

Heat and Temperature: Front End Evaluation Report

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Heat and Temperature Front End Evaluation Report October 28, 1999

Goal: To assess visitors' impressions of the Heat and Temperature area before it was renovated.

Method:

Interview Visitors at front of Life Sciences section (Section 5)
N = 22 visitor groups; N = 37 total visitors

Questions:

1. When you think about heat and temperature, do you think about them as **separate** things or as the **same** thing? Why is that?
2. Is there anything about heat and temperature that you're curious about or want to know more about? OR Was there ever anything that relates to heat and temperature that you found surprising?
3. What kinds of experiences do you think could help a young person start to think about heat and temperature?
4. Can you think of some different ways that heat can move from one place to another? OR What are some different ways of warming things up?
5. Do you have any special interest, knowledge or training in the area of heat and temperature?
6. Is this your first visit to the Exploratorium? Y N

1. When you think about heat and temperature, do you think about them as separate things or as the same thing? Why is that?

Temperature is a measure of heat (or vice versa).

- Same 40: temperature is a measure of Heat. 10: Different - Heat is not the temperature of something.
- Same Temperature is a way of measuring the heat.
- Same F: Just because heat is a temperature. - a way - the word used to describe it. M: A measurement.
- Same Heat is an amplitude of temperature like 10 is an amplitude of numbers. [Can you say more about what amplitude means?] A measure of. A measurement.
- Same 20: Don't think about them much. Totally related - hotter is is, the higher the temperature

Heat is high temperature. Temperature can be high or low.

- Same When you're hot, you think of a high temperature. When you're cold, there's a lower temperature.
- Same F: I get hot when the temperature is up. M: All depends - sometimes it's really hot. But when the wind blows, it's not as hot as it feels.
- Separate 10: Hot and cold are opposites. 40: Heat defines a type of temperature. Heat's related to temperature, but they're different things.
- Separate Temperature can be cold.
- Same Hot and cold and temperature being hot and cold.
- Separate Just think of heat being hot and temperature measuring all spectrums of the scope.
- Same Temperature is going what degree it is outside [And how about heat?] Whether I'm suntanning or not.

Heat is something I feel. Temperature is other (measurement, weather, etc).

- Separate Heat is just an element. temperature is more of a measurement.
- Separate 12: Separate but the same. One's temperature and one's heat. 40: Heat is the extremeness - the feel. The feel of heat. Temperature is the test of heat.
- Separate F: temperature is the weather. Heat is the way I feel. M: They're the same, but I don't think about heat in winter outside, only inside. What's the temperature outside and the heat inside.

Temperature is the weather. Heat is other.

- Separate Temperature is more towards climate. Heat is a specific element.
- Same Temperature is going what degree it is outside [And how about heat?] Whether I'm suntanning or not.
- Same M: Normally, the first thing is climate temperature and heat in climate. Unless you think of it in science or chemical terms, you think more climatic, which is boring.

Other.

- Same Controlling basically everything. [Can you say more?] Heat and cold - it affects us and the world.
- Same Don't think about it much - If I'm hot, I check the temperature!
- Separate Heat is more something of a comfort thing than temperature. [How? In what sense?] In a life sense. [So you mean like your physical body?] Yeah. Heat is external, temperature is more internal.
- Same F: Heat being a temperature. Haven't given it too much thought. M: Heat. Radiant heat. Heat is something that radiates. Something hot.

Same Don't know

2. Is there anything about heat and temperature that you're curious about or want to know more about? OR Was there ever anything that relates to heat and temperature that you found surprising?

Questions about heat / behavior of heat.

10: Can you make light without heat? 40: Relationship between energy of motion and energy of Heat. Like brakes on a car - just a little heat can stop the car.

10: How does heat react to cold when it's mixed?

F: Why does heat rise to the surface of air and space?

M: Model house with heat escaping - a model of heat escaping.

What makes it change? What are the different causes? temperature is a measurement. To change temperature, have to change heat - how do you do that?

Changes of states. I've heard that it's faster to boil something that's [initially] cooler than something that's [initially] warmer.

Difference between dry heat and wet heat.

M: Pressure stuff [Can you say more?] The relationship between heat and temperature and pressure. F: We realized we didn't know the difference between celsius, Kelvin and Fahrenheit. As a method for releasing energy.

Understand speed at which temperatures increase or decrease - what causes it and how long it takes?

Questions about the effect of heat on the body / biological issues.

M: When [at what temperature?] do you begin to sweat? When does heat exhaustion start? What are the early symptoms?

Human body - what happens to bodily functions when subjected to heat or cold?

What lives in extreme weather?

Cold end of the spectrum - so cold it burns. Opposite end of the spectrum. Cold burns.

Can't describe what I want to know more about [2nd Q] If you experience where you combine humidity and temperature - temperature feels different with a high or low humidity.

40: Humidity. How it's created and why. 20: How it affects the body - relate to the sun - heat and temperature give off same stuff.

Questions about the effects of temperature on objects.

40: What temperature does metal - gold - melt? At what temperatures do certain objects freeze?

Conduction - different forms - how heat travels quicker through some things than others.

M: In

cooking, why is food changed because of the application of heat?

F: Think of heat as coming from the sun - are there other natural sources of heat?

F: Display of how heat affects different things, different metals - what melts.

Comments about weather.

Don't have any heat in the West Coast. It's not like the South where we're from.

El Nino and La Nina. - that was interesting - the effects it had on the whole world.

F: Why my heating bill is so high!

What makes it fluctuate so much [you mean like the weather?] Yeah, and the ocean - why it doesn't change much. Where I live, the ocean is the same in winter and summer.

Other / Can't think of anything.

Can't think of anything.

Can't think of anything.

Nothing comes to mind.

Never thought about it. Don't know much about heat and temperature.

3. What kinds of experiences do you think could help a young person start to think about heat and temperature?**Sensing hot and cold.**

40: Show how relative sensations are - like you're cold and hot outside. The role of humidity. Like you can be in a cold room under a hot lamp and still get hot.

Experiencing it - touch - getting cold.

Anything they can touch and compare. Like some things can be the same temperature, but feel different, like metal and wood.

My kids are young - anything tactile, any button pushing or knob turning. My 5 year old knows that water can be ice or boiled. Changes of state.

In Florida, they had one thing that was hot and one was cold and you touched them and something unexpected happened. Yeah, anything unexpected is good.

Displays where they can experience the different cold and hot - where their body feels it.

Don't know. Something with water - something they can try on their own skin.

40: Room where it's heat sensitive - how it feels - different temperatures. 20: Have a heat sensitive room - touch stuff that's at different temperatures. Our body - body heat - relate to [objects]

F: Have different things they could touch. Touch is a huge one.

Activities to change your body temperature / visualize body temperature.

M: Activities like running. Standing in the sun. F: Getting a heat stroke. M: Knowing what's too hot. F: Why it's important to drink water.

Exercise machine - show temperature change as you exercise. Not x-rays, but thermal device to show where you're hot and cold.

Something making them active. Running and seeing how the body heat is rising. How temperature changes. Standing on something hot or cold and seeing how temperature rises and falls. When it's done with your own body, you understand it better than with objects.

Some way to visualize - whenever you see someone's body and see hot spots and where they are. Makes it more real.

Effects of temperature on objects.

10: Hot air balloon - in basket, have a hole with a fabric to put a pole in w hot air going through the pole to the open balloon. F: Demo to show hot air rises.

F: Something with fog - show how fog happens. Also hot pavement - when it rains, steam rises.

When it's dry, you can see the heat coming off. M: Different properties of temperature - things expand and contract. Interesting temperatures - T at which things freeze.

Learning how to read temperatures. Some of the effects of heat on different objects - How it melts.

F: Exposing them to the opposite temperatures. Visually seeing the effects of cold on the environment vs. heat on the environment. M: Show a display with flame and how things combust - turning objects solid under extreme cold.

The uses / dangers of heat or extreme temperatures.

Have something about fire - what helps us use fire and what's dangerous? What about forest fires? How much oxygen does one take?

Something around the dangers of heat. I had one daughter pour a hot coffee pot over her head.

M: One of our kids learned to say "hot" at a very young age by putting her hand on a camping stove. F: Positive and negative connections of heat. [Try to get at these?] Right. Look at different ways heat's important and dangerous.

What experiments do they do in the antarctic?

Other.

10: Electric heat.

Studies in school. Learning stations on T.V.

12: Experiments on heat and temperature

M: Interactive stuff.

Something that's concrete - that they can see vs. something abstract. Could be pictorial

4. Can you think of some different ways that heat can move from one place to another? OR What are some different ways of warming things up?**Environmental conditions / weather / sun / fire.**

Heat is associated with a high pressure system. How pressure associates with rain and snow.

Severe southwestern wind brings in hot Temps. [Different ways of warming things up?] Light bulbs, sun, warm rocks.

10: Global heating

Temperature outside.

40: Changes in atmosphere. Water reflections.

Sun.

Sunlight

Other ways of moving heat? Rays, sun rays.

[2nd Q] Solar, fire

Solar. 20: Solar's really interesting.

Don't know. [2nd Q] Solar.

Solar Energy.

M: Wind. Clouds. Water. F: Fire. M: Solar.

Fire, sun, steam heat. Can relate to steam heat because it's obvious.

20: Fire.

Flames.

Water. Fire. Gas.

Transferred through the air or water.

Electricity. Air.

F: Air and water currents. M: Weather

M: Light.

Heating devices.

Electricity. Gas heat.

Heater

Lightbulb uses electricity to transfer heat.

Gas. If you have something fueled by gas.

Heater with a fan. Microwave oven.

Gasoline.

Fans [2nd Q] Stoves

Use hot water, put through pipes - move heat from water to air. How refrigerators work.

F: Microwave - figure out how a microwave works.

40: Gas. 40: Electricity.

Burning natural gas, electricity

Thermal energy. Through heat, create electricity.

Microwaves

Body heat.

F: Breath. F: Pressure. Touch - from your warm hand. Circulation of my blood.

40: Motion, friction

Warm blankets, warm clothing.

Put clothes on, makes your body warm.

Hold something cold, warm it up, then touch something warmer, it'll heat it up.

Body Temp.

Body heat between different people.

20: Body heat. Clothes.

Everyday objects / see effects of heat or temp.

40: Through objects. Radiate through air. Store it and move it like in a hot rock or something.

M: Reflections off glass or a building.

Metal heat - when it melts, it's melted.

Boiling water. 10: Magnifying.

Heat something up - go from solid to liquid. Ice cubes - frozen, heat it up and it melts.

Boiling. Friction.

M: Friction.

Friction.

Combustion, chemically.

Through some kind of conduit.

Through wires, through air. [2nd Q] Fire, electricity, friction.

Through wood, metal, air, water.

Through air, metal, water, any kind of conductor.

Radiation, conduction, convection.

Radiation, conduction.

F: Convection, conduction and radiation.