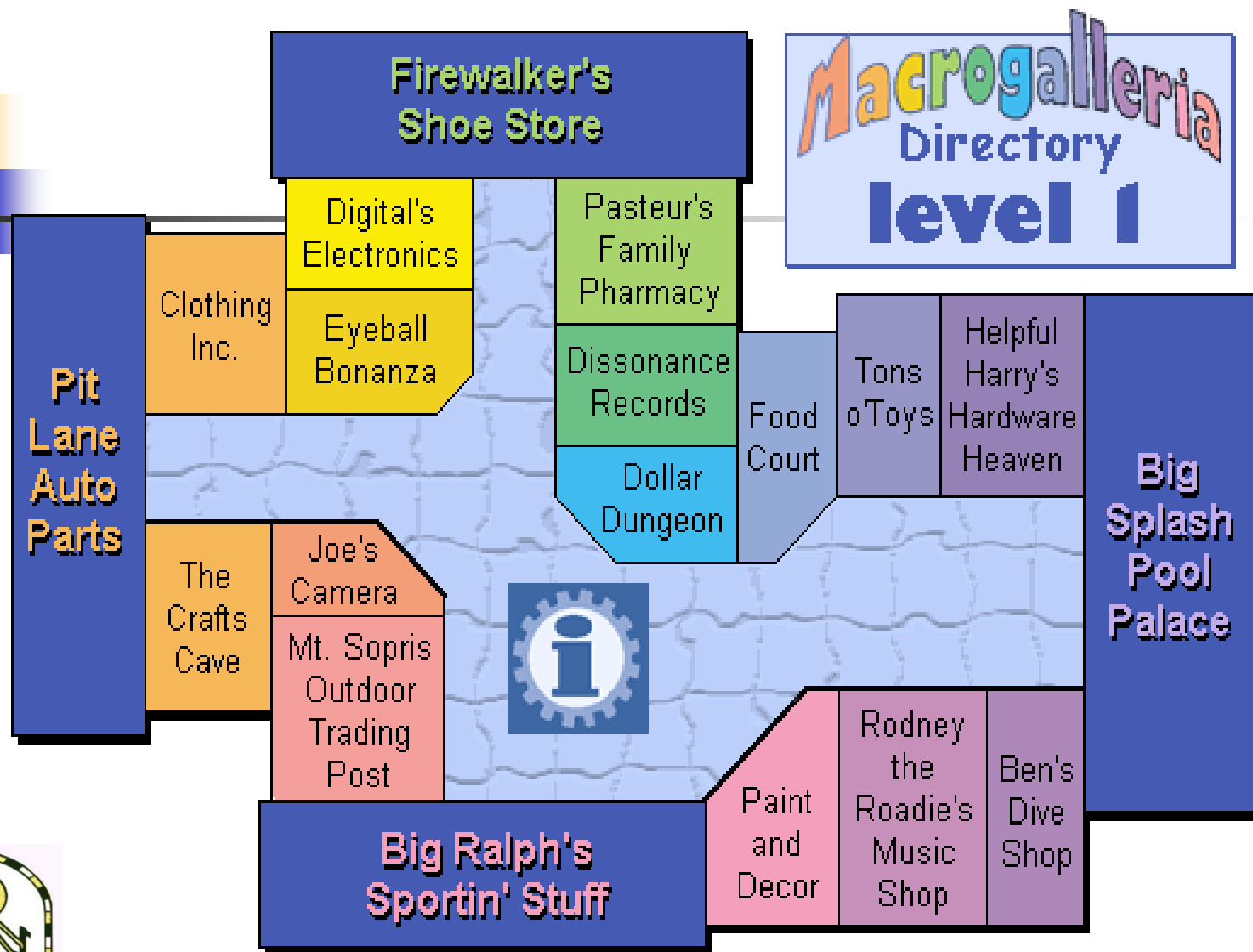
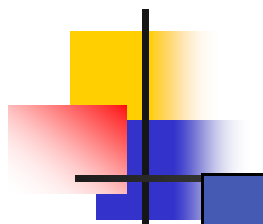


Level One

Polymers Are Everywhere!!!!!!!!!!!!!!

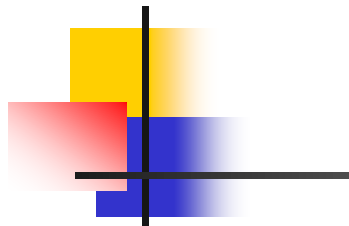
- To get a look at just what this *polymer* stuff means to you, and what these things called polymers have to do with your life, take a stroll through level one of the Macrogalleria!



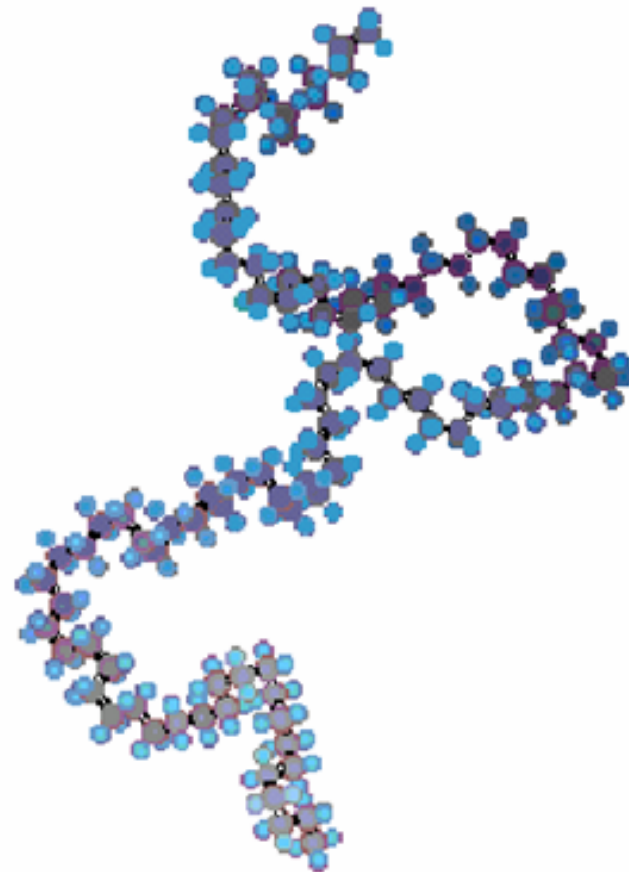
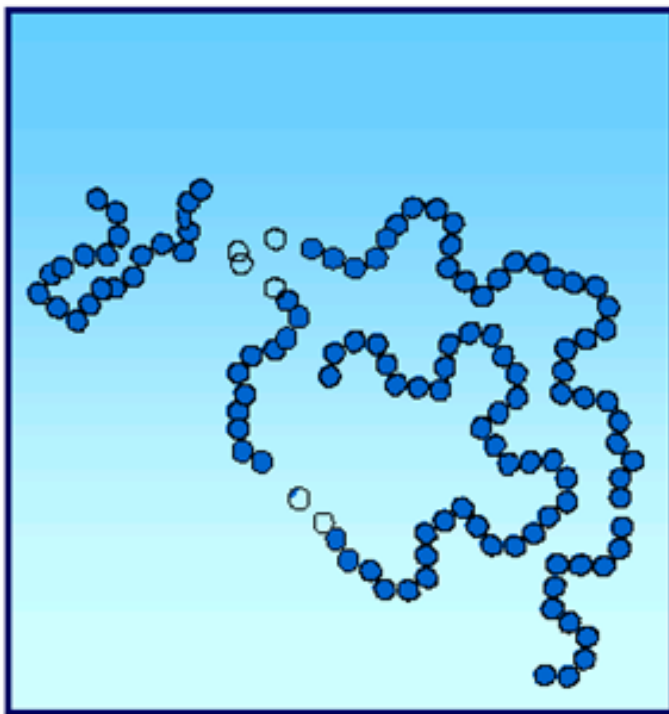


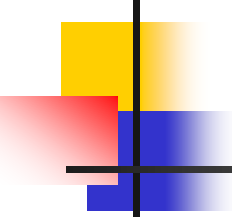
- 
- *Polymers Are Like TV: Both Have Lots and Lots of Repeats*





How big are Polymers ?



- 
- You can choose any of the categories and will find all the fabulous stuff which is made of polymers.



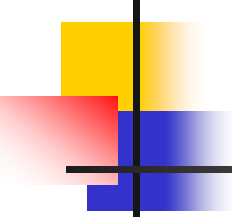


The Food Court

- That's right; we eat polymers, an awful lot of them as it turns out.
- These french fries are loaded with a polymer called starch, which your body digests into sugar to use as fuel

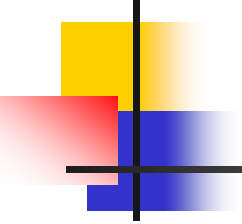




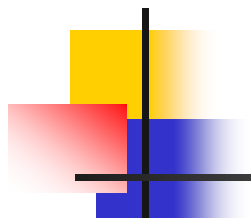
- 
- The cheese on this pizza is loaded with proteins, also essential to good health.
 - Fast food often comes in boxes made of polystyrene foam.
 - The box and the food often taste the same.





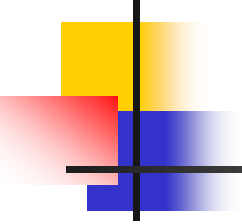
- 
-
- Napkins are made of paper, which is a form of a polymer called cellulose.





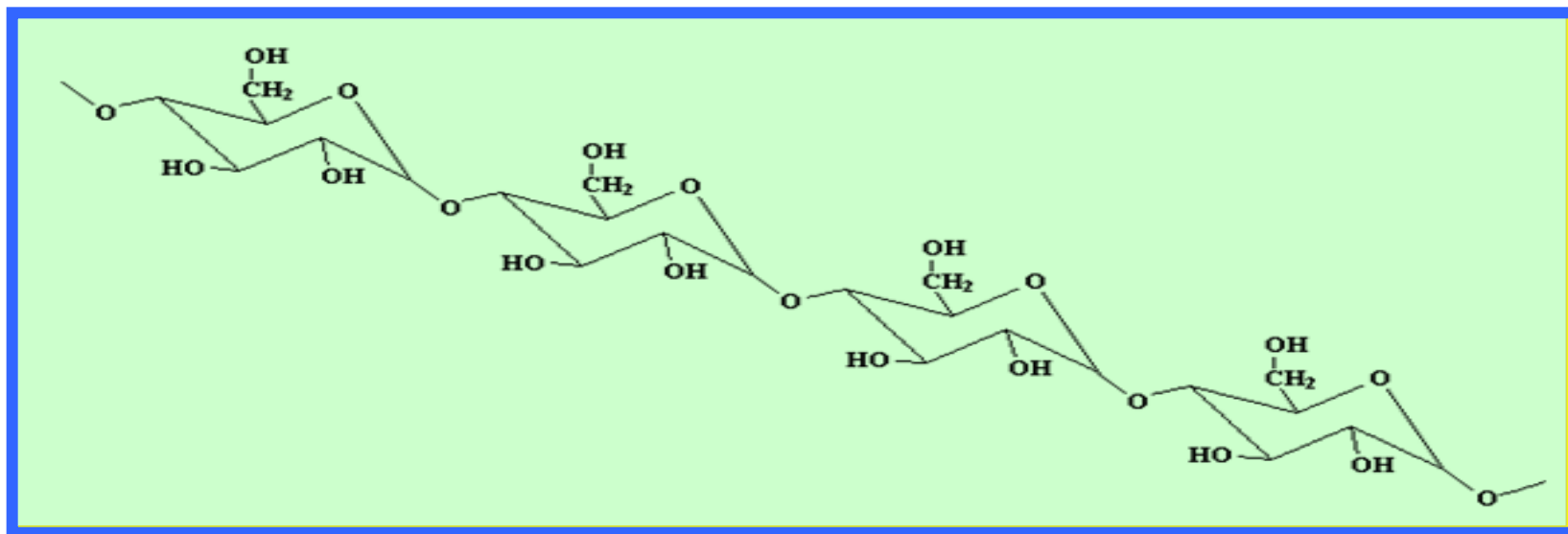
- The paper plates and cups the food comes in are also made of cellulose, of course.



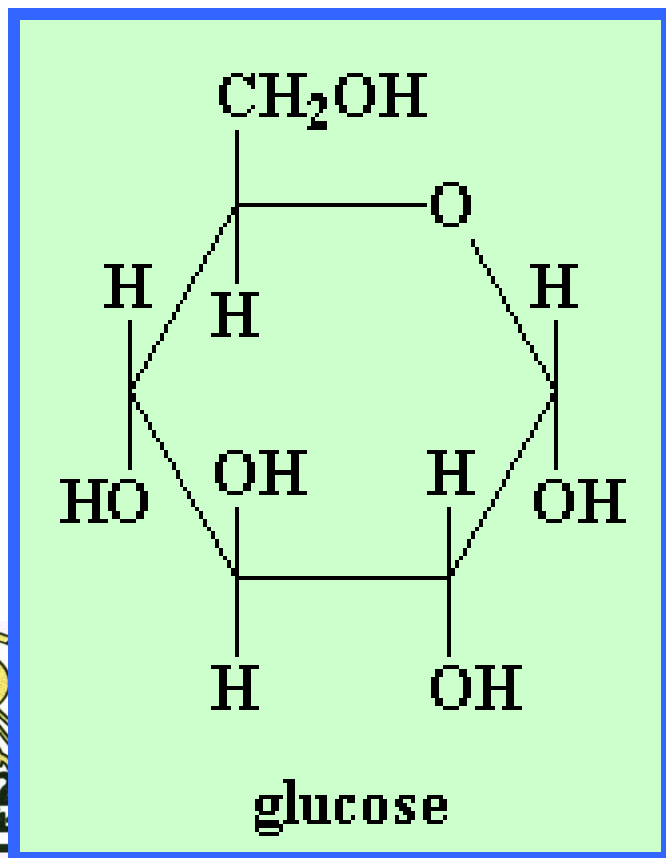
- 
- The cup lids are made of polystyrene. The trays are made of polyethylene.
 - Most of the prizes in the kids' meals are made from polystyrene and polyethylene



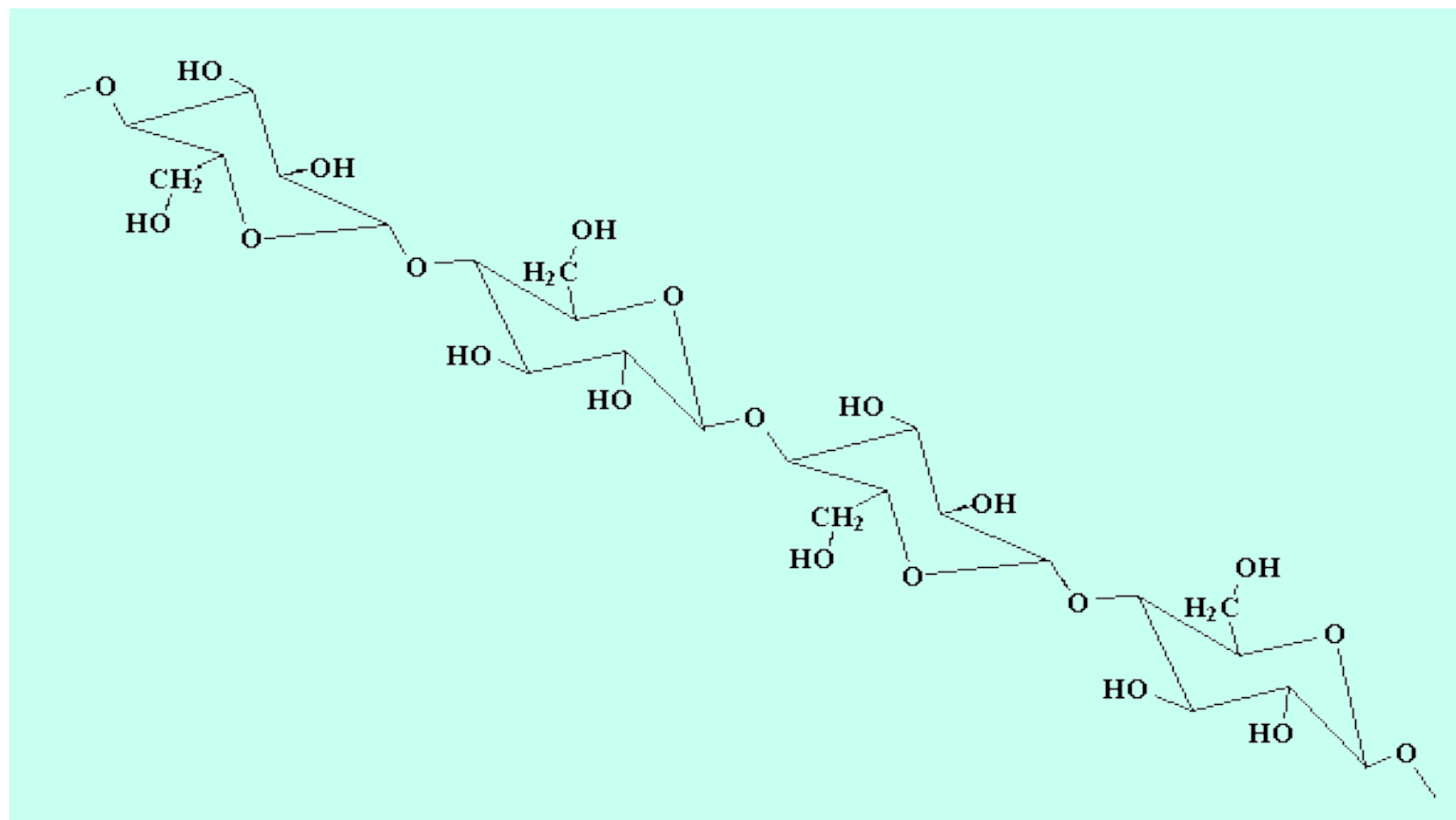
Starch

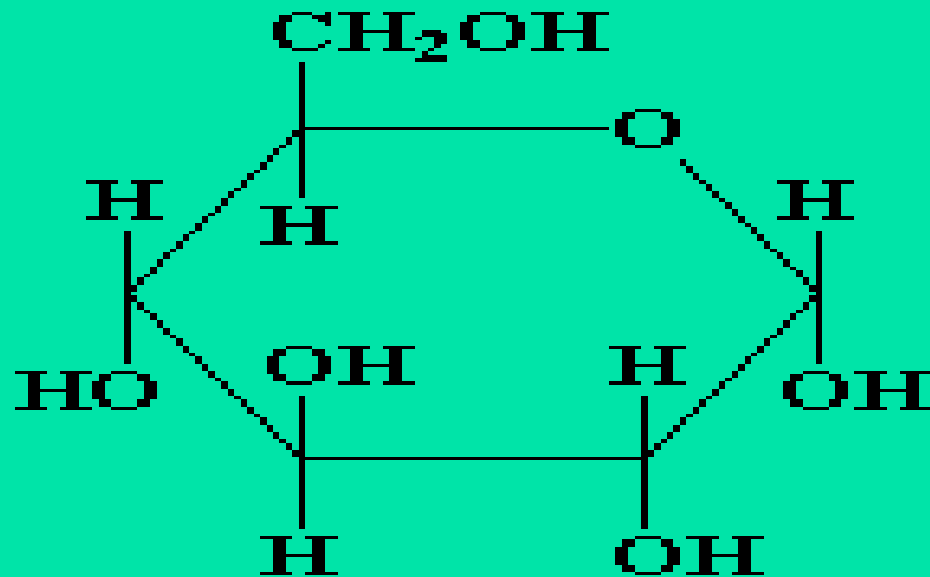


- Starch is important because we eat it! Starch is found in potatoes, and in grains such as corn and wheat. Starch is made up of glucose repeat units.



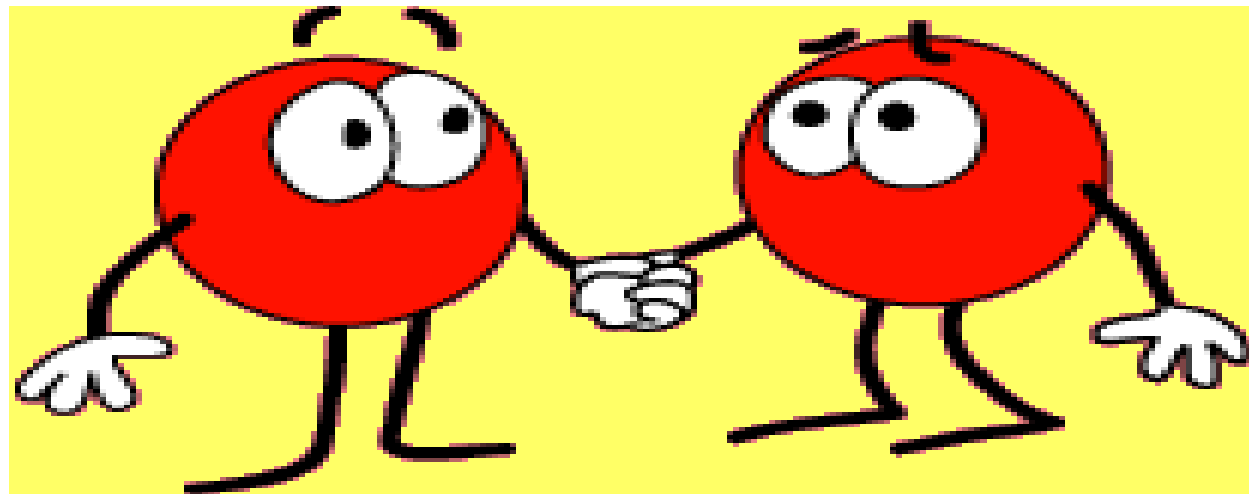
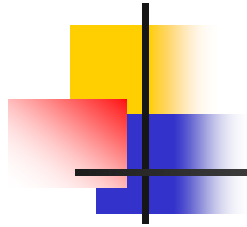
Cellulose

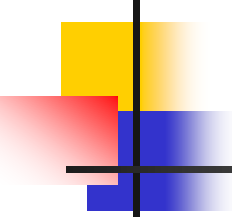




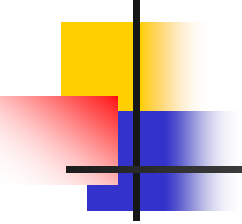
glucose





- 
- Cellulose is one of many polymers found in nature. Wood, paper, and cotton all contain cellulose.
 - Cellulose is an excellent fiber. Wood, cotton, and hemp rope are all made of fibrous cellulose.



- 
- Cellulose has an important place in the story of polymers because it was used to make some of the first synthetic polymers, like cellulose nitrate, cellulose acetate, and rayon.

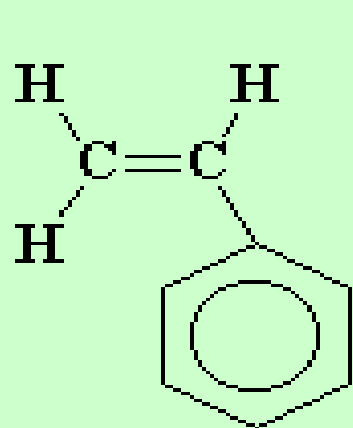




Polystyrene

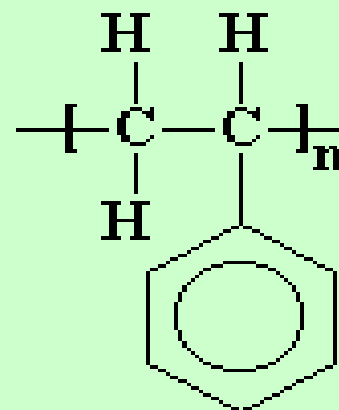
- Polystyrene is a vinyl polymer. Structurally, it is a long hydrocarbon chain, with a phenyl group attached to every other carbon atom.
- Polystyrene is produced by free radical vinyl polymerization, from the monomer styrene.





styrene

free radical
vinyl polymerization



polystyrene

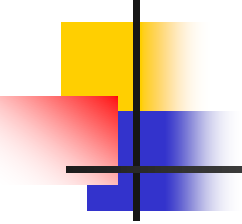
- Polystyrene is also a component of a type of hard rubber called poly(styrene-butadiene-styrene), or *SBS* rubber. SBS rubber is a *thermoplastic elastomer*.



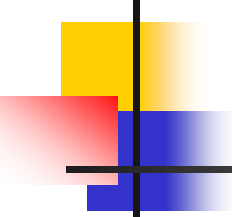


Polystyrene (PS)

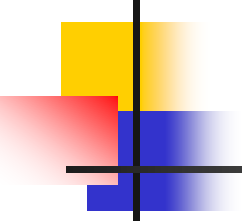


- 
- What would happen if we were to take some styrene monomer, and polymerize it free radically, but let's say we put some polybutadiene rubber in the mix.

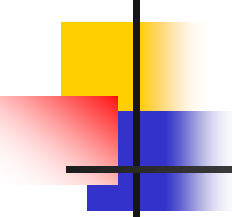


- 
- Take a look at polybutadiene, and you'll see that it has double bonds in it that can polymerize.

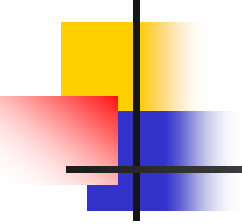


- 
- We end up with the polybutadiene copolymerizing with the styrene monomer, to get a type of copolymer called a *graft copolymer*.



- 
- These rubbery chains hanging off of the backbone chain do some good things for polystyrene.

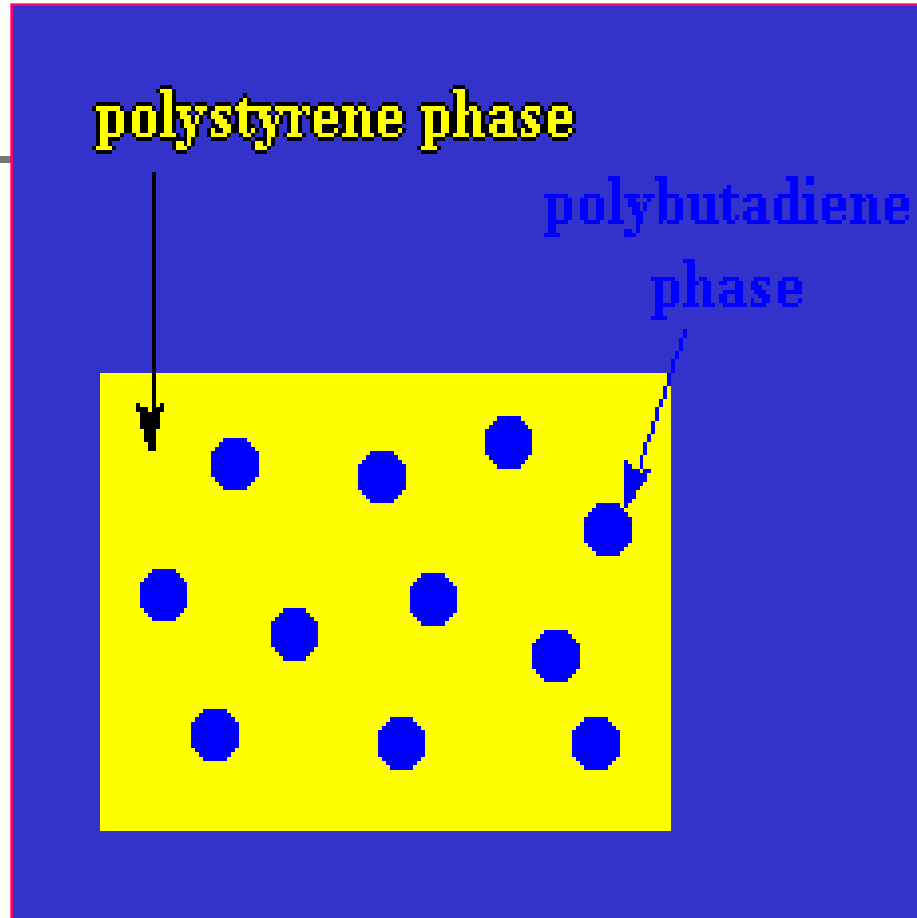


- 
- This makes it stronger, not as brittle, and capable of taking harder impacts without breaking than regular polystyrene.
 - This material is called *high-impact polystyrene*, or HIPS for short.



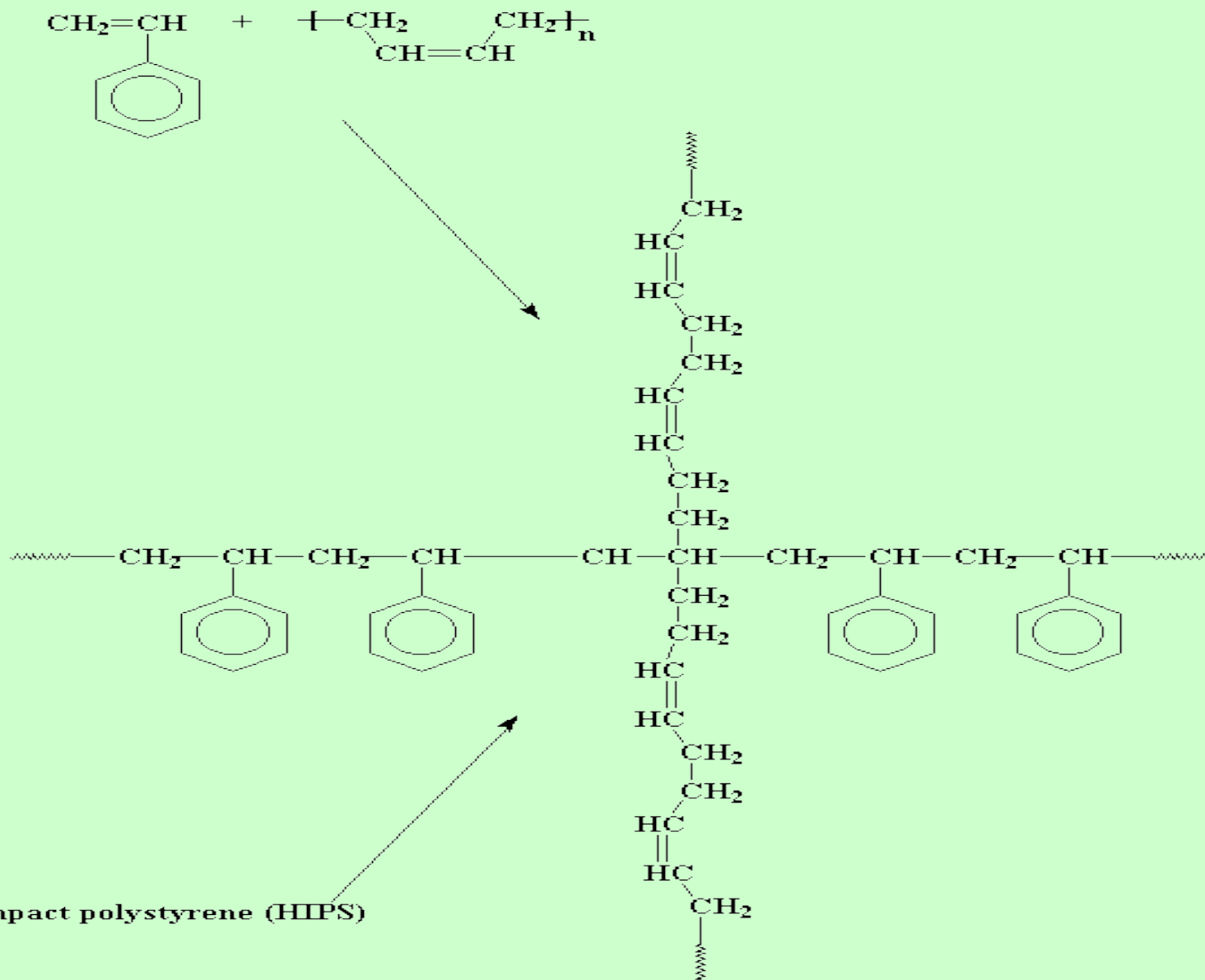
polystyrene phase

polybutadiene
phase

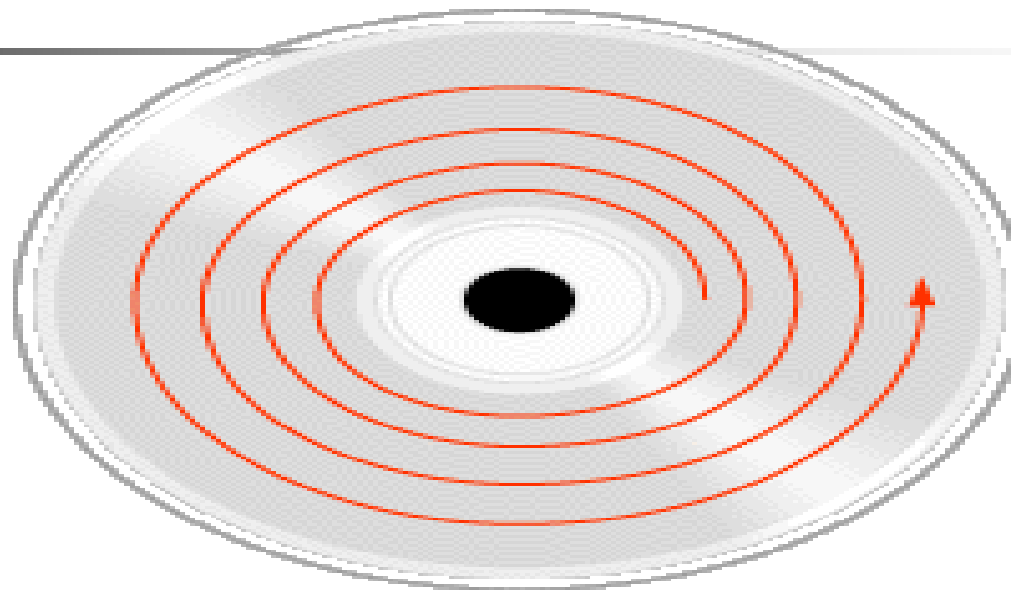
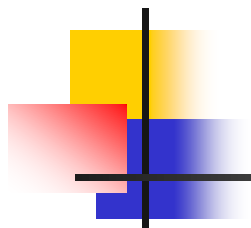


HIPS



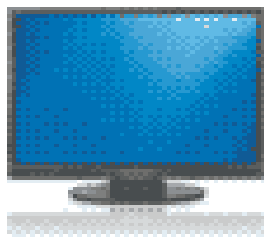
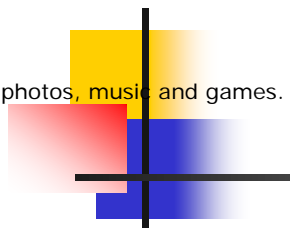


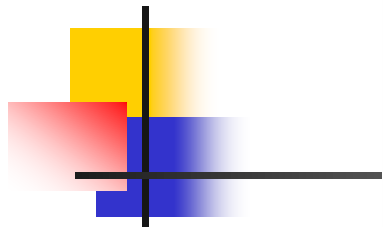


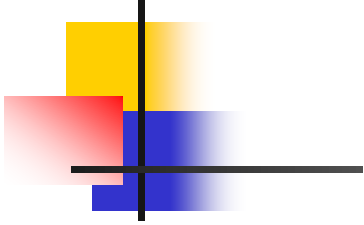


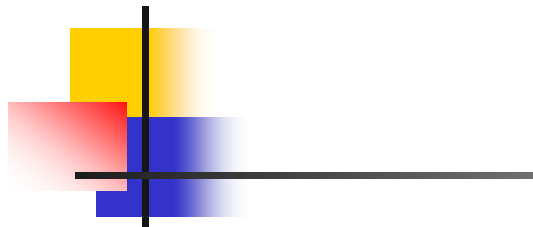
**CD, from
Polycarbonate**





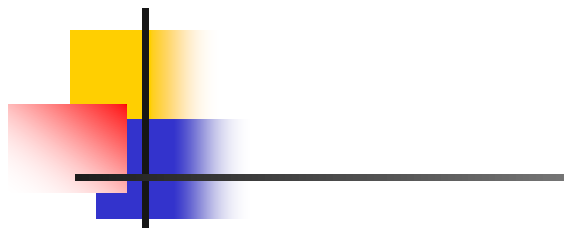






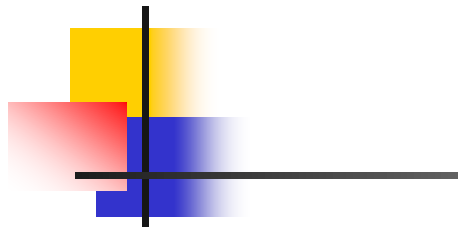
Curly Top
Dryer for Curly Hair

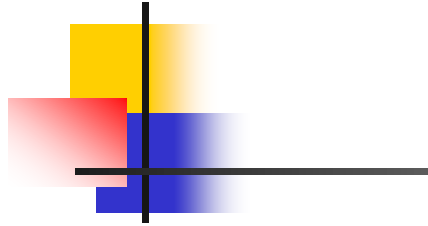




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Robots







