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FSD3817 EXPERIMENTAL RESEARCH ON GAMES FOR CLIMATE CHANGE ENGAGEMENT
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TÄMÄ DOKUMENTTI ON OSA YLLÄ MAINITTUA YHTEISKUNTATIEEELLISEEN TIETOAR-
KISTOON ARKISTOITUA TUTKIMUSAINESTOA.

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Knowledge of climate change and infectious diseases

[KnowPre, KnowPost]

This test was answered by all participants before and after the intervention. The questions were ordered differently in the post-test version. The correct answer for each question, which was provided in some form in the text and games, has been marked with an “x”.

Below each question, we have shared an extract from the scientific literature justifying the answer that the game’s content supported as correct. We have prioritized the latest and most solid evidence, meaning that the IPCC Sixth Assessment Report (AR6) has been used wherever possible, with working group (WG) contributions published between 2021 and 2022 and the synthesis in 2023.

	True	False	I don't know
There is no link between climate change and infectious disease outbreaks.		x	
<p>From the IPCC AR6 WGII report: "The occurrence of climate-related food-borne and water-borne diseases has increased (very high confidence). The incidence of vector-borne diseases has increased from range expansion and/or increased reproduction of disease vectors (high confidence). Animal and human diseases, including zoonoses, are emerging in new areas (high confidence). ... Climate change driven range shifts of wildlife, exploitation of wildlife and loss of wildlife habitat quality have increased opportunities for pathogens to spread from wildlife to human populations, which has resulted in increased emergence of zoonotic disease epidemics and pandemics (medium confidence). ... Climate change will increase the number of deaths and the global burden of non-communicable and infectious diseases (high confidence)."</p>			
Regular people can only act on climate change by consuming differently in areas such as food and energy use.		x	
<p>From Stern, 2000: Environmentally significant behavior includes "environmental activism," "nonactivist behaviors in the public sphere" such as petitioning, financial contributions and policy support and acceptance, "private-sphere environmentalism," which includes consumption, and "other" behaviors including "influencing the actions of organizations" to which citizens belong.</p>			
Most human diseases begin when a person's DNA gets corrupted and develops a new virus, which is then transmitted to other people.		x	
<p>From the IPCC AR6 WGII report: "Diseases transmitted between humans and animals are called zoonoses. Zoonoses comprise nearly two-thirds of known human infectious diseases and the majority of newly emerging ones." The notion that viruses would originate in corrupted human DNA and be transmitted from there is not based on any scientific evidence.</p>			
In spite of climate change, mosquitoes that carry diseases will stay exclusively in tropical areas.		x	
<p>From the IPCC AR6 WGI report: "Warmer temperatures and longer seasonal windows have allowed faster reproduction/replication, accelerated development and increased the number of generations per year of pathogens, vectors and some host animals, which, in turn, increases the populations of disease organisms and disease transmission (Sections 2.4.2.4, 2.4.4.3.3). Higher numbers of ticks, mosquitoes, Culicoides biting midges, deer flies, horseflies and Simuliidae black flies, that transmit a variety of pathogens, are being documented in high-latitude regions and where they have been historically absent (robust evidence, high agreement) (Waits et al., 2018; Caminade et al., 2019; Gilbert, 2021)."</p> <p>"Rising temperatures are likely to cause poleward shifts and overall</p>			

expansion in the distribution of mosquitoes <i>Aedes aegypti</i> and <i>Aedes albopictus</i> , the principal vectors of dengue, yellow fever, chikungunya and Zika (high confidence).”			
The effects of climate change include animal stress, disease, displacement, and extinction.	x		
<p>Some examples from the IPCC AR6 WGII report:</p> <p>Stress: Figure FAQ2.2.1 shows how wildlife is “stressed and declining” as a result of climate change-induced events. The report further shows that “These processes [see “Displacement” below] have led to emerging hybridisation, competition, temporal or spatial mismatches in predator–prey, insect–plant and host–parasite relationships and invasion of alien plant pests or pathogens (medium confidence),” that “Cumulative stressors and extreme events are projected to increase in magnitude and frequency (very high confidence) and will accelerate projected climate-driven shifts in eco-systems and loss of the services they provide to people (high confidence)” and that “Under SSP5-8.5 to mid-century, land suitability for livestock production will decrease because of increased heat stress prevalence in mid and lower latitudes (high confidence).”</p> <p>Disease: For example, “Climate change will have effects on future distribution, incidence and severity of climate-sensitive infectious diseases of livestock (high confidence) (Bett et al., 2017).”</p> <p>Displacement: “Consistent with expectations, species in all ecosystems have shifted their geographic ranges and altered the timing of seasonal events (very high confidence). Among thousands of species spread across terrestrial, freshwater and marine systems, half to two-thirds have shifted their ranges to higher latitudes (very high confidence), and approximately two-thirds have shifted towards earlier spring life events (very high confidence) in response to warming.”</p> <p>Extinction: “Climate change has caused local species losses, increases in disease (high confidence) and mass mortality events of plants and animals (very high confidence), resulting in the first climate-driven extinctions (medium confidence)...”</p>			
The global sea level is expected to rise at the same rate over the 21st century as it did during the 20th century, but climate change mitigation can slow it down before 2050.		x	
The first part of the affirmation is incorrect, since according to the IPCC AR6 WGI report “global mean sea level increased by 0.20 [0.15 to 0.25] m between 1901 and 2018,” noting that “the rate of rise is accelerating.” Global sea level “will increase an additional 30 cm to 1 m or more by 2100, depending on future emissions.” The veracity of the second part of the affirmation depends on the degree of detail applied. As can be seen in Figure SPM.8 in the same report, small differences could be possible by 2050 depending on the emissions pathway.			
Since mosquitoes prefer warmer temperatures, storms and floods severely destroy their habitats.		x	
From the IPCC AR6 WGI report: “Heavy precipitation events have been shown to increase some infectious diseases with aquatic life-cycle components such as mosquito-borne, helminth, and rodent-borne diseases (robust evidence, high agreement) (Anyamba et al., 2001; Zhou et al., 2005; Wu et al., 2008; Brown and Murray, 2013; Anyamba et al., 2014; Boyce et al., 2016).” ... “For example, in Sudan, anomalous high rainfall increased <i>Anopheles</i> mosquito breeding sites, leading to malaria outbreaks (Elsanousi et al., 2018).”			

Thus, it is not supported by science that mosquito habitats would be destroyed by storms due to their preference for warmer temperatures.

Although “flooding ... can reduce mosquito abundance by flushing them out of the system (Paaijmans et al., 2007; Paz, 2015),” floods can also increase the risk of exposure: “In the Caribbean and Pacific Island nations, weather extremes, such as storms and flooding, have led to outbreaks of dengue due to disruption to water and sanitation services, leading to increased exposure to Aedes mosquito breeding sites (Descloux et al., 2012; Sharp et al., 2014; Uwishema et al., 2021).”

Drought, or an extended lack of rain, is becoming more common everywhere in the world due to climate change.

x

The “Synthesis of assessment of observed change in agricultural and ecological drought and confidence in human contribution to the observed changes in the world’s regions” (p. 10 in the IPCC AR6 WGI report’s summary for policymakers) notes a decrease in agricultural and ecological drought in the area of northern Australia (medium confidence) and low agreement in the type of change for multiple regions around the world, despite medium confidence of increases in specific areas in all continents.

The report suggests that “Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, heavy precipitation, and, **in some regions, agricultural and ecological droughts**; an increase in the proportion of intense tropical cyclones; and reductions in Arctic sea ice, snow cover and permafrost.”

Life under water is protected from climate change, which only affects the atmosphere.

x

An example of this are coral reefs. From the IPCC AR6 WGI report: A coral reef is “an underwater ecosystem characterised by structure-building stony corals. ... Both warm- and cold-water coral reefs support high biodiversity of fish and other groups and are considered to be especially vulnerable to climate change.”

Climate change is increased by human activities emitting greenhouse gases such as CO2 and methane, which trap heat in the atmosphere.

x

From the IPCC AR6 WGI report: “Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’.” ... “The change in a GHG concentration because of anthropogenic emissions contributes to an instantaneous radiative forcing. Earth’s surface temperature and troposphere warm in response to this forcing, gradually restoring the radiative balance at the top of the atmosphere.”

Human technology is the only way to take greenhouse gases out of the atmosphere once they have been released.

x

According to the PICC AR6 WGI report, a sink is “Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the

atmosphere (UNFCCC Article 1.8 (UNFCCC, 1992)).” Both natural land (e.g., forests) and ocean carbon sinks exist.			
Some forms of energy generation do not involve directly burning fossil fuels.	x		
An example of this are renewable energies such as wind, solar or hydro, which do not rely on fossil fuel burning to generate energy. See, e.g., the IPCC AR6 WGI report.			
Air conditioning helps us adapt to climate change, but it also releases greenhouse gases that make it worse.	x		
From the IPCC AR6 WGI report, recognizing the importance to increase the efficiency of air conditioners given the presence of short-lived climate forcers (SLCF) in them: “Further improvements in the efficiency of refrigeration and air-conditioning equipment during the transition to low-global-warming-potential refrigerants would bring additional GHG reductions (medium confidence)...”			
From the IPCC AR6 WGIII report: “One possible synergy between SLCF and climate change mitigation is the simultaneous improvement in energy efficiency in refrigeration and air-conditioning equipment during the hydrofluorocarbon (HFC) phase-down, as recognised in the Kigali Amendment to the Montreal Protocol.”			
Most cereals grown in the world are for direct human consumption.		x	
From the 2022 FAO Food Outlook, which can be found here , the utilization of cereals for feed and other uses combined has surpassed the use of cereals for food in the world at least since 2020.			

Type of intended action as signaled at the end of the game or after reading. [Act|Intention]

Please choose an area of action:

I am an advocate. I want to be vocal and spread awareness around me!

One important thing you can do is become an opinion leader. Once you have the knowledge and the interest, you may spread awareness among your friends and family, at work or school, when choosing where to invest your savings... Share your thoughts and learn about others! If you select this action, we will send you an email with various advocacy actions to choose from. Are you willing to do one?

I am an artist. I want to create based on what I know, feel and see!

So you are an artistic person? That is excellent! The world needs visions of where we are heading towards right now. By writing, painting, composing, or engaging in any other creative act, you may clarify to yourself what your desired future looks like, and perhaps even ways to get there. By sharing your creations, you may create a meaningful conversation and get others thinking as well. If you select this action, we will send you an email with various artistic actions to choose from.

I am a conscious citizen. I want to do some low-commitment political action!

Not all collective action has to be time-consuming. As a citizen, you can express your support for climate-friendly policies by voting for climate-aware candidates, signing petitions, or participating in local discussions. Make your voice heard! If you select this action, we will send you an email with various low-scale political actions to choose from. Are you willing to do one?

I am a team player. I'd like to support or engage in collective action!

You can participate in collective action to demand the necessary change. There are plenty of large-scale and local movements you can join. There is power and joy in communities! If you select this action, we will send you an email with various collective actions to choose from. Are you willing to do one?

I am a lone rider. I am ready to take individual action!

There are many things you can do in your daily life to contribute to the solution instead of the problem. For now, be honest about what behaviors you can integrate into your life, and try to choose something that will also improve your well-being. But don't stay small for too long. Aim to progress from there. A few actions that you do as an individual can have a relatively large impact on the environment, while others will have a moderate or low one. If you select this action, we will send you an email with various actions to choose from. Are you willing to do one?

I am a scholar. I want to know more about climate change!

Action begins with knowledge. There will never be a downside to you being more knowledgeable, plus it feels quite good! There are tons of sources on the internet, from documentaries to websites to books, for learning more about the climate and environmental changes we are living. I hope this game showed you one dimension, but there are many others. If you select this action, we will send you an email with various resources that you can select based on your interest. Are you willing to engage with these?

On second thought, **I'd rather not do anything.**