer challenges in a range of subjects, including in population health sciences. Additionally, we run yearly master classes and outreach events, as well as open days across UCL.

If you want more information on how to engage with UCL further, and in particular the BSc in Population Health Sciences, visit our website where you can find out more information.

ucl.ac.uk/epidemiology-health-care/study/undergraduate/population-health-sciences-bsc

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