

Chapter 3.2: Expansion and Contraction





Learning Points

- ◆ State that matter expands when it is heated and contracts when cooled.
- ◆ Explain the expansion and contraction of solids, liquids and gases in terms of particle theory.
- ◆ Describe applications of expansion of solids, liquids and gases.

Expansion and Contraction of Matter in General

Expansion

- ◆ As the average energy (temperature) of particles **increase**, the space between the particles **increase**. Matter in the solid liquid and gas phase **EXPANDS!**

Contraction

- ◆ As the average energy (temperature) of particles **decrease**, the space between the particles **decrease**. Matter in the solid liquid and gas phase **CONTRACTS!**

Expansion and Contraction in Solids

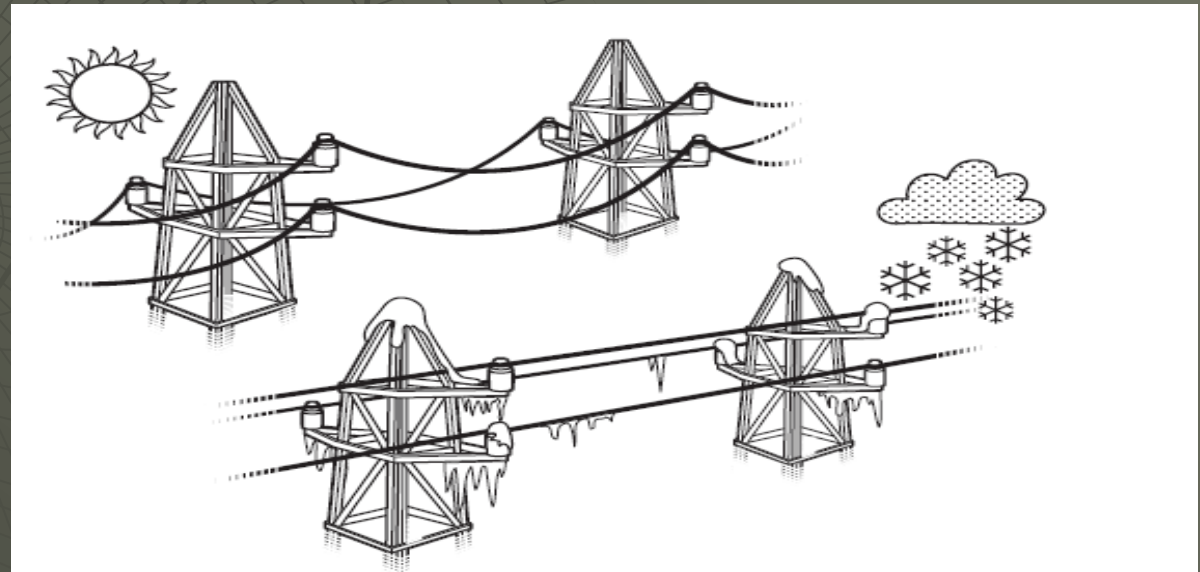
- ◆ **Solids** can **EXPAND** or **CONTRACT** depending on the temperature (average energy of the particles).

Expansion & contraction of solids

When a solid is heated it gets bigger or expands.
When it cools it gets smaller or contracts.



Telephone wires are put up loose in the summer so when winter comes they don't get too tight and snap.

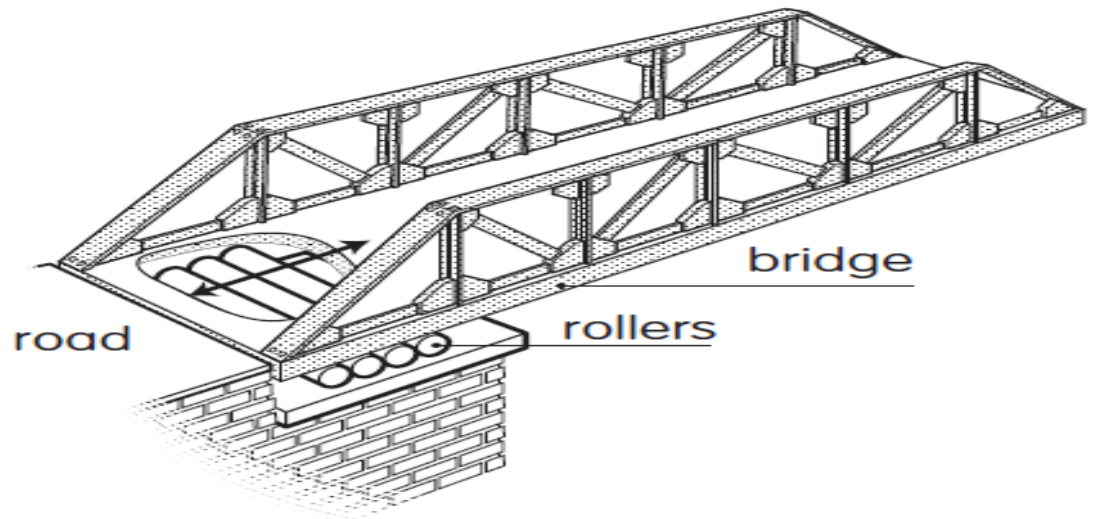


Expansion & contraction of solids

When a solid is heated it gets bigger or expands.
When it cools it gets smaller or contracts.



Bridges have expansion joints and rollers under them so that when it's hot the bridge doesn't buckle.



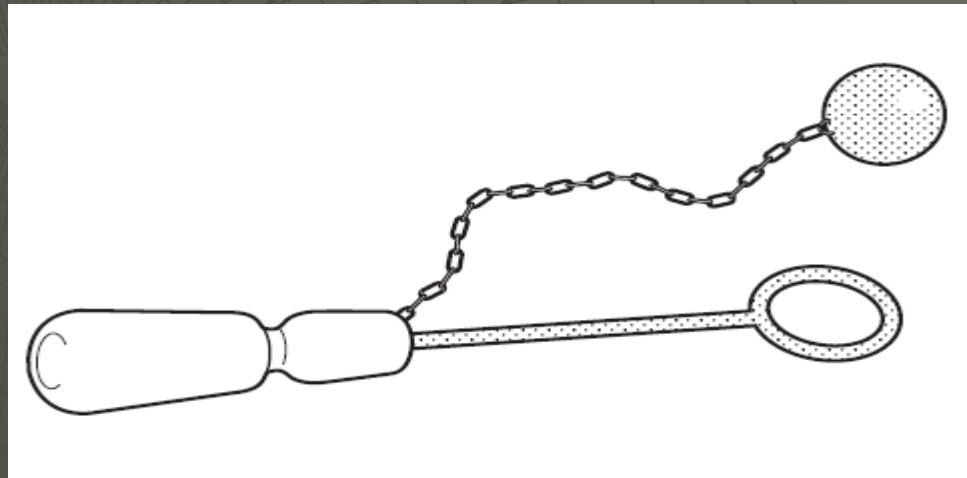
INSTRUCTIONS-Ball and Ring

1. Make sure that you can fit the metal ball through the metal ring.



INSTRUCTIONS-Ball and Ring

2. Heat the ball carefully in the blue flame of a Bunsen burner for at least 5 minutes.
3. Place the heated ball through the metal ring.





WHAT DID YOU FIND
OUT?

SOME QUESTIONS?

Q. How do the sizes of the bar and ball change again when they get cold?

Q. Can you explain why solids get bigger when they are heated and smaller when they are cooled?

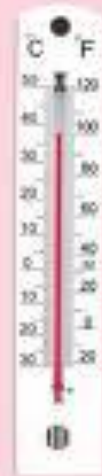
HINT: What happens to how the particles in the bar and ball are arranged when they are heated and then cooled.

EXPLANATION

- The particles in solids are close together.
- When a solid is heated it expands the distance between its particles become larger.
- When the solid is cooled it contracts and its the particles move back close to each other.

Expansion and Contraction in Liquids

- ◆ **Liquids** can **EXPAND** or **CONTRACT** depending on the temperature (average energy of the particles).
- ◆ This is demonstrated by the **liquid** used in a **thermometer**. As the **liquid** expands and contracts, it moves up and down the inside tubing (the *bore*) of the thermometer.



Expansion & contraction of liquids

Mercury and alcohol are liquids that expand and contract in thermometers.



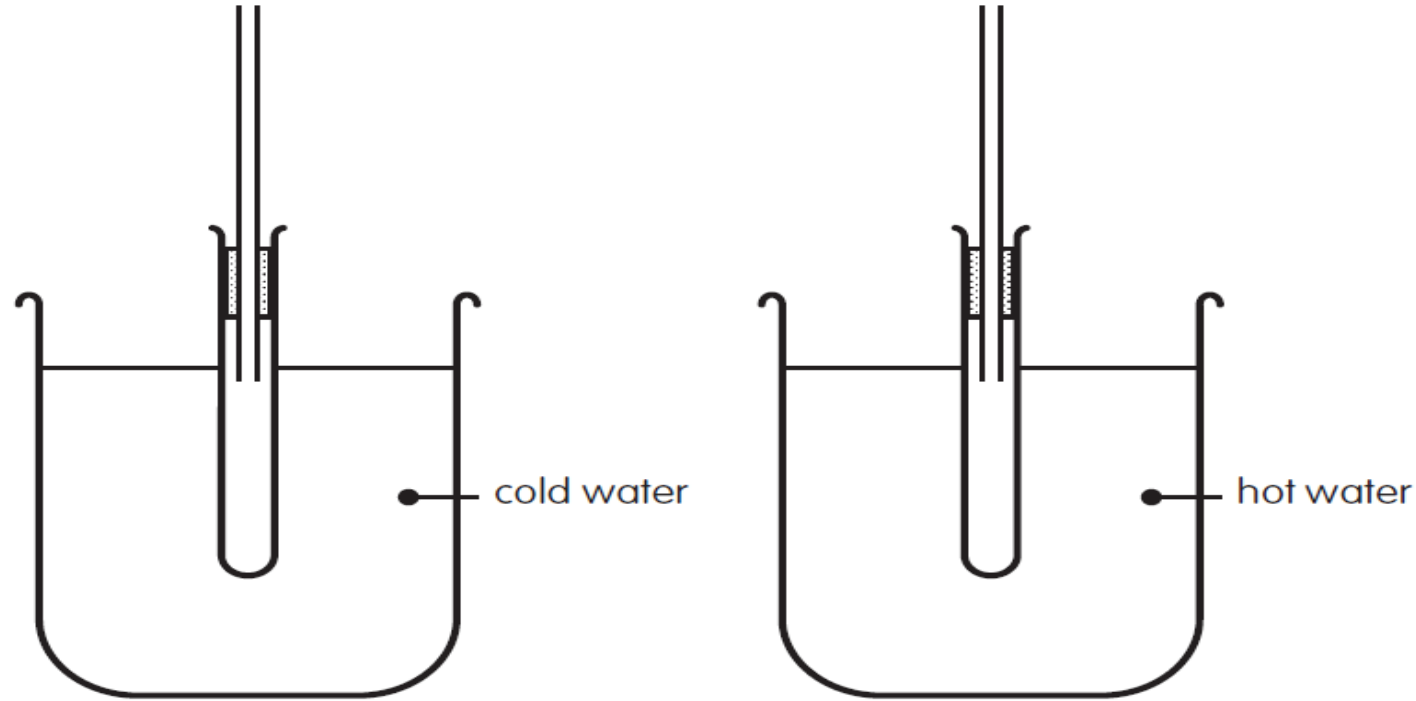
EXPERIMENT

AIM: To find out what happens to liquids when they are heated and cooled.

INSTRUCTIONS

1. Fill two test-tubes to near the top with the red coloured water provided.
2. Place the tops on the test-tubes and secure them using a clamp-stand.

3. Lower the test-tubes into a beaker containing either hot or cold water.



4. Watch what happens to the level of the red water in each test-tube over the next 5 minutes.



WHAT DID YOU FIND
OUT?

SOME QUESTIONS?

Q. Can you explain why liquids expand when they are heated and contract when they are cooled?

Q. What happens to how the particles in the red liquid are arranged when they are heated and then cooled?

EXPLANATION

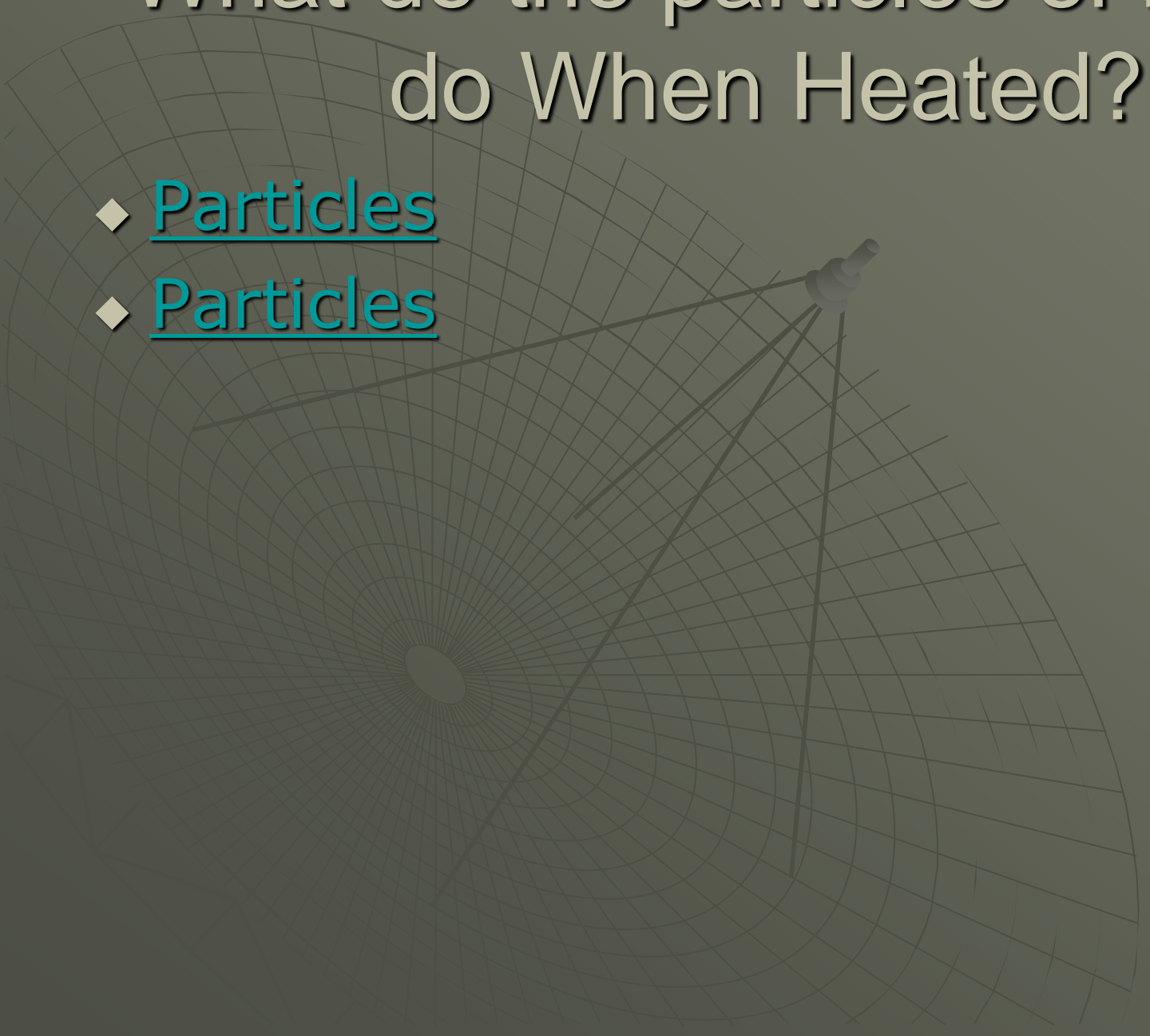
- The particles in liquids are a little further apart to each other than is the case in a solid.
- When a liquid is heated the distance between its particles become larger and it expands.
- When the liquid is cooled it contracts and its the particles move back close to each other.

Expansion and Contraction in Gases

- ◆ **Gasses** can **EXPAND** or **CONTRACT** depending on the temperature (average energy of the particles).

What do the particles of Matter do When Heated?

- ◆ Particles
- ◆ Particles

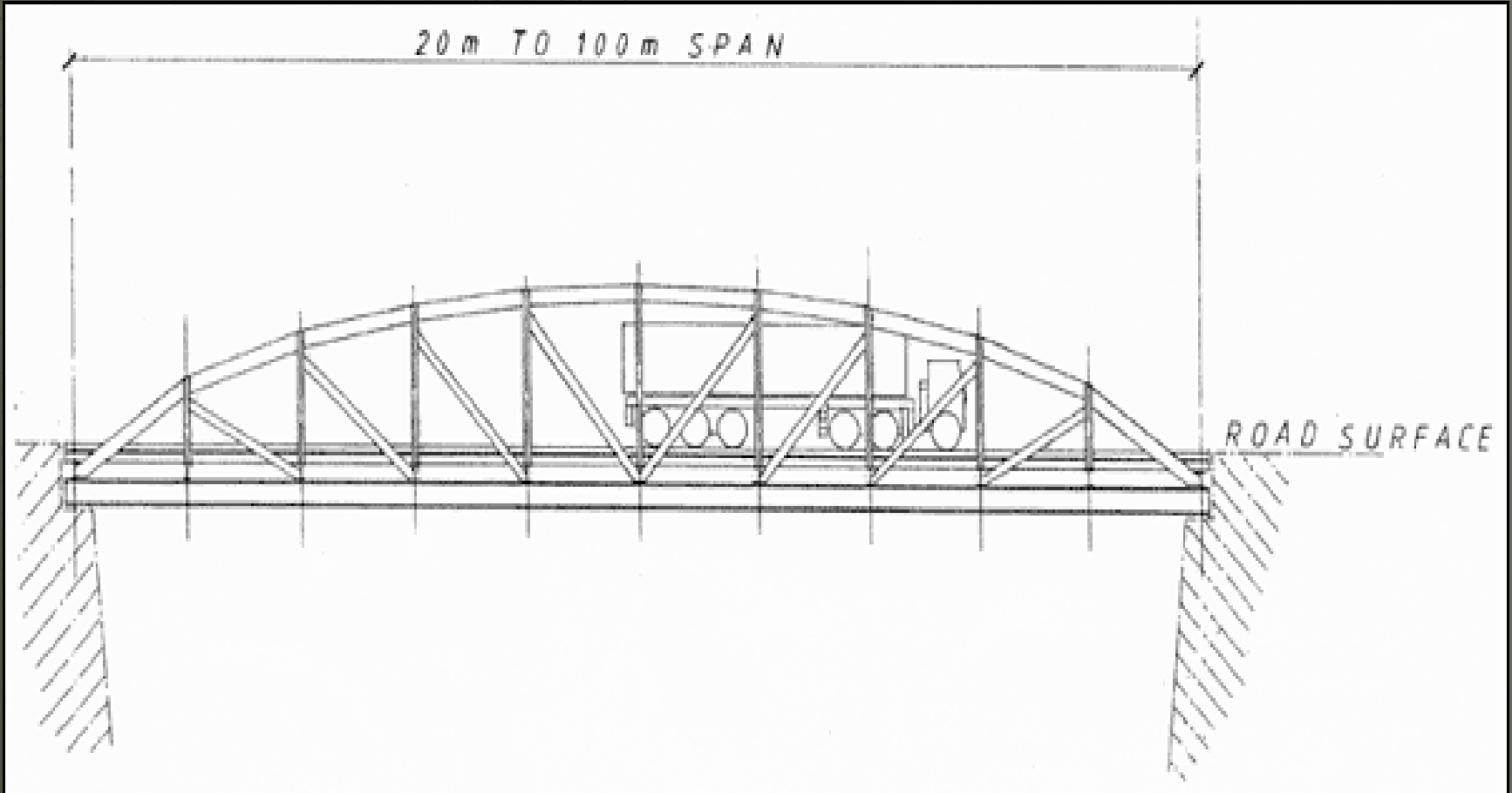


Steel Bridges

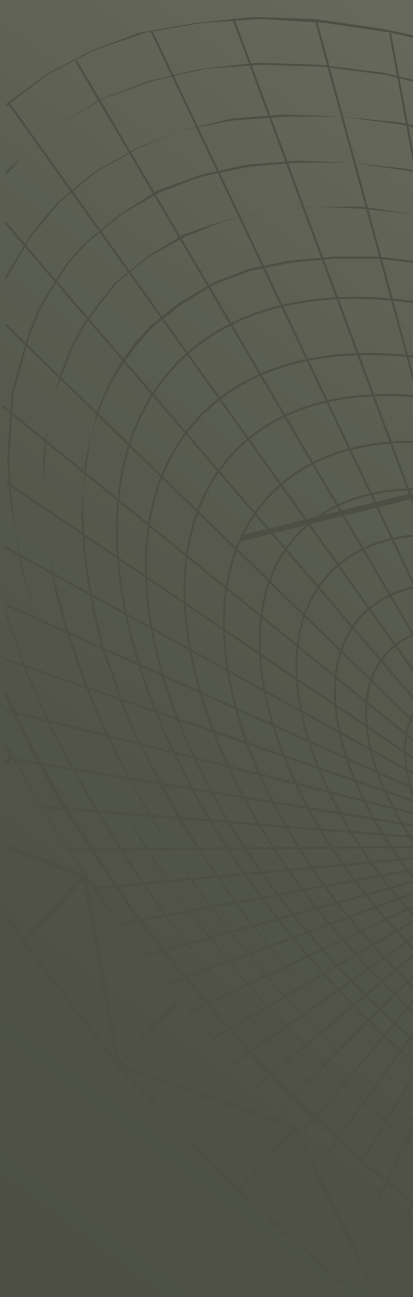
- ◆ Have expansion joints.



Bridge Expansion Joint Example







Railroad Tracks

- ◆ Have gaps at each joint.



Railroad Rails



Concrete roads

- ◆ Have expansion joints built in.



Concrete Roads



Concrete Roads



Pavements

- ◆ Pavements are built with expansion joints to try and avoid the cracking that may occur.
- ◆ Sometimes a sidewalk will develop a crack even with expansion joints. Do you know what happens to the size of the cracks in the winter and summer?

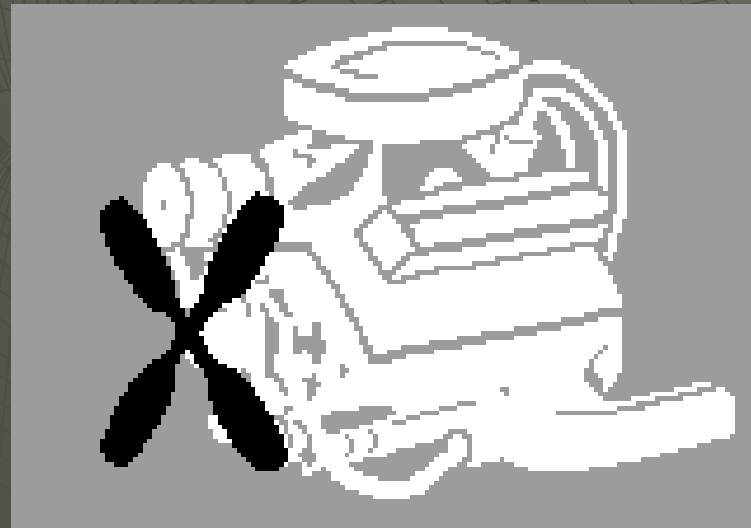
Sidewalks



Cars

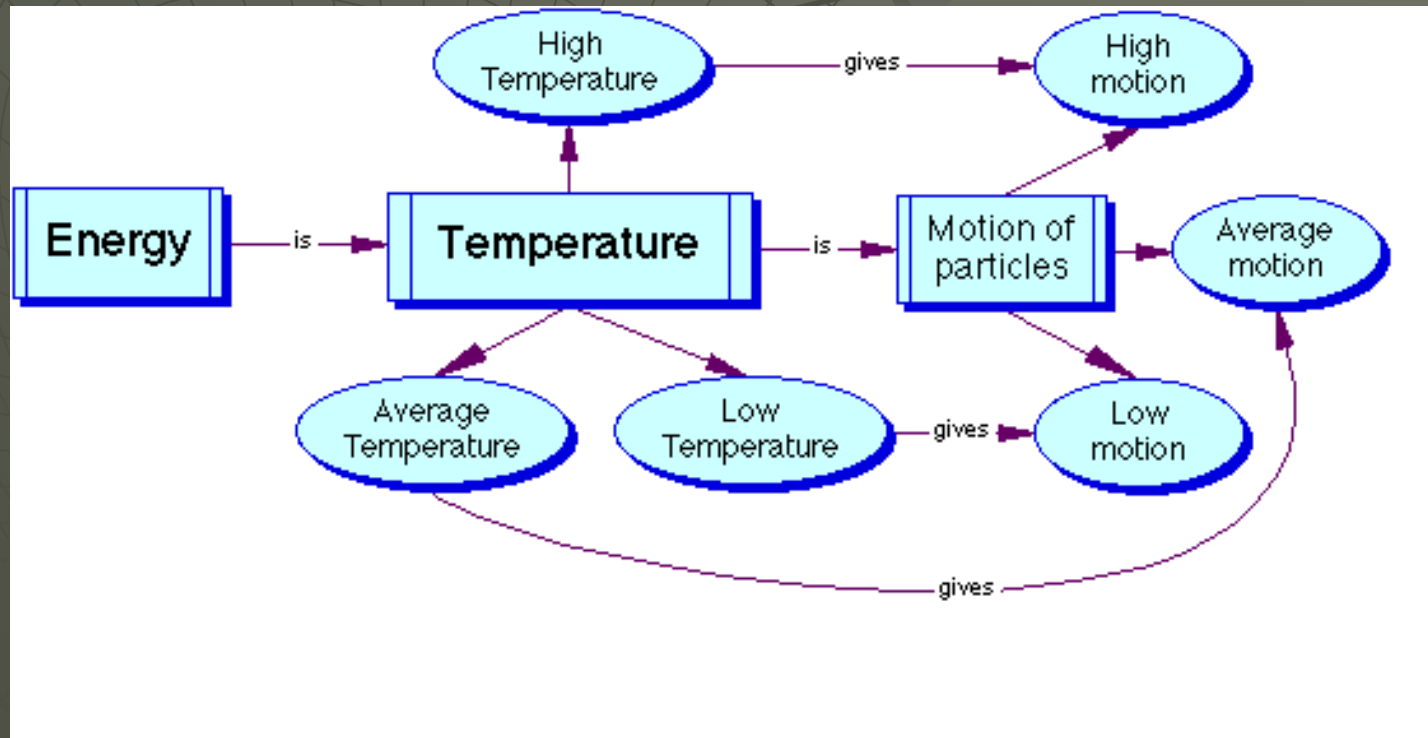


- ◆ Cars have engines with many working parts. The parts are engineered to be a little loose when cold so that when the engine becomes warm the parts do not expand



Study the chart and summarize in your own words it's meaning.

◆ Quick Review



◆ Summary Sentences.

- **1. When matter is heated the particle's speed _____ and the spacing _____.**
- **2. When matter is cooled the particle's speed _____ and the spacing _____.**