**Unit 10 Temperature and expressing cause and effect**

1. Discuss – what does it mean if: *you are in hot water*

 *someone is hot-blooded*

 *you hear hot news*

 *the debate is hot*

 *the analysis is cold*

 *you are given cold welcome*

2. Fill in correct temperatures. Choose from this list:

-210 °C, -39 °C, 32 °F, 4 °C, 20 °C, 310 K, 78 °C, 117 °C

a) At …………………. water has the least volume and maximum density.

b) ……………………….., or 293 K, is a comfortable room temperature.

c) Water freezes at……………

d)……………………………is a normal human body temperature.

e) At …………………..nitrogen freezes.

f) ………….is the hottest temperature on the moon.

g) ………………….is the boiling point of alcohol.

h) ………………….is the freezing point of mercury.

3. Explain these terms in relation to temperature:

*heat thermodynamic equilibrium electrical conductivity second law of thermodynamics*

 *kinetic theory large scale definition steam engines*

Then fill these terms in the gaps in the text. *https://www.grc.nasa.gov/www/k-12/airplane/thermo.html*

**Thermodynamics** is a branch of physics which deals with the effects of 1 \_\_\_\_\_, energy and work on a system. It was born in the 19th century as scientists were first discovering how to build and operate 2 \_\_\_\_\_\_\_. Thermodynamics deals only with the [large scale response](https://www.grc.nasa.gov/www/k-12/airplane/gasprop.html) of a system which we can observe and measure in experiments. Small scale gas interactions are described by the 3\_\_\_\_\_\_\_\_\_\_ of gases. The methods complement each other; some principles are more easily understood in terms of thermodynamics and some principles are more easily explained by kinetic theory.

The zeroth law of thermodynamics begins with a simple definition of 4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It is observed that some property of an object, like the pressure in a volume of gas, the length of a metal rod, or the 5 \_\_\_\_\_\_\_\_\_\_ of a wire, can change when the object is heated or cooled. If two of these objects are brought into physical contact, there is initially a change in the property of both objects. But, eventually, the change in property stops and the objects are said to be in thermal, or thermodynamic, equilibrium. Thermodynamic equilibrium leads to the 6 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of [temperature.](https://www.grc.nasa.gov/www/k-12/airplane/temptr.html) When two objects are in thermal equilibrium they are said to have the same temperature. During the process of reaching thermal equilibrium, [heat](https://www.grc.nasa.gov/www/k-12/airplane/heat.html), which is a form of energy, is transferred between the objects. The details of the process of reaching thermal equilibrium are described in the [first](https://www.grc.nasa.gov/www/k-12/airplane/thermo1.html) and 7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

3. Qs for the discussion:

a) What is the lowest temperature measured on Earth? How was it taken?

b) How is temperature different from other physical quantities, i.e. distance or time?

c) Why does the presence of a large body of water nearby, such as a sea or ocean, tends to moderate the temperature extremes of the climate on adjacent land?

d) What is the triple point? For example, the triple point of water occurs at 273.16 K and 611.2 Pa.

e) Why is it more difficult to heat the object than to cool it?

f) How and when did people start measuring temperature?

g) What is the Absolute Zero Temperature and can we reach it? Why Y/N?

**4. Listening. The Absolute Zero Temperature. Fill in the gaps**

<https://www.youtube.com/watch?v=IAXY8cX9_ss> 8:00

a) Joseph Louis Gay-Lussac discovered that the volume of a gas at a constant pressure changes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the changes in temperature.

b) When a gas is cooled to -273 °C, it\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) Gay-Lussac came to a conclusion that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) The Absolute Zero Temperature is a concept similar to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because it is difficult to further analyze.

e) If cooled, the molecules of the cooled gas will\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which will start the process of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

f) An amazing phenomenon scientists have discovered by cooling metal is that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

g) When some gases are cooled, they show “miracles”, such as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

h) The special qualities of the Bose-Einstein condensate include\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**5. Expressing cause and effect**

Circle the letter of the answer that best matches the meaning of each of these sentences.

1. Increasing the temperature increases the rate of a chemical reaction.

1. Chemical reactions cause an increase in temperature.
2. An increase in the rate of a chemical reaction may be caused by increasing the temperature.

2. Ions are formed when an acid is dissolved in water.

1. Ions cause an acid to be dissolved in water.
2. Dissolving an acid in water causes ions to be formed.

3. Heating solid carbon dioxide (dry ice) produces a gas.

1. A gas results from heating solid carbon dioxide.
2. Carbon dioxide turns solid when heated.

4. Vibrations in the air cause the sound of the wind.

1. Air vibrations are a result of the wind.
2. The sound of the wind is a result of air vibration.

**6. Cause – effect sentence patterns**

|  |  |  |
| --- | --- | --- |
| A mixing of wavelengths | causesresults inproducesinduces | a white light. |
| White light is | caused bydue toinduced bya result ofproduced by | a mixing of wavelengths. |
| IfWhenAs | all the wavelengths are mixed, a white light is produced. |  |
| A white light is produced | ifwhenas | all the wavelengths are mixed. |

 **In each of the following sentences identify cause and effect.**

1. When copper is heated to 1083°C, it melts.
2. Changes occur in plants when they absorb energy from the sun.
3. The rotation of a compass needle is due to the earth´s magnetic field.
4. Ashes result from the burning of wood.
5. Acids turn litmus paper red.
6. Rubbing a comb with a cloth produces a negative electric charge.
7. Fast-moving charged particles induce the ionization of atoms.
8. The ocean´s tides are caused by the gravitational pull of the moon.
9. The more iron is exposed to moist air, the more it rusts.
10. Color is produced by the reflection of light.

**7. Using the patterns above, transform the following sentences.**

*If we change the temperature of a substance, its properties alter.*

*The change in the temperature of a substance* ***results in*** *alterations of its properties.*

1. If we raise the temperature of the ice over 0 °C, it melts.

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2. If we increase highly the temperature of some materials, these may change their color.

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3. If we heat tungsten, it produces visible light.

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4. If we heat different materials, most of them expand.

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

5. If we supply heat to a gas, its molecules move faster.

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

6. If we change the temperature of a metal, its resistance to electricity alters.

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

8. Fill in the missing letters of this important principle and try to explain it.

 C - R R - L - T - - N D - - S N - T I M P L - C - - S - T - - N

6. Reading. Scan the text about cause-effect relationship and match the paragraphs and their headings.

<http://ghcimdm4u.weebly.com/5-cause-and-effect.html>

*Reverse Cause-Effect Relationship Presumed Relationship*

 *Cause-Effect Relationship Accidental Relationship*

 *Common-Cause Factor*

**Cause and Effect**

A strong correlation does not prove that the changes in one variable cause changes in the other. There are various types and degrees of causal relationship between variables.

a) \_\_\_\_\_\_\_\_\_\_\_\_\_\_: A change in X produces a change in Y. Such relationships are sometimes clearly evident, especially in physical processes. For example, increasing the height from which you drop an object increases its impact velocity. Similarly, increasing the speed of a production line Increases the number of items produced each day (and, perhaps, the rate of defects).

b) \_\_\_\_\_\_\_\_\_\_\_\_\_: An external variable causes two variables to change in the same way. For example, suppose that a town finds that its revenue from parking fees at the public beach each summer correlates with the local tomato harvest. It is extremely unlikely that cars parked at the beach have any effect on the tomato crop. Instead, good weather is a common-cause factor that increases both the tomato crop and the number of people who park at the beach.

c) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: The dependent and independent variables are reversed in

the process of establishing causality. For example, suppose that a researcher observes a positive linear correlation between the amount of coffee consumed by a group of medical students and their levels of anxiety. The researcher theorizes that drinking coffee causes nervousness, but instead finds that nervous people are more likely to drink coffee.

d) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: A correlation exists without any causal relationship between variables. For example, the number of females enrolled in undergraduate engineering programs and the number of “reality” shows on television both increased for several years. These two variables have a positive linear correlation, but it is likely entirely coincidental.

e) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: A correlation does not seem to be accidental even though no cause-effect relationship or common-cause factor is apparent. For example, suppose you found a correlation between people´s level of fitness and the number of adventure movies they watched. It seems logical that a physically fit person might prefer adventure movies, but it would be difficult to find a common cause or prove that the one variable affects the other.

**7. Comment on the causal relationships in the examples. What are their types (a – e)?**

1. Ice cream sales and shark attacks
2. Number of high school graduates and pizza consumption
3. The more firemen are sent to the fire, the more damage is done
4. Astrological sign and IQ in the early elementary school years
5. Parents´ educational level and their children´s success in school
6. The fish population in a lake and the number of cottages around the lake
7. The stock price of a telephone company and the cost of car insurance

**8. Listen to one more example – Ice cream sales and the incidence of polio.**

What kind of causality it that? <http://ghcimdm4u.weebly.com/5-cause-and-effect.html>

**9. Causal nets** are used in representing causal connections and in calculating probabilistic relations

between events. Describe the graph below. (Type of causality and directions of arrows).



1. **Pair or group work. Choose one of the topics below. Think of possible causes and effects and the types of causal relations. Then draw a similar causal net and be ready to explain it to class.**
2. The consequences of overpopulation
3. The reasons why people ignore elections
4. Listening to music improves mood and helps process anger
5. Why do athletes use doping?
6. The consequences of plagiarism
7. Influence of artificial intelligence on modern society
8. The effect of nuclear energy on the modern world
9. Why is global web insecure?
10. Global warming