

## Chapter 14 The Behavior of Gases

### 14.1 Properties of Gases

### 14.2 The Gas Laws

### 14.3 Ideal Gases


### 14.4 Gases: Mixtures and Movements

## Why is there a recommended pressure range for the air inside a soccer ball?



In organized soccer, the pressure of the air inside the ball must be no lower than 0.6 atmospheres and no higher than 1.1 atmospheres at sea level.

### Compressibility

 Why are gases easier to compress than solids or liquids?

## 14.1 The Gas Laws > Compressibility

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Because gases can be compressed, the air bag absorbs some of the energy from the impact of a collision.



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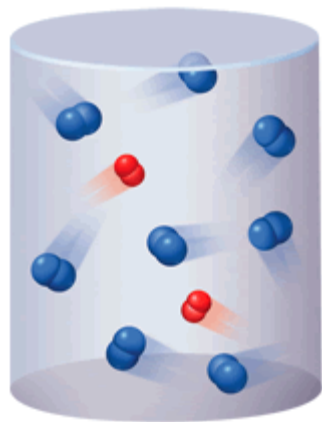
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- The volume of the particles in a gas is small compared to the overall volume of the gas.
- The distance between particles in a gas is much greater than the distance between particles in a liquid or solid.
- Under increased pressure, the particles in a gas are forced closer together.

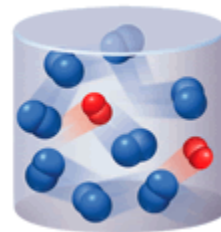
## 14.1 The Gas Laws > Compressibility

This model shows identical air samples in two different containers. Each container has 8 nitrogen molecules and 2 oxygen molecules.

In the larger container, the molecules are farther apart.



In the smaller container, the air sample is compressed, and the molecules are closer together.






**Explain why air is easily compressed, but wood is not easily compressed.**



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*The volume of the particles in a gas, such as air, is small compared to the overall volume of the gas. So, the distance between particles in air is much greater than the distance between particles in a solid, such as wood. Under pressure, the particles in a gas can be forced closer together, or compressed.*

### Factors Affecting Gas Pressure


 What are the three factors that affect gas pressure?

## 14.1 The Gas Laws > Factors Affecting Gas Pressure

The four variables generally used to describe a gas and their common units are:

- number of moles ( $n$ )
- volume ( $V$ ) in liters
- temperature ( $T$ ) in kelvins
- pressure ( $P$ ) in kilopascals

## 14.1 The Gas Laws > Factors Affecting Gas Pressure

 The amount of gas, volume, and temperature are factors that affect gas pressure.

## 14.1 The Gas Laws > Factors Affecting Gas Pressure

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- If you inflate an air raft, for example, the pressure inside the raft will increase.
- Collisions of gas particles with the inside walls of the raft result in the pressure that is exerted by the enclosed gas.

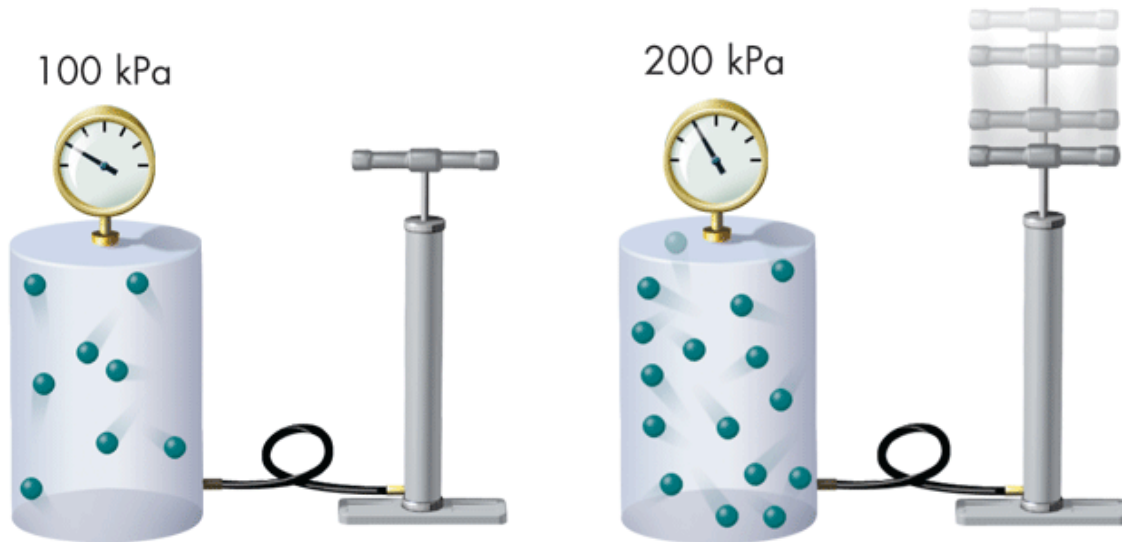
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- If you inflate an air raft, for example, the pressure inside the raft will increase.
- Collisions of gas particles with the inside walls of the raft result in the pressure that is exerted by the enclosed gas.
- Increasing the number of particles increases the number of collisions which explains why the gas pressure increases.

## 14.1 The Gas Laws > Factors Affecting Gas Pressure

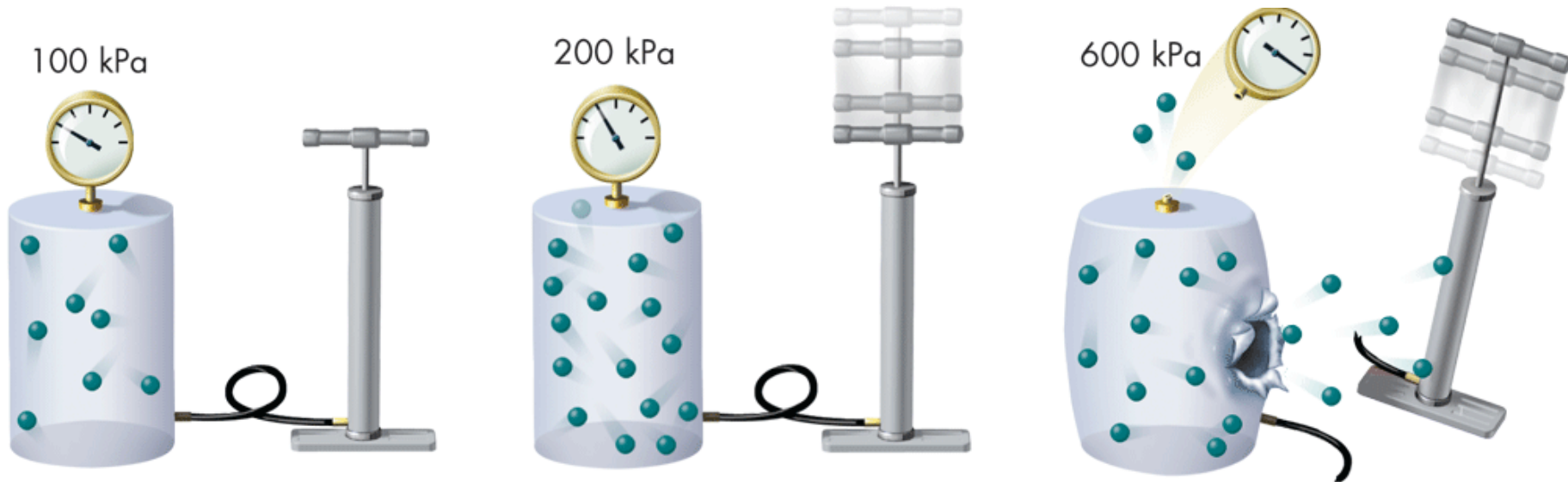
When a gas is pumped into a closed rigid container, the pressure increases as more particles are added. If the number of particles is doubled, the pressure will double.



## 14.1 The Gas Laws > Factors Affecting Gas Pressure

When a gas is pumped into a closed rigid container, the pressure increases as more particles are added. If the number of particles is doubled, the pressure will double.

- Once the pressure exceeds the strength of the container, the container will burst.



## 14.1 The Gas Laws > Factors Affecting Gas Pressure

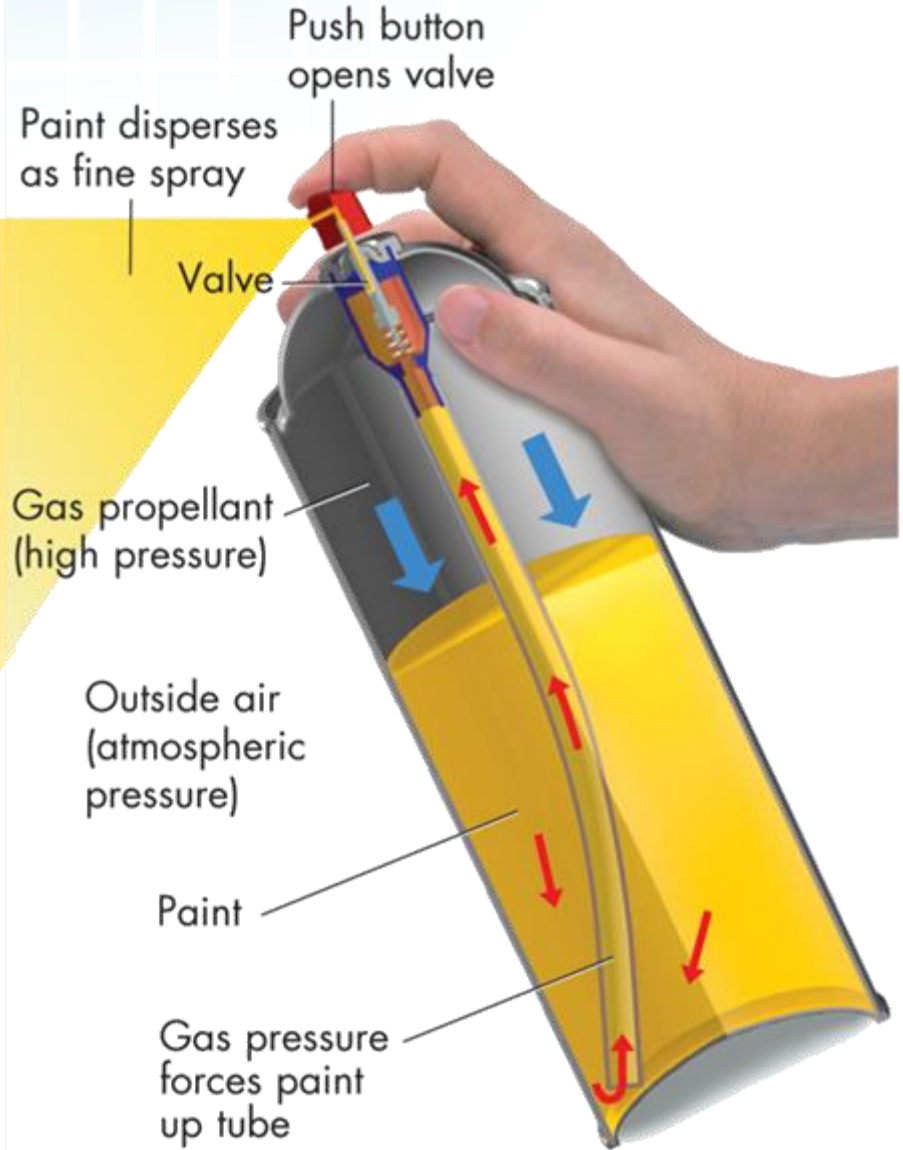
- If the pressure of the gas in a sealed container is lower than the outside air pressure, air will rush into the container when the container is opened.

## 14.1 The Gas Laws > Factors Affecting Gas Pressure

- If the pressure of the gas in a sealed container is lower than the outside air pressure, air will rush into the container when the container is opened.
- When the pressure of a gas in a sealed container is higher than the outside pressure, the gas will flow out of the container when the container is unsealed.

# 14.1 The Gas Laws > Factors Affecting Gas Pressure

The operation of an aerosol can depends on the movement of a gas from a region of high pressure to a region of lower pressure.



### Volume

You can raise the pressure exerted by a contained gas by reducing its volume.

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- The more the gas is compressed, the more pressure the gas exerts inside the container.

### Volume

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- If the volume is doubled, the particles can expand into a volume that is twice the original volume.

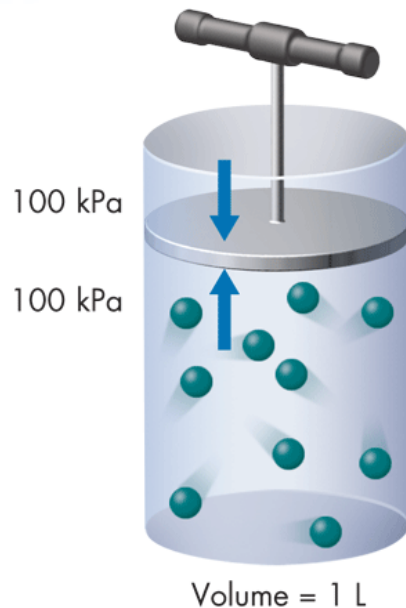
### Volume

Increasing the volume of the contained gas has the opposite effect.

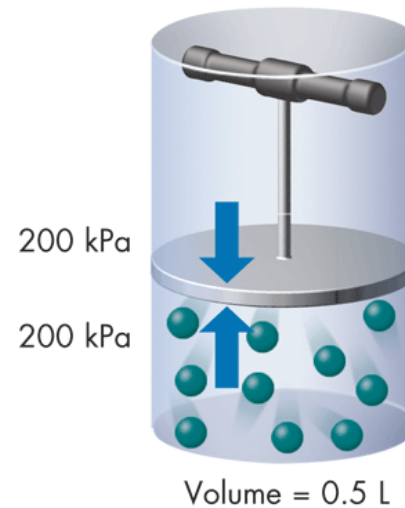
- If the volume is doubled, the particles can expand into a volume that is twice the original volume.
- With the same number of particles in twice the volume, the pressure of the gas is cut in half.

## 14.1 The Gas Laws > Factors Affecting Gas Pressure

A piston can be used to force a gas in a cylinder into a smaller volume.



When the volume is increased, the pressure the gas exerts is decreased.



When the volume is decreased, the pressure the gas exerts is increased.

### Temperature

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- The temperature increases and the average kinetic energy of the particles in the gas increases.

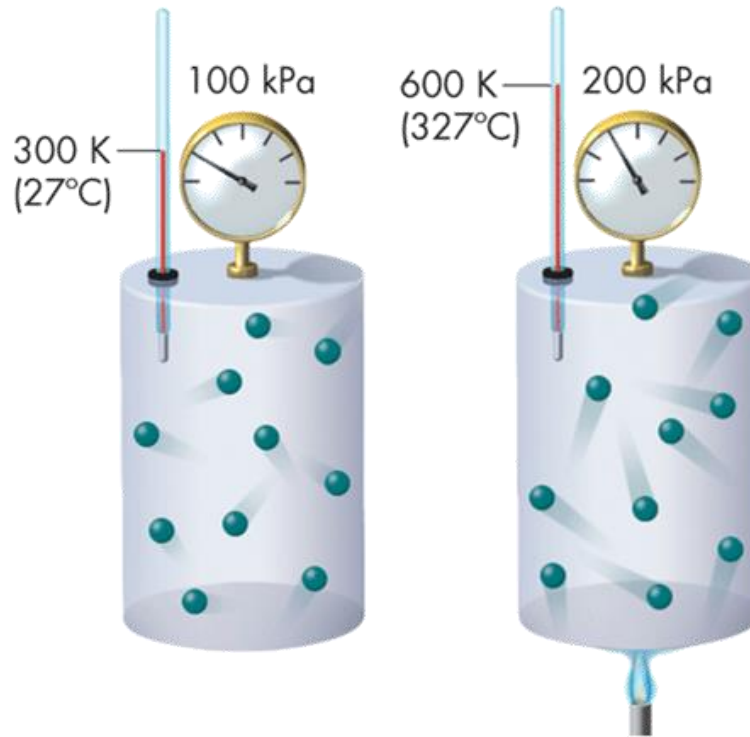
### Temperature

You can use kinetic theory to explain what happens as a gas is heated.

- The temperature increases and the average kinetic energy of the particles in the gas increases.
- Faster-moving particles strike the walls of their container with more energy.

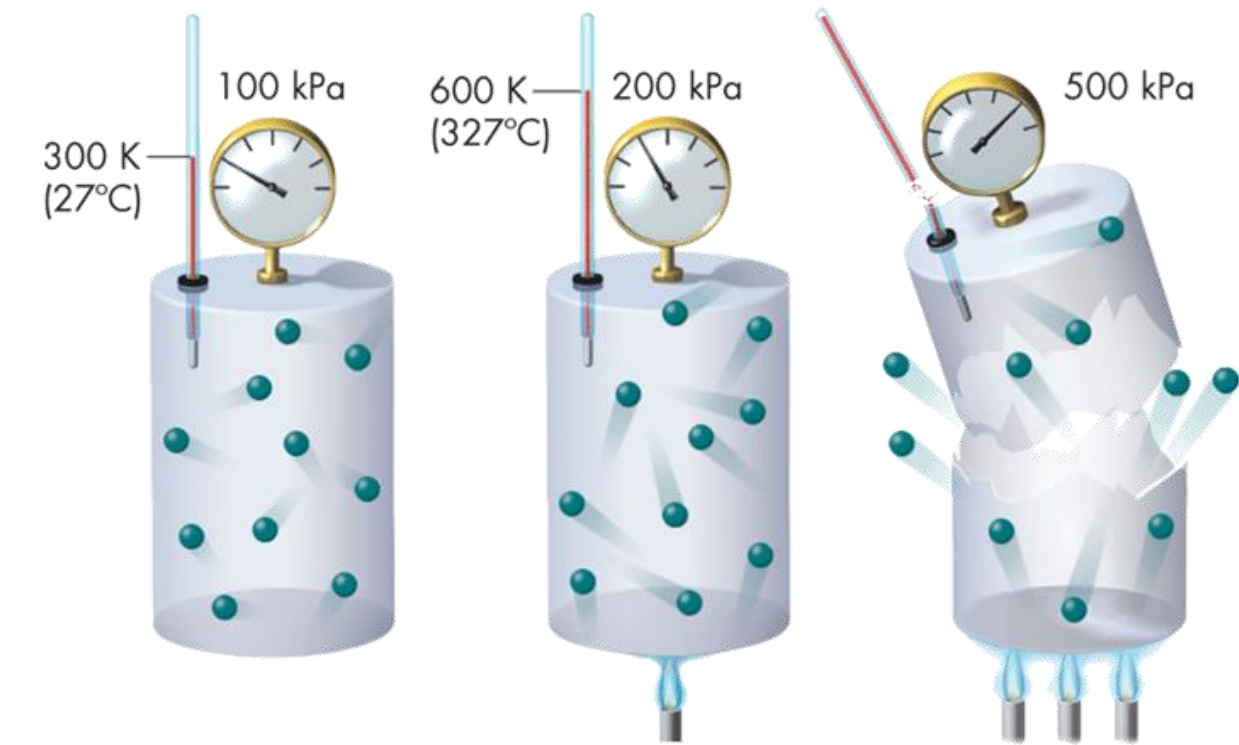
## 14.1 The Gas Laws > Factors Affecting Gas Pressure

An increase in temperature causes an increase in the pressure of an enclosed gas.



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The container can explode if there is too great an increase in the gas pressure.



**How does the pressure of a contained gas change when the volume of the gas is increased?**

- A.** The pressure increases.
- B.** The pressure decreases.
- C.** The pressure does not change.



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**Which do you think would travel farther if kicked with the same amount of force: a properly inflated soccer ball or an underinflated soccer ball?**



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*A properly inflated soccer ball will travel farther.*





**What might happen to an overinflated soccer ball if you kicked it too hard?**

**What might happen to an overinflated soccer ball if you kicked it too hard?**

*If the pressure is too high, the ball may burst when it is kicked.*

## 14.1 The Gas Laws > Key Concepts

-  Gases are easily compressed because of the space between particles in a gas.
-  The amount of gas ( $n$ ), volume ( $V$ ), and temperature ( $T$ ) are factors that affect gas pressure ( $P$ ).

**compressibility**: a measure of how much the volume of matter decreases under pressure

# 14.1 The Gas Laws >

**END OF 14.1**