Style Engineers

Marvelous Materials

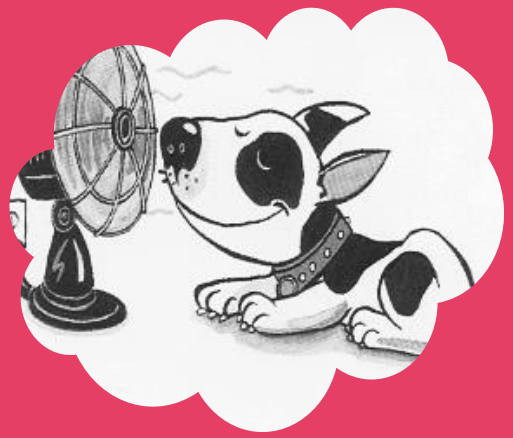
ACTIVITY

Regulating Body Heat

Fashion through science

Three ways heat moves from a body to the environment :

CONVECTION



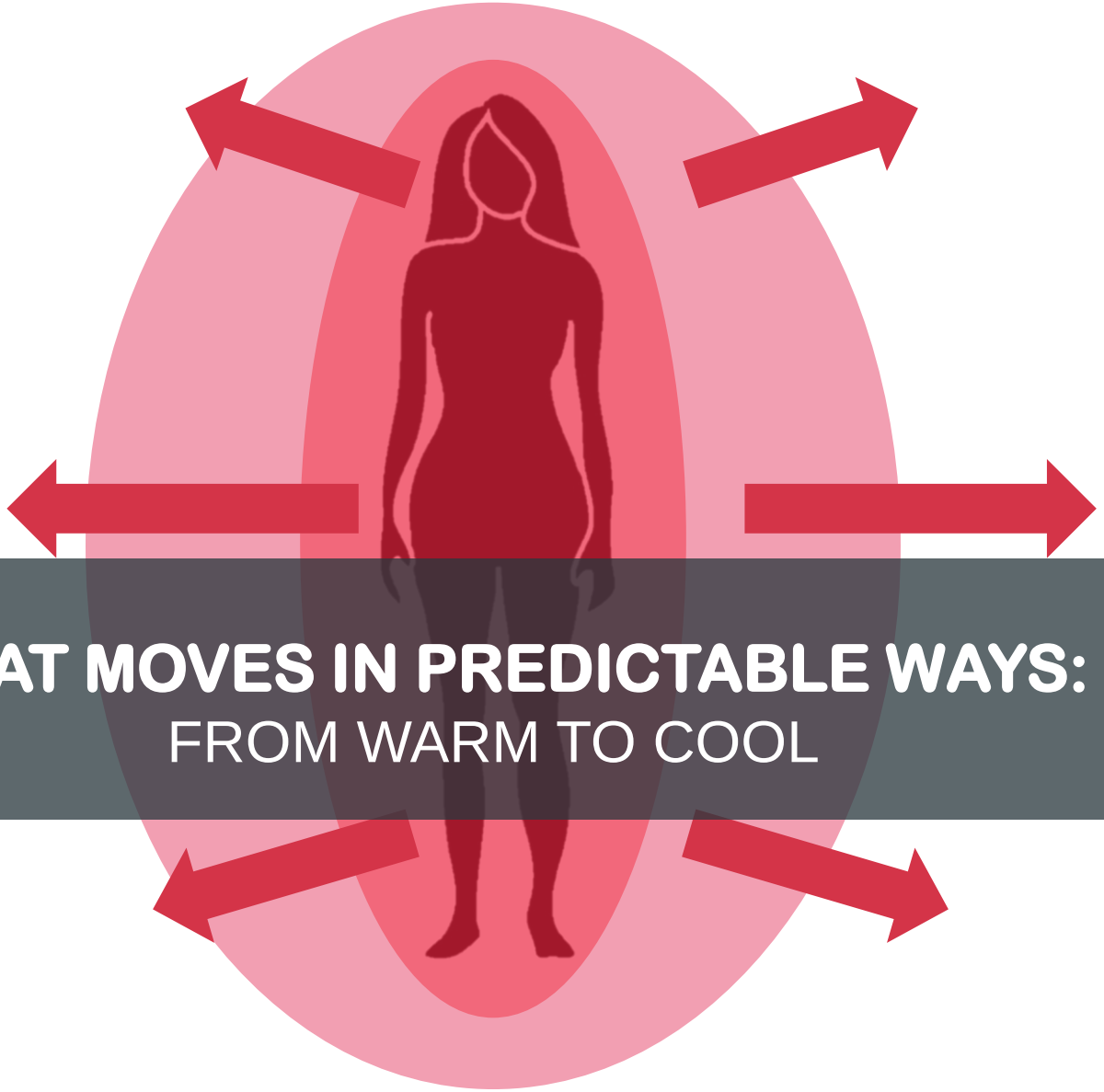
When air moves heat away

EVAPORATION

When water turns to vapor

CONDUCTION

When surfaces touch and transfer heat



HEAT MOVES IN PREDICTABLE WAYS:
FROM WARM TO COOL

In cold weather, the body looses heat through conduction when it touches cold objects.

CONDUCTION

When surfaces of two objects touch

Regulating Body Heat

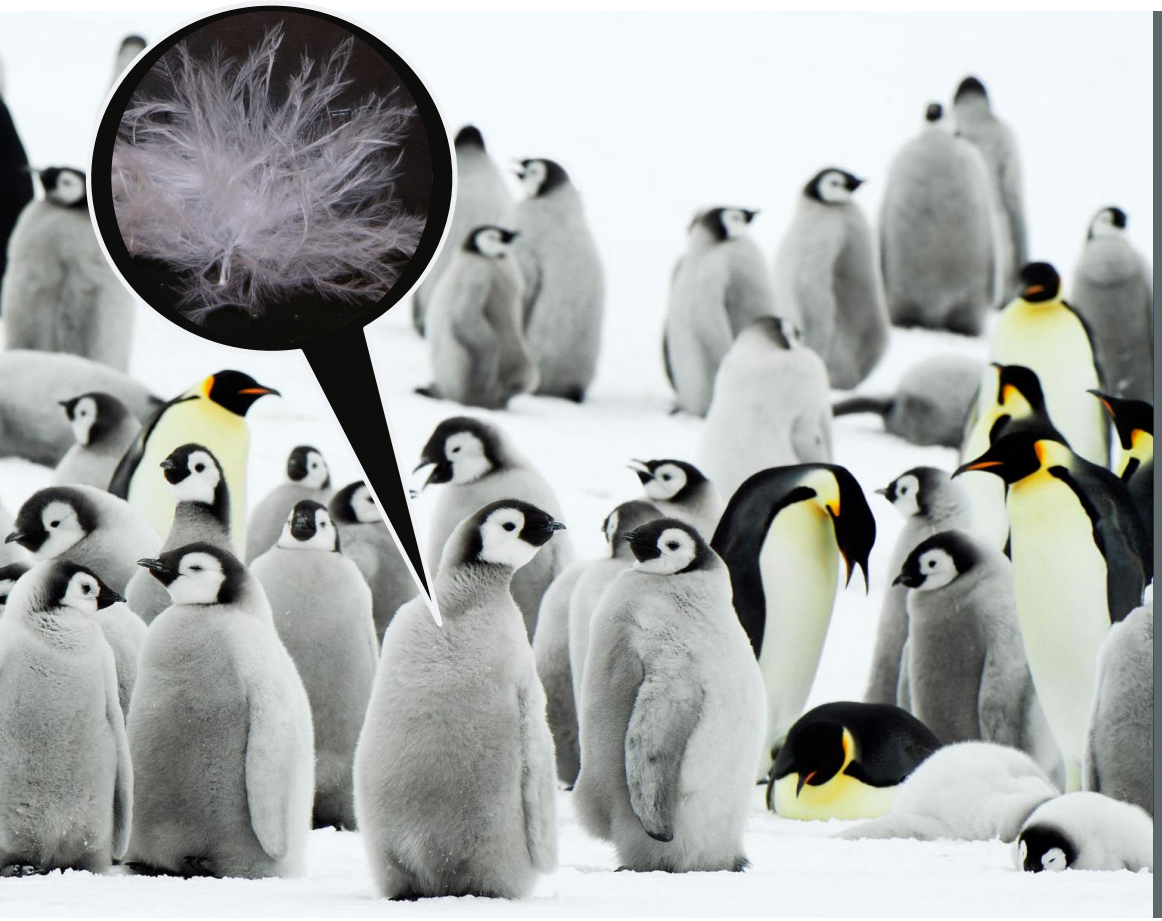
People consider themselves thermally comfortable when they do not need to take off or put on additional clothing to feel cooler or warmer.

Clothing materials can reduce heat loss from conduction and convection.

INSULATION

Insulation is a protective layer that prevents or slows conductive heat loss.

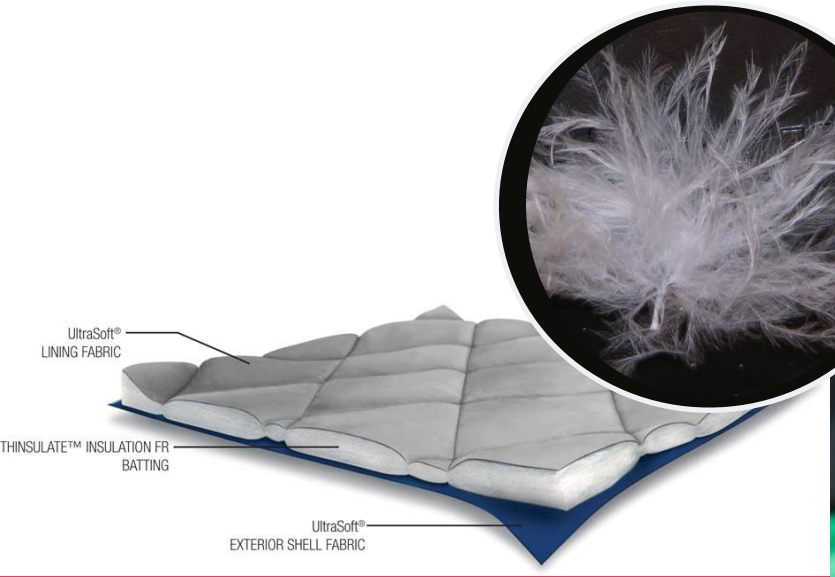
THE POWER OF THE AIR LAYER



Materials that have spaces to trap air are better insulators.

Downy feathers can trap lots of air and keep penguins warm.

We can use this idea to keep us warm too, by adding a layer of air inside our clothing.



How well a fabric keeps you warm is determined by how much air it can hold.

IS THICKER ALWAYS BETTER?

Aerogels are NOT thick, but they insulate well.

AEROGELS ARE THE WORLD'S LIGHTEST SOLID AND ARE MADE UP OF 99.98% AIR.

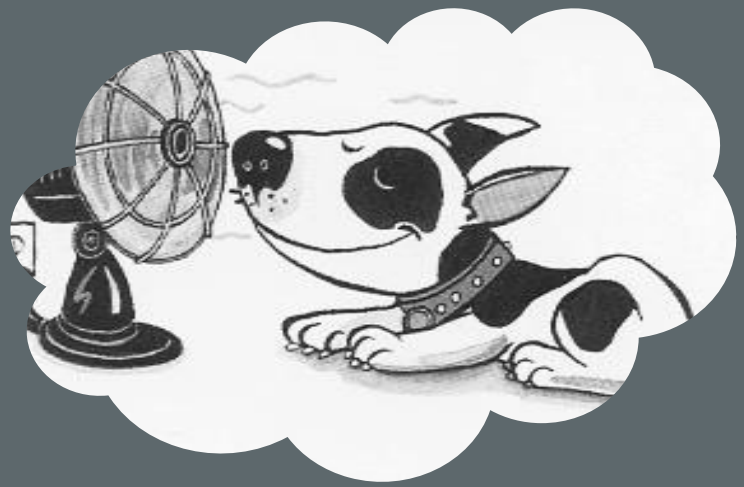
THEY HAVE THE LOWEST THERMAL CONDUCTIVITY OF ANY KNOWN SOLID!

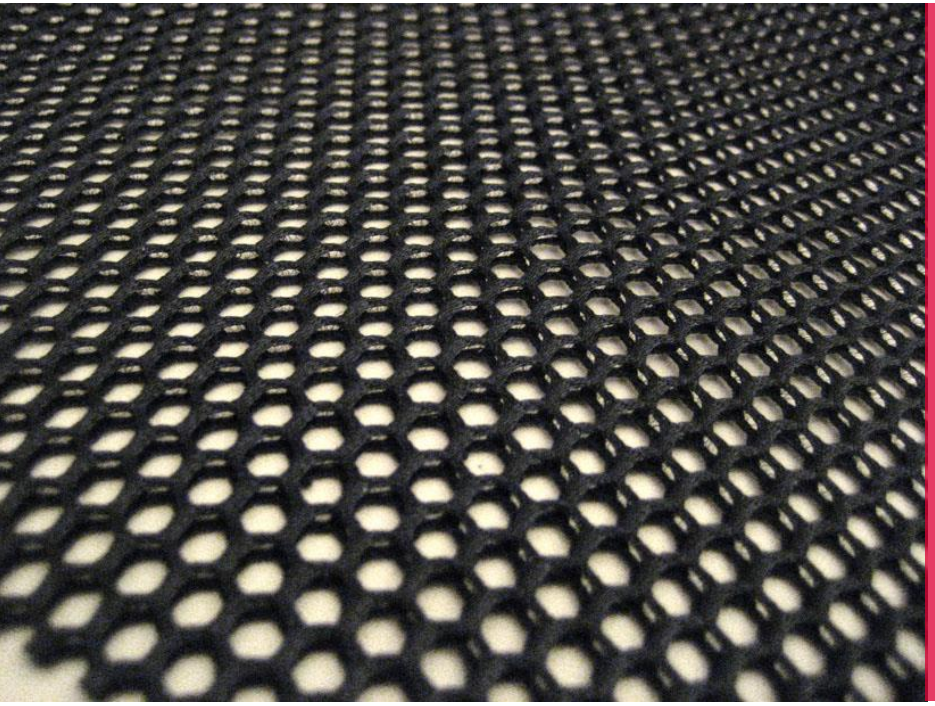
Remember, it is the ability of each material to trap air, that allows it to keep you warm.

AIR MOVEMENT THROUGH CLOTHING IS ANOTHER WAY WE LOSE HEAT

CONVECTION

Occurs when air moves heat away from the body





WHAT IF YOUR WINTER CLOTHING LOOKED LIKE THIS?

PERMEABILE FABRICS ALLOW CONVECTIVE HEAT LOSS

Materials with no open spaces block convective heat loss.

That's WIND PROTECTION

GARMENT LAYERS WORK TOGETHER TO CREATE A WHOLE SYSTEM THAT CAN PROTECT THE WEARER FROM THERMAL TRANSFER.

Layers allow use of different materials for different functions: insulation and wind protection.

Air is trapped between garment layers as well as in each material.

CAN A MATERIAL INSULATE SO WELL THAT YOU CAN OVERHEAT?

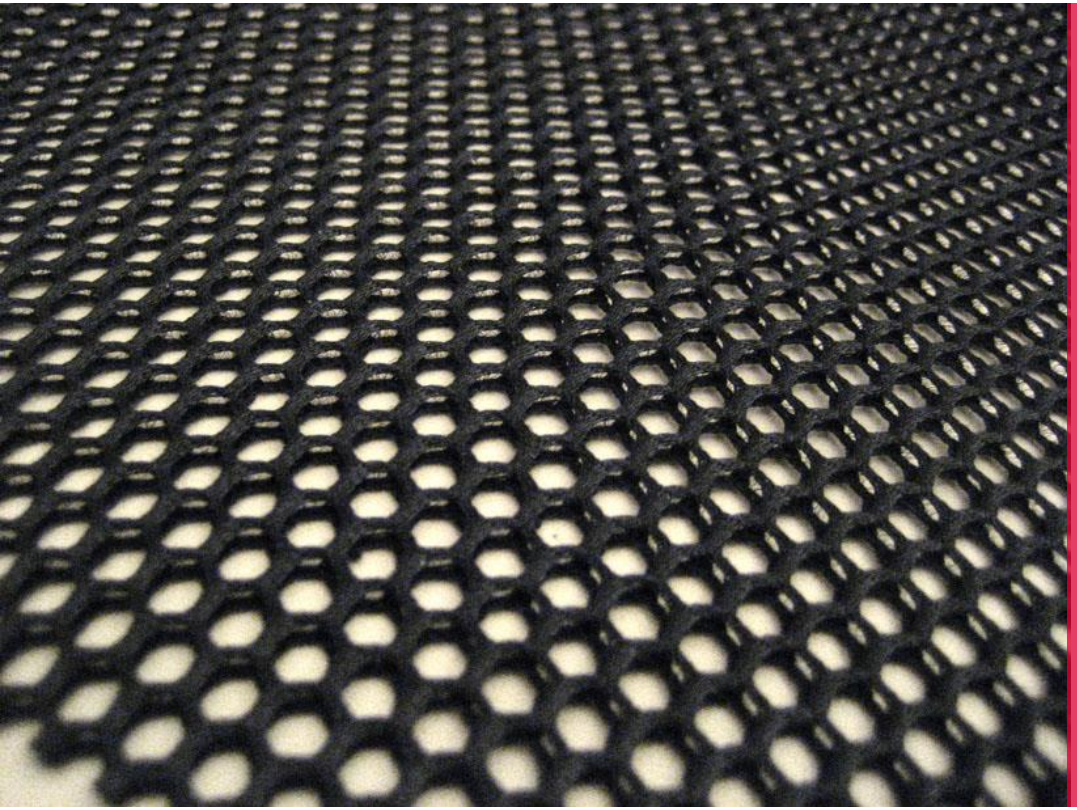
Even in cold environments we sweat.

Water vapor, or sweat, can be trapped inside our clothes.

That is a lot of water vapor coming off my feet. If I had my boots on it would all be trapped inside my shoes!

If our clothes cannot let the water vapor out, it can be trapped and condense inside our clothing.

How do we get rid of moisture?



- Adjustable Garment Openings
- Inner layers that move moisture away from the body

SUMMARY

Heat loss is due to conduction of heat through clothing materials in contact with the skin and convection via air flow through openings in materials.

Clothing materials modify the flow of heat from the body to the environment, making us comfortable.

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