

Hypothermia Mechanism Test

This paper presents a test on an inexpensive design to induce rapid and comfortable hypothermia on a subject at head level. Based on the existing literature in medicine and cryonics on inducing local hypothermia in the most optimal way possible, the experiment is designed with the following elements:

1. A transparent plastic box.
2. Wire thermocouple thermometer.
3. Aquarium motor
4. $\frac{1}{2}$ m plastic tube.
5. Coarse salt. (10 grams)
6. Ice (300 grams)
7. $\frac{1}{2}$ L of water
8. Sphere of minced meat 3 cm in diameter. (36 cm^3 volume)
9. An electronic scale.

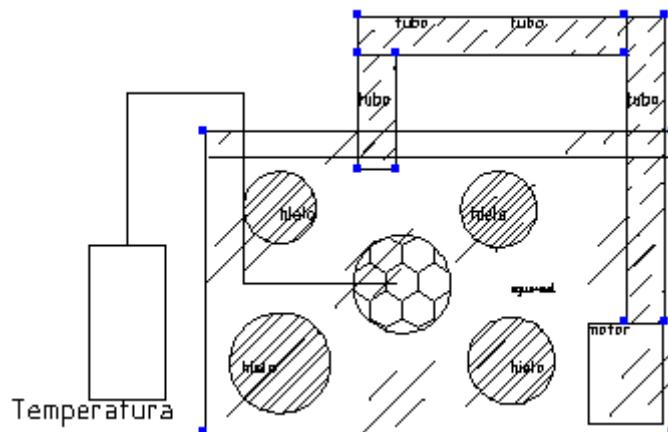
The materials can be purchased in shops, hardware stores and aquarium stores for a total price of less than ten euros.

The plastic box is filled with $\frac{1}{2}$ L of water, 300 grams of ice. The sphere connects to the thermometer, taking the temperature from the very center. The aquarium motor is assembled with the plastic tube, slightly narrower for heat modeling and fitting. In such a way that once the device is started it takes cold water from the bottom and pumps it through the tube to discharge the water over the ice and exchanges the temperature by cooling the water and dissolving the salt, which accelerates the dissolution of the ice and allows it to cool faster the water. This rapid exchange of temperatures makes it possible to accelerate the drop in the internal temperature of the meat sphere.

Volume calculation:

Volume of a sphere: $V = (4/3) (\pi) (r^3)$, where "r" is the length of the radius.

$$V = (4/3) (\pi) (3^3) = 36\pi \text{ cm}^3.$$



Design made in [LibreCAD](#)

The following photos are in chronological order with temperature, time, and time of registration (T00: 00) together with notes taken during the process that indicate changes in it.



17:41, T00: 00; 39.0° C, all the elements are arranged, assembled and the water pump starts up.



17:44, T00: 03, 24.8° C The temperature drops 15.2° C in three minutes.



17:45, T00: 04, 22.7° C The temperature passes at a rate of 1.1° C per minute.

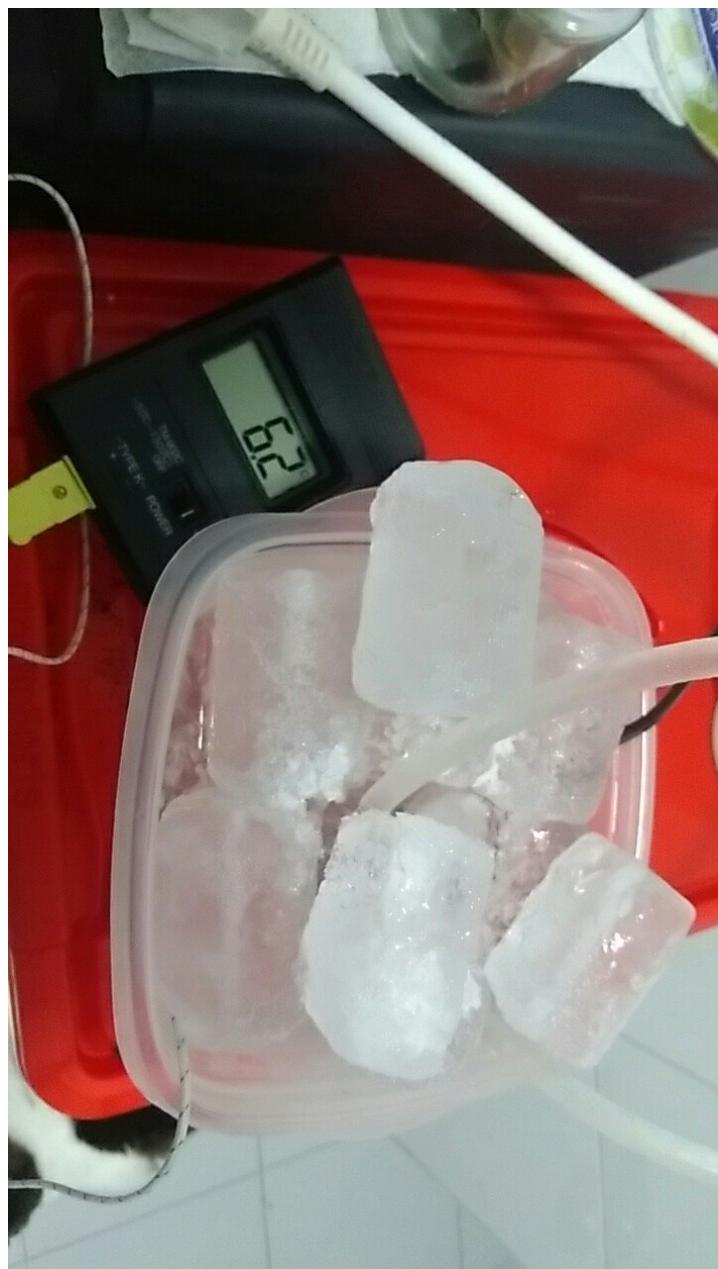


17:47, T00: 06

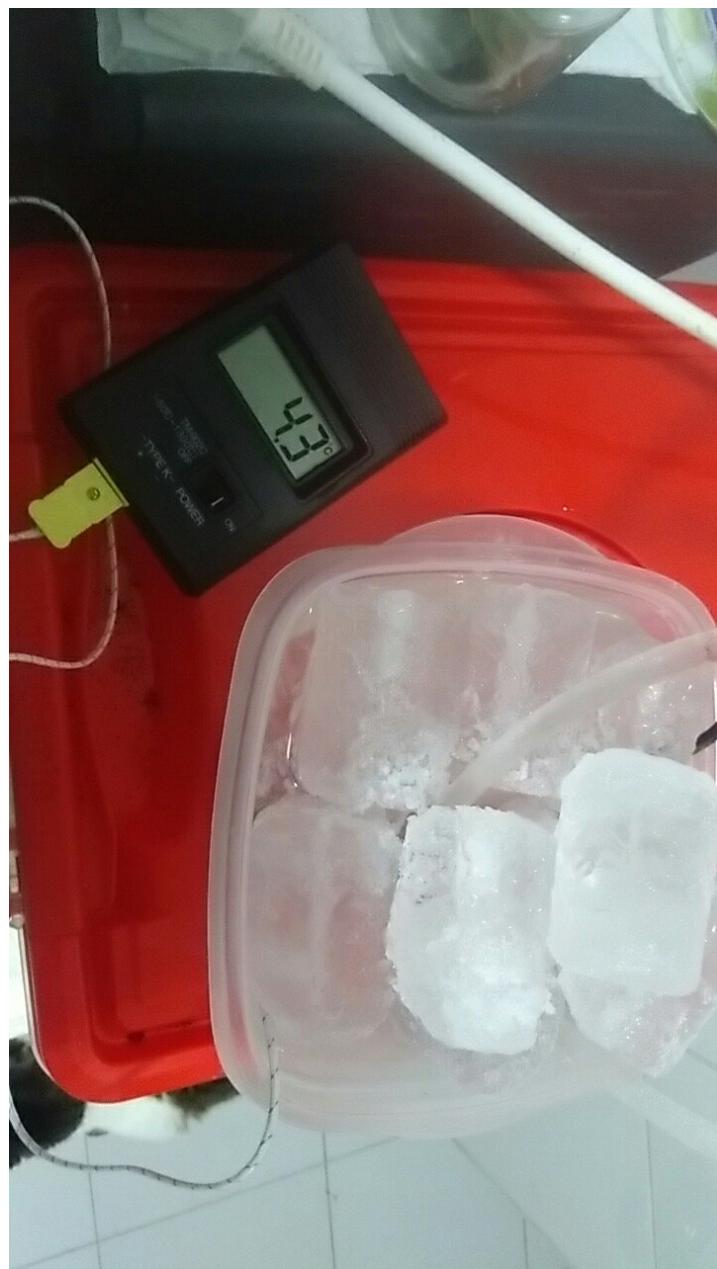
The temperature drops one degree every four seconds on average.



17:53, T00: 12 Based on the [Cryonicsprotocol](#) Institute for perfusion
of patients, phase one of would begin at this point
[exsanguinating](#) the body with serum from transplants.



17:57, T00: 16 From this point the rate of descent from degree to degree lengthens by ten seconds.
(Phase 2 of the Cryonics Institute procedure)



18:00, T00: 19 (Phase 3 of the Cryonics Institute procedure)



18:07, T00: 26, starting from an animal temperature of 39°C of the febrile type (Feline average 38°C) implies a drop of 37° C in 26 minutes.



Side view of the device, the motor can be seen in its function of circulating the water from the base to the mass of ice that protrudes.is regularly removed Waterfrom the melting ice.



18:31, T00: 00 In 24 minutes it only drops 1.2 degrees indicating that it is reaching a cap due to conditions. (From this point, Cryonics Institute phase 4 can be infused.)

Do not lower the temperature any further. Any subsequent descent if it were a head will be by perfusion.

Minor improvements; For the water to be circulated, apply fine salt, for the ice in alternate layers, thick sand. (Next experiment)

(After consultation in cryobiology)

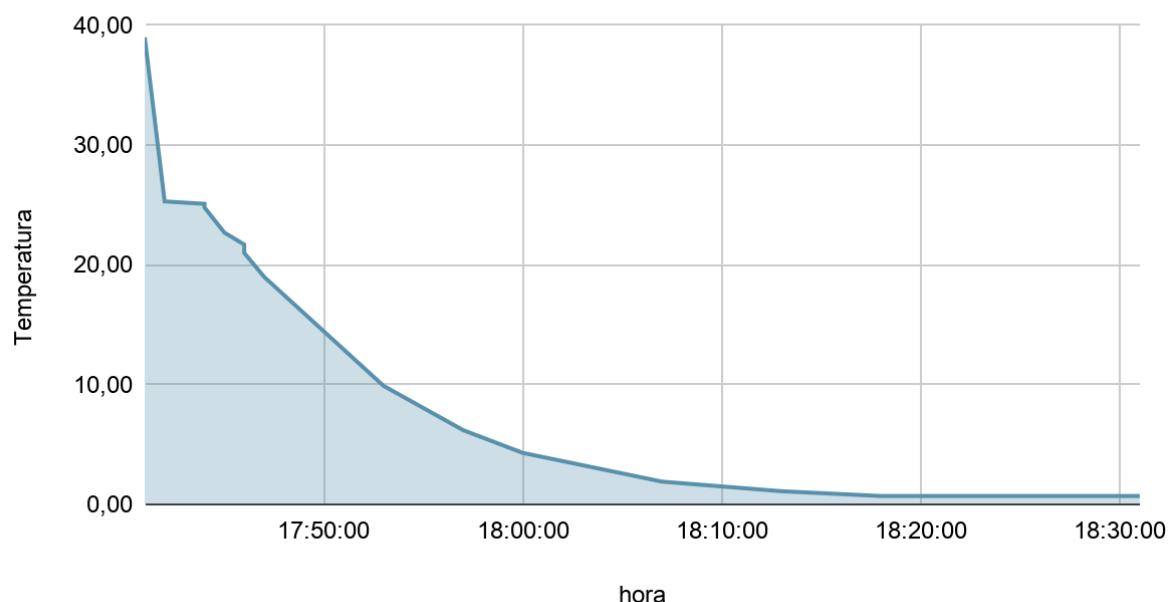
To be able to go below 0 degrees with water and ice you need to add salt. In particular you can theoretically go down to - 21.2 degrees Celsius if the amount of salt you add to the water is 23.3% by weight.

Graphs of the experiment:

Input data.

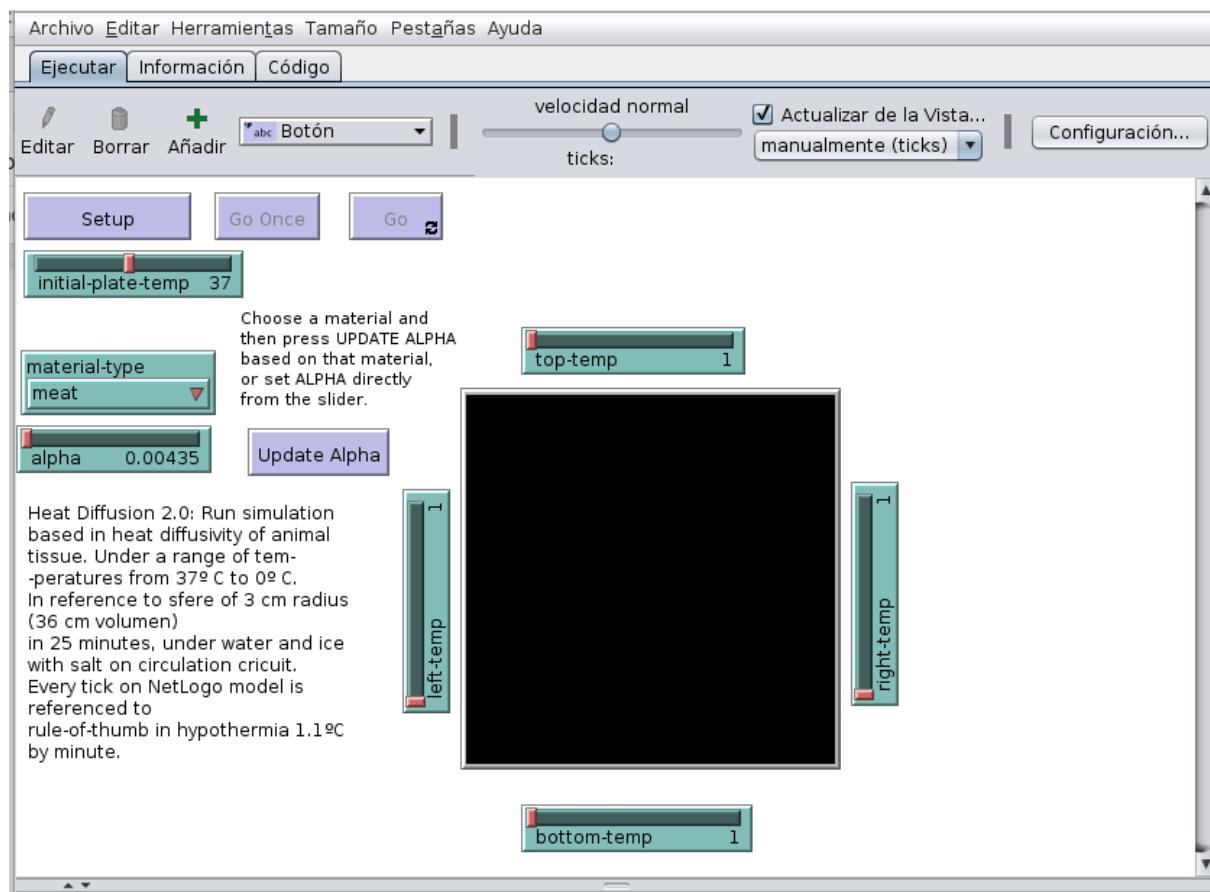
hora	Temperatura
17:41:00	39,00
17:42:00	25,30
17:44:00	25,10
17:44:00	24,80
17:45:00	22,70
17:46:00	21,70
17:46:00	21,00
17:47:00	19,00
17:53:00	9,90
17:57:00	6,20
18:00:00	4,30
18:07:00	1,90
18:13:00	1,10
18:18:00	0,70
18:31:00	0,70

Temperatura frente a hora



Simulation in NetLogo:

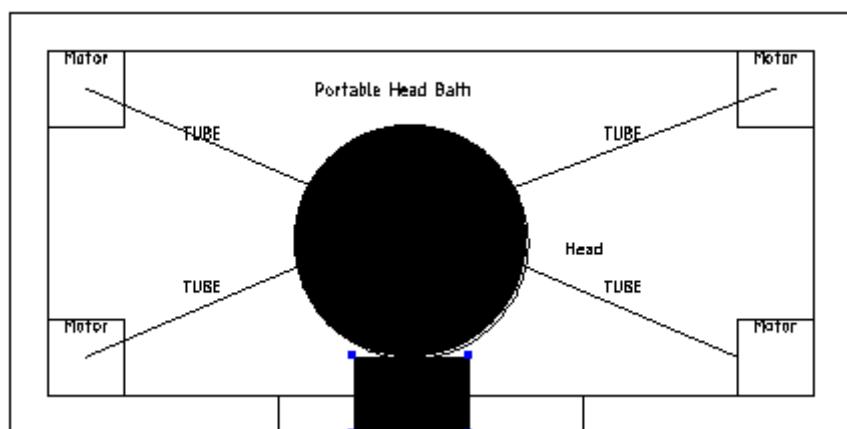
model [heat diffusion](#) Derived from the, from the sample project repository [NetLogo](#), a second version with the added factor of heat diffusion per square centimeter of average animal tissue (averaged 5 types of tissue animal, see attached sources in the simulation information section) The project code can be accessed on [GitHub](#).



[Ideas for next experiment]

For the inflatable head bath you can put four water pumps with a tube, one per corner. Powered by an adapter. Allowing a homogeneous circulation and a flow four times greater of water. Applying the cryobiology consultation, it is calculated that in a

bath portable head the volume is 4L, with 23.3% of fine salt for the water, so it is worth one kilo. For the ice to be deposited in alternate layers, it would be coarse salt. That in combination with the perfusion only of the head and the body covered with ice packs allows this descent.



Design made in LibreCAD

The cost of adding four motors, tubes and an adapter should not exceed ten euros. Extrapolating that the average volume of a head is 3,900 cm³ indicates that with the four-tube method it may take between two and ten times longer (between 50 and 250 minutes, depending on initial conditions).

Future experiments:

1. substitute water for alcohol
2. substitute ice for water from dry ice.
3. Take measurements

Technical annex:

The mini aquarium water pump has the following characteristics (it is a standard)

Flow rate: 200 L / h. (speed 2), 100 L / h (speed 1)

Consumption / power: 220V / 50Hz 3W

Measurements: 40x45x30mm

Price: € 4

Seller: Aliexpress

50 cm long silicone tube made of silicone, heat moldable.

Price: 50 cents.

Seller: hardware.

Plastic container:

Price: € 1

Seller: hardware store.

Thermocouple cable thermometer:

Price: € 3.5

Seller: Aliexpress

Consumption: 2 batteries, 1.5 v

Range: -100° C, 200° C

Sources:

<https://benbest.com/cryonics/cryonics.html>

www.cryonics.org

www.alcor.org

