Appendices

**Appendix 1:**

**Photos of extreme climate**









**Appendix 2:**

**Information cards on extreme climate phenomena**

**Strong Winds (Hurricane, Typhoon, Cyclone and Tornado)**

Wind is air movement created by differences in atmospheric pressure. Wind has both direction and speed, which continuously change and affect many aspects of the weather, including rain, haze and more. Winds are classified according to their characteristics and the reasons for their formation.

A hurricane is a highly intense tropical storm that forms over the Atlantic Ocean. This kind of storm is called a typhoon when it forms in the Western Pacific Ocean or a cyclone in the Gulf of Bengal and the Indian Ocean.

Hurricanes occur mainly in the summer and can form within a few days or even hours. This kind of storm spins around itself, causing strong winds and much rain. It forms above the warm areas of the ocean. Combined with a mass of cumulonimbus clouds, a region of low pressure develops, sucking in air and water vapor from its surroundings. This “pumping” mechanism increases the strength of the winds and the amount of energy in the vortex, until the development of a process in which the storm amplifies itself. The intensity of the storm is ranked from 1 to 5 according to its wind speed. The diameter of the storm reaches 500 – 750 km and the wind speed exceeds 120 km/h.

When a hurricane reaches the coast, huge waves crash with great intensity on the ground and together with the strong rain cause great damage and destruction to lives and possessions. Within a very short time entire beaches can disappear and be swallowed up, crops can be destroyed, houses and trees can be uprooted, and floods and flash floods can occur. In recent years we have witnessed the occurrence of such storms at a higher frequency and greater intensity than in the past, for example, Hurricane Katrina in 2005, Sandy in 2012 and more.

In the Mediterranean Sea such storms cannot occur because high atmospheric pressure prevents the storm clouds from forming.

In contrast to the great hurricane vortices that spread out over great areas, tornadoes are small storms that spread out over a more limited area. In contrast to hurricanes that come from the ocean, tornadoes develop and cause damage on the land. Tornadoes form in thunderclouds, cumulonimbus, when certain conditions prevail in the atmosphere. A tornado looks like a narrow, funnel-shaped vortex. It lasts for a few minutes and its diameter spans hundreds of meters to a few kilometers. The wind speed in a tornado vortex reaches 500 km/h; it creates great suction that “sucks” in all objects in its path – houses and trees may fly, trees may be uprooted. Tornadoes form mainly during the spring and summer. In Israel tornadoes are relatively rare. In 2006 there was a tornado in the Western Galilee that caused damage.

When there is information about an approaching hurricane or tornado, defensive measures are usually taken, and it is accepted practice to notify residents and equip them with emergency lighting and food, as supply cutoffs and isolation of many areas are expected due to the storm.



**Sources of information**

1. [הוריקנים](http://www.brainpop.co.il/category_8/subcategory_113/subjects_619/) Hurricanes, BrainPOP website
2. [איך נוצרת סופת הוריקן?.](http://davidson.weizmann.ac.il/online/maagarmada/earth_sci/%D7%9B%D7%99%D7%A6%D7%93-%D7%A0%D7%95%D7%A6%D7%A8%D7%AA-%D7%A1%D7%95%D7%A4%D7%AA-%D7%94%D7%95%D7%A8%D7%99%D7%A7%D7%9F) How does a hurricane form? Dr. Erez Garty, Davidson Institute
3. [הוריקן](http://kids.gov.il/sababa/sababa_pool/pages/4367) Hurricane, Sababa website
4. [רוח](http://www.brainpop.co.il/category_8/subcategory_108/subjects_626/) Wind, BrainPOP website
5. [טורנדו](http://www.brainpop.co.il/category_8/subcategory_113/subjects_615/) Tornado, BrainPOP website
6. A journey through the atmosphere: weather and climate – selected chapters. Dr. Yoav Yair, Meira Segev and Billy Savir, Publication of the Center of Educational Technology (מטח).
7. [רוחות וסופות](file:///C:\Users\thu197\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\FE2GP0RL\cet.ac.il\Pages\item.asp%3fitem=5212) Winds and storms, Dr. Yoav Yair and Dr. Rami Klein, Center of Educational Technology.

**Hamsin / Sharav/ Heat Waves**

Many researchers in Israel and around the world agree that in recent years there is has been a significant increase in global warming and in the number of extreme climate phenomena around the world.

The average temperature of the earth has risen by about 0.6 degrees Celsius in the last hundred years. Each decade was warmer than the previous one. This may not sound significant but each increase of a tenth of a degree may cause extreme changes in the climate and in extreme natural phenomena.

The earth is surrounded by a layer of atmosphere to a distance of 50 km. In one of the upper layers there is a concentration of greenhouse gases (like methane and carbon dioxide). The heat radiation emitted by the earth due to the sun’s radiation hits the layer of greenhouse gases and most of it is returned to the earth (this is the “Greenhouse Effect” which enables life to exist).

This problem has continued from the Industrial Revolution until today. Very large amounts of carbon dioxide are emitted to the atmosphere, thickening the greenhouse gas layer and causing more heat radiation to return to the earth (heat radiation that is trapped in the atmosphere), and thus the earth’s temperature increases. This increase contributes directly to the greenhouse effect, causing an increase in ocean temperatures, a decrease in the amount of ice and snow, melting of icebergs, a rise in sea level, a rise in the number of extreme heat waves and highly intense storms and a decrease in the number of extreme cold events around the world.

The “Greenhouse Effect” (trapping of heat in the atmosphere) is amplified by natural processes like volcanic eruptions and changes in the intensity of the incoming solar radiation, but it is mostly caused by human activities, for example, combustion of fossil fuels (oil, coal and natural gas) and clearing of forests that reduces photosynthesis and the production of oxygen.

Reducing greenhouse gas emissions will contribute to reducing the temperature. Around the world, a process of reducing the amount of carbon dioxide in the atmosphere, a “carbon diet” is taking place. The best way to do this is to decrease combustion of fossil fuels extracted from the earth’s crust, like coal and oil; in other words, to save electricity. If we save electricity, the Electric Company will need to produce less electricity, will burn less fuels and less carbon dioxide will be emitted to the atmosphere – we should rather produce electricity from renewable sources, and from gas, that pollutes less than oil and coal. Another way is to reduce our use of private vehicles, and to car pool, use public transport, ride our bikes more and walk more instead of driving short distances. The amount of carbon dioxide emitted by human activities can also decrease if we plant forests, groves and gardens, stop clearing forests and plan ecological houses.

Geoengineering researchers offer solutions like scattering iron in the oceans to encourage growth of algae that absorb carbon dioxide from the atmosphere, covering deserts with polyethylene-aluminum sheets to reflect radiation back to the atmosphere before it is absorbed into the ground or painting roofs and streets of entire cities in white.

Every few years there is a climate summit in which several countries participate and together they sign an agreement for action on climate change.



**Sources of information**

1. [החמסין הישראלי התחממות גלובלית, וגלי חום קיצוניים](http://davidson.weizmann.ac.il/online/maagarmada/earth_sci/%D7%94%D7%97%D7%9E%D7%A1%D7%99%D7%9F-%D7%94%D7%99%D7%A9%D7%A8%D7%90%D7%9C%D7%99-%D7%94%D7%94%D7%AA%D7%97%D7%9E%D7%9E%D7%95%D7%AA-%D7%92%D7%9C%D7%95%D7%91%D7%9C%D7%99%D7%AA-%D7%95%D7%92%D7%9C%D7%99-%D7%97%D7%95%D7%9D-%D7%A7%D7%99%D7%A6%D7%95%D7%A0%D7%99%D7%99%D7%9D) The Israeli “Hamsin” and global warming, and extreme heat waves, Dr. Ran Tivony, Davidson Institute.
2. [מדענים מנסים להציל את כדור הארץ מסכנות ההתחממות הגלובלית, אבל אולי כל זה כבר מאוחר מדי](http://www.haaretz.co.il/misc/1.1285530) Scientists are trying to save the earth from the dangers of global warming, but maybe it’s already too late, Yotam Feldman, “Haaretz”
3. [מהו עומס חום ומהו מדד חום?](http://www.ims.gov.il/IMS/TRAINING/FAQ/Climateweather/Heat.htm) What is a heat load and what is a heat index? Israel Meteorological Service

**Haze**

Haze is the appearance of a large amount of particles like sand, air pollution and dust in the atmosphere, which make it difficult for us to see and breathe and cause extreme air pollution.

Usually, haze forms at the end of a heat wave and from a change in the weather system. Haze generally appears together with a dust storm.

Haze forms when a stable, heavy layer of air prevents air pollution from rising upwards. Thus the haze does not rise or dissipate but stays on the ground. Weak winds also contribute to preventing the haze from dissipating.

The causes of haze may vary. Air currents from the desert are the main cause of haze. In Israel they usually come from deserts in North Africa and Sinai.

Haze usually occurs during the change of seasons – in the spring and sometimes in the summer. Summer or autumn haze is a rarer occurrence. Haze usually appears in crowded, urban areas.

In some cases the haze may also be caused by humans. Examples of this include large fires, or Lag B’Omer bonfires. In many cases, in industrial cities the haze created by pollution from industrial factories or vehicles is extreme and appears all year round to the extent that the sun’s light does not reach the ground (in order to clean the air in Beijing before the Olympic Games, it was necessary to stop the operation of factories and vehicles for two months).

Health-wise, people with heart and lung disease, the elderly, children and pregnant women shoul avoid spending time in the open air during periods of haze.



**Sources of information**

1. [מה זה אובך?](https://eureka.org.il/item/48217/%D7%9E%D7%94-%D7%96%D7%94-%D7%90%D7%95%D7%91%D7%9A) What is haze? Eureka
2. [תחזית מזג האוויר בישראל](http://www.israelweather.co.il/forecast/index.html) Weather forecast for Israel, Boaz Dayan

**Melting/Thawing Icebergs**

In recent years the amount of ice has been continuously decreasing.

The giant icebergs of Antarctica are cracking and being swept into the Southern Atlantic Ocean. Ice has been seen melting on the Himalayan Mountains.

Global warming caused by humans leads to climate change, including a change in the state of the icebergs, a rise in the level of the seas and oceans and flooding in coastal areas.

Observations made by satellites show that during the 20th century the sea level rose by 1-2 mm each year. Forecasters predict that by the year 2100 the sea level will have risen by 10-90 cm.

The greatest warming has been measured in the Polar Regions – in Alaska, Siberia, Antarctica and most of the oceans. In addition, nearly all of the glaciers on the mountain tops, throughout the entire world, are shrinking. Glaciers from the last Ice Age (about 10,000 years ago) are melting.

This may have severe consequences for the environment and for human well-being:

* An increase in ocean temperatures leads to increased evaporation and further warming.
* Disappearance of the icebergs.
* A rise in sea level. Millions of people living in coastal areas may be harmed by flooding. The floods may damage entire regions and make wells and drinking water salty.
* Such floods on densely populated plains may cause a refugee problem.
* Damage to habitats of animals and their food in the Polar Regions, putting these animals in danger of extinction.
* Melting of the icebergs at the Poles brings about a reduction in the amount of light reflected from the earth, leading to further warming.

**What can be done?**

To prevent floods it is recommended to raise low lying areas prone to flooding, including streets and roads, by adding soil, as well as installing new drainage infrastructure and giant pumps that are capable of returning the water to the sea. This approach has already proved itself in some neighborhoods in the USA.

Any action that causes a reduction in warming will also cause a reduction in the amount of ice melting from the icebergs.

**Sources of information**

1. [המסת קרחונים](http://kids.gov.il/sababa/sababa_pool/pages/4347) Melting icebergs, Sababa.
2. [המסת קרחונים](http://earthweb.tau.ac.il/content/iceberg-melt) Melting icebergs, Gateway to Environmental Biology.
3. [הפשרת קרחונים ועלייה בגובה פני הים](http://davidson.weizmann.ac.il/online/maagarmada/earth_sci/%D7%94%D7%AA%D7%9E%D7%95%D7%A1%D7%A1%D7%95%D7%AA-%D7%A7%D7%A8%D7%97%D7%95%D7%A0%D7%99%D7%9D-%D7%95%D7%A2%D7%9C%D7%99%D7%99%D7%94-%D7%91%D7%92%D7%95%D7%91%D7%94-%D7%A4%D7%A0%D7%99-%D7%94%D7%99%D7%9D) Thawing icebergs and the rise in sea level, Dr. Erez Garty, Davidson Institute.
4. [כבר לא תחזית: שינוי אקלים מציפים את חופי ארה''ב](http://www.haaretz.co.il/news/world/america/1.3062299) No longer a forecast: climate change is flooding US beaches, Justin Gillis, New York Times, Haaretz.

**Flash Floods**

A flash flood is a strong flow of water, usually appearing sudde nly, and flooding low, dry areas within a short time. In the past, precipitation events were spread over more days and brought less rain on average. Today, storms bring a larger amount of rain over fewer days / a shorter time.

The causes of flash floods are storms, melting snow and flooding rivers.

Flash floods are created by a combination of several factors: a rain storm that brings a lot of rain in a short time; a large catchment basin that collects great amounts of water; a soil surface that does not allow water to infiltrate the soil and thus intensifies its flow across the land; too little vegetation to slow down the water flow; buildings, paths and roads that seal the soil and prevent water from infiltrating.

Flash floods and floods can cause great damage to infrastructure and the landscape; lead to electricity outages and transportation problems; and destroy entire fields of crops, leading to long periods of hunger. In addition, standing water is a source of diseases and more.

Floods are the most common and widespread natural disaster. The following steps may be taken to block or moderate the water flow:

Deepening the course of rivers that tend to overflow during the rainy season, regularly maintaining drainage channels along roads and communities and dividing the main waterway into a number of channels; building large and small dams (they are important as water reservoirs for agriculture and for producing electricity) - in rainy years the dam is used to divert water from communities and reduce flood damage; establishing a system for predicting flash floods, thus allowing evacuation of vulnerable populations. It is best to avoid establishing communities in areas with alluvial fans and flood plains of large rivers.

In August 2009, during a typhoon that hit Taiwan, 900 mm of rain fell over a few days. More than 300 mm fell during one of the days. Such an amount of rain causes floods, mudslides and great damage.

In Israel, flash floods flood river courses and riverbeds in the Judean Desert and the Negev. On January 19, 2010, following a great flash flood, the Nitzana Bridge collapsed and residents were disconnected from water and electricity. On March 3, 2016 the following warning was issued: “Warning for tomorrow: flash floods of extraordinarily high intensity in the south according to the Water Authority forecast; significant flash floods are expected tomorrow in the south – they may cause damage and lead to road closures…”

**Sources of information**

1. [שיטפונות](http://www.brainpop.co.il/he/category_8/subcategory_108/subjects_4311/) Flash floods, BrainPOP.
2. [שיטפונות.](http://cms.education.gov.il/EducationCMS/Units/Tochniyot_Limudim/Chinuch_Leshoni/KishoriSafa/Shitafon/TextShitafon.htm) Flash floods, text.
3. [שיטפונות](https://eureka.org.il/search/%D7%A9%D7%99%D7%98%D7%A4%D7%95%D7%A0%D7%95%D7%AA/) Flash floods, Eureka.
4. [שיטפונות והצפות](http://kids.gov.il/sababa/sababa_pool/pages/4372) Flash floods and flooding, Sababa.

**Wildfire**

Wildfire is a burning fire that has gone out of control, spreading uncontrolled over a large area. For fire to form, three conditions must exist: flammable material, oxygen and heat = the fire triangle. In addition there is also a chemical chain reaction.

A wildfire may form due to various reasons: A fire that was not extinguished and went out of control (a burning cigarette butt, a bonfire that was not extinguished properly etc.), an electrical short-circuit, fallen power lines, an accident, a lightning strike, and sometimes the sun itself or arson.

Wildfire may also result from climate change: the amount of carbon gases in the atmosphere is increasing, leading to an increase in the average world temperature and longer drought periods, and drier fuel materials which therefore burn more easily.

To fight wildfire we must remove one of the factors that cause it. Firefighters spray water or a dilute solution of fire retardants. Spreading sand cools down the fuel and prevents emission of flammable vapors that flame the fire.

To reduce wildfire damage firebreaks are established in the forest – these are areas without vegetation that are designed to prevent spread of wildfire. To prevent wildfires, organizations responsible for the forested areas carry out controlled burning near communities in order to create non-flammable areas.

Throughout history a few great wildfires destroyed entire cities. For example, in 1666 there was a great fire in London, in 1945 a great fire in Chicago, and in 1962 the great fire of Rome. In Israel – in 1995 at Sha’ar HaGai, in 2010 a great fire on Mt. Carmel that also caused human deaths, and in 2016 waves of fires occurring in a number of places over a number of days destroyed vast areas of woodland as well as property. The Israel Meteorological Service provides daily forecasts of fire risk calculated according to the ‘spreading index’ that expresses the level of difficulty in controlling wildfire and the ‘combustion index’ that expresses the chance on a scale of 1 to 100 that a source of fire will turn into a wildfire that must be extinguished.

**Sources of information**

1. [שריפות יער](http://www.brainpop.co.il/he/category_8/subcategory_108/subjects_6975/) Forest fires, BrainPOP.
2. [האש והתפשטות השריפה](http://davidson.weizmann.ac.il/online/maagarmada/chemistry/%D7%94%D7%90%D7%A9-%D7%95%D7%94%D7%AA%D7%A4%D7%A9%D7%98%D7%95%D7%AA-%D7%94%D7%A9%D7%A8%D7%99%D7%A4%D7%94) Fire and the spread of wildfire, Davidson Institute.
3. [השירות המטאורולוגי הישראלי](http://www.ims.gov.il/IMS/RESEARCH/fire_index/) Israel Meteorological Service, wildfire index.

**Extreme Cold Waves**

Snow storms take place in temperate-polar climates. In the winter they also take place in high altitude locations.

These events take place a few times a year and bring ground and air transport to a standstill. They are usually accompanied by significant frost events.

Frost events may also damage agriculture and cause great damage.

One famous snow storm was ‘Nemo’ which took place in North America over four days in 2013. Thousands of houses were destroyed and hundreds of thousands of houses remained without electricity.

In January 2016, one of the most severe snow storms took place in New York.

In February 2017 there was a storm on the east coast of the USA, with snow storms accompanied by strong winds.

In Israel, snow events occur each winter but the most well-known and significant one was in 1950, when snow fell throughout the country, except for the Arava and southern Negev, and including the coastal plain and Tel Aviv. This event ended with a significant frost event.

According to weather surveys carried out by the Israel Meteorological Service, there has been a decrease in the number of snow storms in Israel in the last two decades. This phenomenon has been observed around the world and can be linked to global warming and rising temperatures.

**Sources of information**

1. [מזג אוויר קיצוני השירות המטאורולוגי](file:///C:\Users\thu197\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Document\Desktop\מזג%20אוויר%20קיצוני%20השירות%20המטאורולוגי.docx) Extreme weather, Israel Meteorological Service.
2. [**תופעות אקלימיות, סופות שלגים**](http://www.israelweather.co.il/page2.asp?topic_id=82&topic2_id=295&sub_topic_id=1)**,**Climate phenomena, snow storms, weather forecast for Israel, Boaz Dayan.
3. [שינויים פתאומיים באקלים](http://lib.cet.ac.il/pages/item.asp?item=11376) Sudden changes in the climate, Prof. Richard B. Alley, Center of Educational Technology.

**Appendix 3:**

**Summary Table: Extreme Climate Events**

1. **In the table, write down the information you gathered from your friends following presentation of extreme climate events**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristics**  **Name of phenomenon** | **Causes of phenomenon** | **Location of phenomenon** | **Environmental damage caused by the phenomenon** | **How can damage by the phenomenon be reduced?** |
| **Flash floods** |  |  |  |  |
| **Hamsin / Sharav / Extreme heat waves** |  |  |  |  |
| **Haze** |  |  |  |  |
| **Strong winds:**  **Hurricane/tornado** |  |  |  |  |
| **Wildfire** |  |  |  |  |
| **Melting/thawing icebergs**  **Extreme cold / snow storms** |  |  |  |  |

1. Examine the table and mark in one color the characteristics common to the different phenomena. Write: what is common to all these phenomena?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Summarize what can be concluded from this table about:

a. The location of the phenomena:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. The causes of the phenomena:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Which phenomena, in your opinion, can humans prevent/reduce through their behavior? How?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. What did you learn from this task?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix 4: Summary – Personal Task**

1. Summarize what you learned in this unit

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What aroused your interest in this unit?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What difficulties did you face while learning this unit?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What actions happened after learning this unit?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What is the importance of these actions?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix 5:**

**Information for the Teacher on Extreme Climate Events in Israel and Around the World**

Today there is broad global consensus that climate change is indeed occurring on the earth.

In recent years we have witnessed a great increase in air temperature, ground surface temperature and ocean temperature (since 1850, the year in which temperature began to be measured around the world).

The forecast for the 21st century around the world in general and in the Mediterranean Basin in particular predicts an increase of 2.2 – 5.1 degrees Celsius in average temperature, a 4-27% decrease in rainfall, and increase in the intensity of extreme rain events, an increase in the number of heat waves and more.

Due to climate change and the great pressure caused by the population on natural resources, during the next few years marked consequences are expected for resources, economic sectors, and socio-economic sectors around the world.

Due to these changes there are two possible responses for preventing or reducing damage to natural resources, to humans, and to property: reducing greenhouse gas emissions and prior preparation.

The importance of preparation for these changes is also expressed through collaborative projects (such as the European Union project for coordinating a research program on climate change ERA NET CIRCLE (http//:www.era-circle.net) in which Israel is a partner) and climate summits that take place at different places around the world.

The first climate summit took place in 1979 in Geneva.

In 1998 the UN established the Intergovernmental Panel on Climate Change (IPCC). It includes more than 250 partner nations from around the world. Its last announcement from 2013 predicted an increase in heat waves and amounts of extreme rain.

In the last and largest climate summit that took place in December 2015 in Paris it was decided to reduce greenhouse gas emissions. Each country was given a target with the aim of finding a global solution to the problem of global warming.

In Israel

From monitoring and studies in recent years we have witnessed climate change in many fields. For example: warming of 2 degrees Celsius since the 1970s; an increase in the number of heat waves; more extreme seasonal and daily rainfall; a hotter summer and colder winter, a rise in sea level at a rate of 10 mm per year and more.

The forecast predicts a continuing trend of change: a rise in average temperature of 5 degrees Celsius by the end of the 21st century, a decrease of 20 mm in the amount of rain by 2050, and increase in the number and frequency of extreme climate events such as extreme drought years, flash floods, heat waves and more.

Climate change has varying and significant consequences in many fields: water, the ocean and its beaches, agriculture, biodiversity, energy and public health.

In light of this information the Ministry of Environmental Protection has issued intermediate recommendations for preparing for these changes in each field.

Examples of recommendations: saving water and preventing pollution, improving water, drainage and sewage infrastructure, preventing ocean pollution, protecting coastal cliffs, reducing erosion, developing a model for predicting crop development, increasing the energy efficiency of planning and construction in cities, nature reserve and forest management, prevention and treatment of forest fires, explanation of the potential harm to health and training of public health experts, provision of vaccines, and more.

Prepared from the following sources:

1. [דו"ח של המשרד להגנת הסביבה- לשכת המדען הראשי: היערכות ישראל לשינויי אקלים גלובליים, יולי 2008](http://cms.education.gov.il/NR/rdonlyres/40967771-7737-44DF-92A2-A102DF9ADE82/108419/Aklim.pdf)

Report by the Ministry of Environmental Protection – Office of the Head Scientist: Israel’s Preparation for Global Climate Change, July 2008

1. [שינויים אקלימיים בישראל, ממצאי השרות המטאורולוגי, מרץ 2015](http://www.ims.gov.il/NR/rdonlyres/C5A08C0E-A799-492C-ABAD-182AF72C1F53/0/%D7%A9%D7%99%D7%A0%D7%95%D7%99%D7%99%D7%9D%D7%90%D7%A7%D7%9C%D7%99%D7%9E%D7%99%D7%9D%D7%91%D7%99%D7%A9%D7%A8%D7%90%D7%9C_%D7%9E%D7%A8%D7%A52015_%D7%A1%D7%95%D7%A4%D7%99.pdf)

Climate Change in Israel, Findings of the Israel Meteorological Service, March 2015

1. [מגמות באירועי מזג אוויר קיצוניים בישראל, השרות המטאורולוגי, ספטמבר 2016](http://www.ims.gov.il/NR/rdonlyres/F68A0D64-A40E-4A7E-8405-89F6E7F0CE06/0/ExtremetrendsoverIsrael_.pdf)

Trends in Extreme Weather Events in Israel, Israel Meteorological Service, September 2016

**Appendix 6: Sources of Information on Extreme Climate Events**

|  |  |  |
| --- | --- | --- |
| Number | Source | Topic |
| 1 | Davidson Institute | [איך נוצרת רעידת אדמה](http://davidson.weizmann.ac.il/online/maagarmada/earth_sci/%D7%90%D7%99%D7%9A-%D7%A0%D7%95%D7%A6%D7%A8%D7%AA-%D7%A8%D7%A2%D7%99%D7%93%D7%AA-%D7%90%D7%93%D7%9E%D7%94) How An Earthquake Is Formed |
| 2 | BrainPOP | [רעידות אדמה](http://www.brainpop.co.il/he/category_8/subcategory_108/subjects_608/) Earthquakes |
| 3 | Eureka | [רעידות אדמה וצונמי ובעלי חיים](http://eureka.org.il/tag/%D7%A8%D7%A2%D7%99%D7%93%D7%AA_%D7%90%D7%93%D7%9E%D7%94/) Earthquakes and Tsunamis and Animals |
| 4 | BrainPOP | [שיטפונות](http://www.brainpop.co.il/he/category_8/subcategory_108/subjects_4311/) Flash Floods |
| 5 | Eureka | [שיטפונות במדבר](http://eureka.org.il/search/%D7%A9%D7%99%D7%98%D7%A4%D7%95%D7%A0%D7%95%D7%AA) Flash Floods in the Desert |
| 6 | Language Department | [טקסט בשפה בנושא שטפון](http://cms.education.gov.il/EducationCMS/Units/Tochniyot_Limudim/Chinuch_Leshoni/KishoriSafa/Shitafon/TextShitafon.htm) Text on Flash Floods for Language Classes |
| 7 | Pacific TWC | [Earthquakes of the First 15 Years of the 21st Century](https://www.youtube.com/watch?v=ph7Eczs-nTI) |
| 8 | Paper | [סקירת אירועים קיצוניים בישראל / השרות המטאורולוגי (מאמר)](http://www.ims.gov.il/ims/odot/news/extreme+events.htm)  Survey of Extreme Events in Israel / Israel Meteorological Service (Paper) |
| 9 | Article | [מדענים מנסים להציל את כדור הארץ מסכנות](http://www.haaretz.co.il/misc/1.1285530)  Scientists Try to Save the Earth from Danger |
| 10 | Davidson Institute | [החמסין הישראלי, התחממות גלובלית וגלי חום קיצוניים](http://davidson.weizmann.ac.il/online/maagarmada/earth_sci/%D7%94%D7%97%D7%9E%D7%A1%D7%99%D7%9F-%D7%94%D7%99%D7%A9%D7%A8%D7%90%D7%9C%D7%99-%D7%94%D7%94%D7%AA%D7%97%D7%9E%D7%9E%D7%95%D7%AA-%D7%92%D7%9C%D7%95%D7%91%D7%9C%D7%99%D7%AA-%D7%95%D7%92%D7%9C%D7%99-%D7%97%D7%95%D7%9D-%D7%A7%D7%99%D7%A6%D7%95%D7%A0%D7%99%D7%99%D7%9D)  The Israeli Hamsin, Global Warming and Extreme Heat Waves |
| 11 | Eureka | [אובך](https://eureka.org.il/tag/%D7%90%D7%95%D7%91%D7%9A/) Haze |
| 12 | Haaretz, Yotam Feldman | [מדענים מנסים להציל את כדור הארץ מסכנות ההתחממות הגלובלית, אבל אולי כל זה כבר מאוחר מדי](http://www.haaretz.co.il/misc/1.1285530)  Scientists Are Trying to Save the World from the Dangers of Global Warming, but Maybe It’s Already Too Late |
| 13 | Davidson Institute | [סופת הוריקן](http://davidson.weizmann.ac.il/online/maagarmada/earth_sci/%D7%9B%D7%99%D7%A6%D7%93-%D7%A0%D7%95%D7%A6%D7%A8%D7%AA-%D7%A1%D7%95%D7%A4%D7%AA-%D7%94%D7%95%D7%A8%D7%99%D7%A7%D7%9F)  Hurricanes |
| 14 | BrainPOP | [הוריקן](http://www.brainpop.co.il/category_8/subcategory_113/subjects_619/preview.weml) Hurricanes |
| 15 | Sababa | [הוריקן](http://kids.gov.il/sababa/sababa_pool/pages/4367) Hurricanes |
| 16 | Nrg | [הסערה כבר כאן: הצפות במרכז, שלג ירד בחרמון](http://www.nrg.co.il/online/1/ART2/851/553.html)  The Storm is Already Here: Floods in the Center, Snow Fell on Mt. Hermon |
| 17 | Davidson Institute | [שרפות](http://davidson.weizmann.ac.il/online/maagarmada/chemistry/%D7%94%D7%90%D7%A9-%D7%95%D7%94%D7%AA%D7%A4%D7%A9%D7%98%D7%95%D7%AA-%D7%94%D7%A9%D7%A8%D7%99%D7%A4%D7%94) Wildfire |
| 18 | Center of Educational Technology | [שרפות](http://lib.cet.ac.il/Pages/item.asp?item=5236) Wildfire |
| 19 | Keren Kayemet Le’Israel | [שרפות](http://globeblog.co.il/2013/12/24/%D7%A2%D7%9C-%D7%94%D7%A7%D7%A9%D7%A8-%D7%91%D7%99%D7%9F-%D7%94%D7%94%D7%AA%D7%97%D7%9E%D7%9E%D7%95%D7%AA-%D7%94%D7%92%D7%9C%D7%95%D7%91%D7%9C%D7%99%D7%AA-%D7%95%D7%A9%D7%A8%D7%99%D7%A4%D7%95%D7%AA?param=846) Wildfire |
| 20 | Davidson Institute | [קרחונים](https://www.youtube.com/watch?v=BscyoYgaxwU) Icebergs (video) |
| 21 | Sababa | [הפשרת קרחונים](http://kids.gov.il/sababa/sababa_pool/pages/4347) Thawing Icebergs |
| 22 | Center of Educational Technology | [צונאמי](http://lib.cet.ac.il/Pages/item.asp?item=5217&kwd=4193) Tsunami (waves) |
| 23 | BrainPOP | [צונאמי](http://www.brainpop.co.il/he/category_8/subcategory_108/subjects_609/preview.weml) Tsunami |
| 24 | YouTube | [תרגיל צונאמי](https://www.youtube.com/watch?v=v-ehM2qs4Es)  Tsunami exercise |
| 25 | Flow chart, Haaretz | [הצעות גיאו-הנדסיות](http://www.haaretz.co.il/hasite/images/printed/P161009/800hazaot.jpg)  Geoengineering Recommendations |
| 26 | Paper in the digital newspaper Zavit, Dr. Daniel Madar | [התחזית: רעידות אדמה והתפרצות הרי געש](http://zavit.org.il/%D7%94%D7%AA%D7%97%D7%96%D7%99%D7%AA-%D7%A8%D7%A2%D7%99%D7%93%D7%AA-%D7%90%D7%93%D7%9E%D7%94-%D7%95%D7%94%D7%AA%D7%A4%D7%A8%D7%A6%D7%95%D7%99%D7%95%D7%AA-%D7%95%D7%95%D7%9C%D7%A7%D7%A0%D7%99%D7%95/)  The Forecast: Earthquakes and Volcanic Eruptions |
| 27 | Haifa Municipality | [איך תדעו מה לעשות? הנחיות להכנת הבית והמשפחה למצבי משבר וחירום](http://www.b-way.co.il/2016/haifa/11_herum/index.html#earthquake)  How Will You Know What To Do? Guidelines for Preparing the How and Family for Crisis and Emergency Situations |
| 28 | Information Center – papers on climate change | [מרכז ידע להיערכות לשינויי אקלים – דוח 1](http://www.iccic.org.il/)  Israel Climate Change Information Center – Report #1 |
| 29 | Zafrir Rinat, Haaretz | [מזג האוויר המשוגע וההתחממות הגלובלית](http://www.haaretz.co.il/news/science/1.1904308)  The Crazy Weather and Global Warming |
| 30 | YNET Environment – Dr. Nimrod Epstein | [מספר עובדות על שינוי אקלים עולמי](http://www.ynet.co.il/articles/0,7340,L-3392400,00.html)  A Few Facts About World Climate Change |
| 31 | Ministry of Economics and Industry | [היערכות לשינוי אקלים](http://www.economy.gov.il/Industry/Industry_and_Environment/ClimateChange/Pages/default.aspx)  Preparation for Climate Change |
| 32 | Mako | [איך ישראל נערכת לשינוי אקלים קיצוני?](http://www.mako.co.il/news-israel/health-q4_2015/Article-0a74d374158b051004.htm)  How is Israel Preparing for Extreme Climate Change? |
| 33 | Ministry of Environmental Protection | [היערכות לשינוי אקלים](http://www.sviva.gov.il/subjectsEnv/ClimateChange/AdaptationKnowledgeCenter/Pages/default.aspx)  Preparation for Climate Change |
| 34 | Ministry of Environmental Protection – Office of the Head Scientist | [היערכות ישראל לשינויי אקלים גלובליים](http://cms.education.gov.il/NR/rdonlyres/40967771-7737-44DF-92A2-A102DF9ADE82/108419/Aklim.pdf)  Israel’s Preparation for Global Climate Change |
| 35 | Zavit – News Agency for Science and the Environment | [הילדים של שינוי האקלים](http://zavit.org.il/%D7%9B%D7%95%D7%9C%D7%A0%D7%95-%D7%99%D7%9C%D7%93%D7%99%D7%9D-%D7%A9%D7%9C-%D7%A9%D7%99%D7%A0%D7%95%D7%99-%D7%94%D7%90%D7%A7%D7%9C%D7%99%D7%9D)  Children of Climate Change |
| 36 | Gordon College – Ehud Kalfon | <http://www.gordon.ac.il/sites/gordon/UserContent/files/aklim.pdf>[אקלים קיצוני ושריפות](https://www.gordon.ac.il/sites/gordon/UserContent/files/aklim.pdf)  Extreme Climate and Wildfire |
|  | **Videos** |  |
| 1 | YouTube | [האמת המטרידה](https://www.youtube.com/playlist?list=PL91690C457FD348F1) An Inconvenient Truth – Al Gore |
| 2 | Channel 2 | [מזג אויר קיצוני - פרופ' דני רבינוביץ](https://www.youtube.com/watch?v=81UTMf77ng8)  Extreme Weather – Prof. Dani Rabinowitz |
| 3 | Tonight at 6 – Channel 1 | [מזג האוויר הקיצוני, פרופ' דני רבינוביץ](file:///C:\Users\לימור%20חיימי\Downloads\מזג%20אויר%20קיצוני,%20פרופ'%20דני%20רבינוביץ)  The Extreme Weather – Prof. Dani Rabinowitz |
| 4 | Netanya Academic College | [עוד שינוי קיצוני במזג האוויר - עו"ד ציפי איסר איציק](https://www.youtube.com/watch?v=XvosBZ62NsY)  Another Extreme Change in the Weather – Adv. Tzipi Isser-Itzik |
| 5 | Paris Climate Summit – Education Channel | [הסכם היסטורי בוועידת האקלים בפריז](https://www.youtube.com/watch?v=B05_H8ZlKoY)  An Historic Agreement at the Paris Climate Summit |
| 6 | Channel 2 | [התחממות כדור הארץ](https://www.youtube.com/watch?v=d6sfIn8mjQo) Global Warming |
| 7 | National Geographic | [כדור הארץ מתחמם](https://www.youtube.com/watch?v=JrcXDTh8K7U) The Earth is Warming Up |
| 8 | Channel 2 News – Asaf Yehezkeli | [דיקפריו מנסה להציל את כדור הארץ / לפני המבול](http://www.mako.co.il/news-world/international-q4_2016/Article-de3cce42c38f751004.htm)  DiCaprio Tries to Save the Earth / Before the Flood |
| 9 | The Hebrew University of Jerusalem | [מדוע תשע"ה |האם ניתן לעצור את התחממות כדור הארץ](https://www.youtube.com/watch?v=cJ3-hVKeaVE)  Is It Possible to Stop Global Warming – Prof. Menachem Luria |