

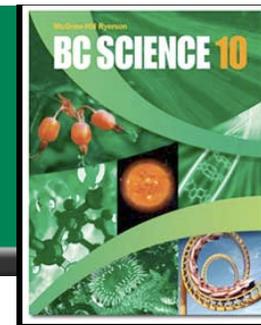
These notes are posted on my site for the following reasons:

- for students to copy in their own hand-writing
  - ◆ in order to complete their class notes
  - ◆ if student did not have enough time in class
  - ◆ if student was away and missed this section
- for assistants and tutors to follow progress of the concepts taught

Photocopied/printed notes can not be used during the Unit Notebook Check in class.

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## 6.2 Factors Affecting the Rate of Chemical Reactions



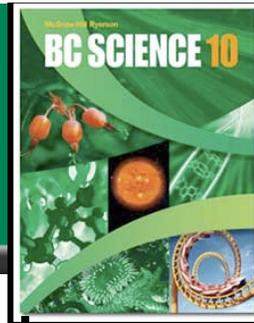
- Often, controlling the rate of a chemical reaction is as important as having the reaction occur in the first place.
  - ◆ Many factors can determine the rate a chemical reaction occurs.
- To make a reaction happen quickly:
  - ◆ Increase the temperature where the reaction occurs
  - ◆ Increase the concentration of reactants
  - ◆ Increase the amount of surface area that reacts
  - ◆ Add a catalyst, or remove an inhibitor
- To make a reaction happen slowly:
  - ◆ Decrease the temperature where the reaction occurs
  - ◆ Decrease the concentration of reactants
  - ◆ Decrease the amount of surface area that reacts
  - ◆ Remove a catalyst (if present), or add an inhibitor

A bicycle chain slowly rusts

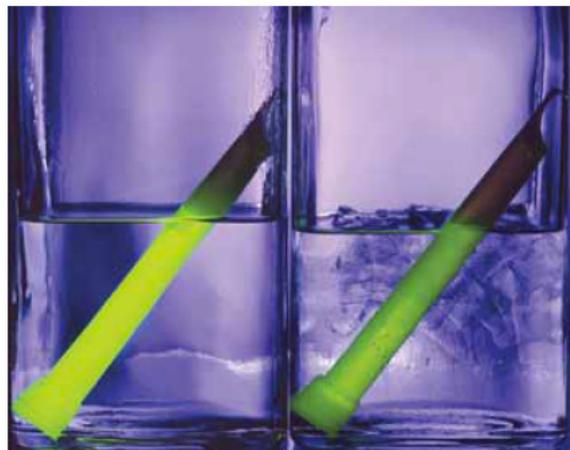


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# Temperature

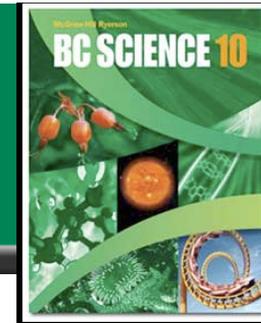


- **Temperature is a measure of the average energy of molecules.**
  - ◆ The more energy molecules have, the higher the temperature.
  - ◆ When molecules have more energy, they move around more, bump into other molecules more, and therefore react faster.
- **The rate of reaction changes with the temperature.**
  - ◆ Higher temperature = faster reaction rate, and vice versa.
  - ◆ Sometimes we want slower reactions (we use a fridge to prevent spoilage).
  - ◆ Sometimes we want faster reactions (we cook food to speed up the production of new molecules).



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# Concentration



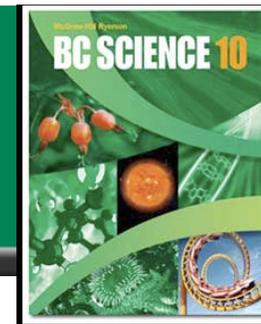
- **Concentration refers to how many molecules of a substance exist in a certain volume.**
  - ◆ How much solute (what's dissolved) is there in a certain amount of solvent (what the substance is dissolved in).
  - ◆ Concentration is measured in mass per unit volume (g/L).
- **Usually, the higher the concentration of reactants, the faster the reaction occurs.**
  - ◆ Since there are more molecules per unit volume in high concentrations, there are more opportunities for molecules to collide and react.
  - ◆ A splint of wood glows brighter in highly concentrated oxygen than in normal air, with a lower concentration of oxygen.



Changing the concentration of  $O_2$  changes the intensity of flames.

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# Surface Area



- **Chemical reactions occur when and where atoms and compounds collide.**
  - ◆ **The more atoms and molecules there are to collide, the higher the reaction rate.**
- **Increasing surface area increases the rate of reaction.**
  - ◆ **Since there are more atoms and compounds exposed to react, more reaction takes place.**
  - ◆ **Surface area can be increased by creating smaller pieces.**
    - **A powdered substance has far more surface area than one, large chunk.**
  - ◆ **The increase in surface area must also be exposed for reaction; a powder only reacts more quickly if it is spread into the air instead of lying on a pan.**

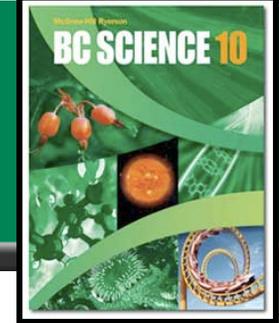


Steel wool (on the right) is made up of small strands of steel, and therefore has much more surface area than an equivalent amount of solid steel.



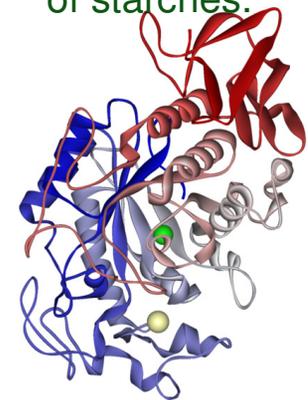
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# Catalysts



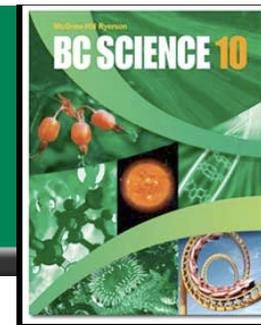
- **Sometimes increasing the temperature or concentration is not a desirable method to increase reaction rate.**
  - ◆ Changing these two variables may be impractical or dangerous.
- **A catalyst is a chemical that allows a reaction to occur more quickly without actually participating in the reaction itself.**
  - ◆ The catalyst speeds up the reaction rate, but does not get used up as a reactant.
  - ◆ Catalysts often lower the amount of energy necessary to break the bonds in the reactants.
- **Enzymes are an example of biological catalysts**
  - ◆ Saliva has enzymes that help speed the breakdown of starches when they enter the mouth.

Salivary amylase  
increases the digestion  
of starches.



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## Catalysts (continued)



- A catalytic converter is a device installed in all cars to decrease pollution.
  - ◆ Car exhaust passes through the catalytic converter before leaving the car.
  - ◆ Catalysts found in the honeycomb-shaped filters in the converter help to change many of the pollutants.
    - Poisonous carbon monoxide is changed into  $\text{CO}_2$
    - Hydrocarbons are converted into  $\text{CO}_2$  and  $\text{H}_2\text{O}$
    - Nitrogen oxides are changed into  $\text{N}_2$  and  $\text{O}_2$ 
      - $2\text{N}_2\text{O}_3 \rightarrow 2\text{N}_2 + 3\text{O}_2$



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[Take the Section 6.2 Quiz](#)