

3.19 TECH CONNECT: THE NICOTINE PATCH

SECTION 3.19 QUESTIONS

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Understanding Concepts

- (a) Because the skin has both water-soluble (polar) and fat-soluble (nonpolar) components, any drug molecule that travels through the skin must be a suitable size and must be soluble in both polar and nonpolar solvents.
(b) The carbon rings and the methyl group are the nonpolar components of the nicotine molecule. The nitrogen atoms are more electronegative than the carbon atoms, and thus provide a polar portion of the molecule. Thus, nicotine has both polar and nonpolar characteristics, and its size is sufficiently small to allow it to travel through the skin.

Making Connections

- [Sample answer]
Drug delivery systems, e.g., nicotine patches, estrogen patches.
Problem to be solved: Patients quitting smoking need a bridging program to relieve withdrawal from nicotine. Patients require estrogen to relieve symptoms of menopause due to surgery.
Existing solution: nicotine gum, estrogen capsules.
Problems: Patients may forget to take medication. As well, a low but continuous dosage is most effective.
Improved solution: Polymers could be used to provide an adhesive patch on the skin, allowing the nicotine or estrogen to be absorbed through the skin on a continuous basis.
- Student answers will vary.

The Estrogen Skin Patch

The skin patch is used in hormone replacement therapy, to deliver the hormone estrogen to women to relieve some of the symptoms of menopause. Estrogen can also be taken in pill form, but some studies have indicated that estrogen pills can cause an increase in the body's production of a substance called C-reactive protein. This protein seems to increase the risk of heart disease. Another study indicated that the increase in C-reactive protein was twice as high if the estrogen was taken in pill form as opposed to as a skin patch. A possible explanation for this difference is that the active components in an estrogen pill must be metabolized by the liver before they enter the blood stream. The skin patch delivers the estrogen in a useable form directly to the blood stream, so lower dosages are needed. The disadvantages of the skin patch are that the adhesive and the moist conditions under the patch may, over an extended period of use, cause skin irritations. In addition, some people may have allergic reactions to one of the components of the patch. Other preferable methods of replacing estrogen may be from natural foods that are rich in estrogen, such as soybean products in the form of soymilk or tofu.

3.20 ACTIVITY: MAKING POLYMERS

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PART 1: MAKING GUAR GUM SLIME—A CROSSLINKED POLYMER

Observations

- The slime stretches and then returns to its original shape. It is stretchable and flexible.
- The slime breaks.
- The slime breaks with a sharp surface at the break.
- The slime takes on the shape of a long string.
- The slime softens and starts to liquefy.

Analysis

- Crosslinking holds polymer strands together. Any deformation of the slime is restored by the crosslinks between polymer strands.
- Crosslinks are broken by sharp pulling of the polymer.
- Sharp force on the slime breaks all the crosslinks along the line of force, leaving the slime broken with a sharp surface.

- (d) As the slime passes gently through the hole of the funnel, some crosslinks are broken and reformed, leaving the polymer with a new shape.
- (e) The presence of an acid hydrolyzes the crosslinks, causing the slime to turn into a liquid.

Synthesis

(g)

Thickener	Source	Molecular structure	Reasons for similar properties
Cornstarch	germ of corn kernels	polysaccharides: amylose and amylopectin	These polymers react with water, usually when heated, to form hydrated crosslinked molecules throughout the solution, resulting in a thickening of the solution.
Carrageenan	varieties of red seaweed	long-chain carbohydrate polymer (polysaccharide) made up of repeating sugar units	
Gelatin	beef bones and skin, treated with bases	protein polymer made up of amino acids	

PART 2: MAKING GLYPTAL—A POLYESTER

Observations

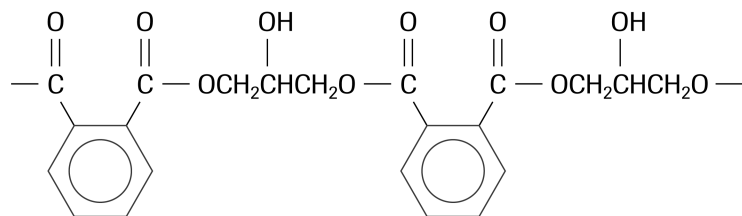
- (h) Glyptal is a hard clear plastic. It gets marred in contact with organic solvents such as acetone because it is soluble in acetone.

Analysis

- (i) Sample properties: hard, clear, strong solid; insoluble in water but soluble in acetone (paint thinner or nail polish remover).

Synthesis

- (j) It hardens quickly to form a protective coating that is insoluble in water. It is miscible with organic solvents that may be present in paints.
- (k) This polymer could also be used in varnishes and as a substitute for glass (e.g., plastic containers, drinking glasses).
- (l) The hydroxyl group on the middle carbon of glycerol provides opportunity to form ester bonds with orthophthalic acid, forming strong crosslinks. A hard plastic is therefore formed, which does not soften when heated. The hydrocarbon portions of the plastic molecule provide nonpolar groups, making the plastic insoluble in water, but soluble in an organic solvent such as acetone.



glyptal

3.21 CASE STUDY: CONTACT LENSES

SECTION 3.21 QUESTIONS

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Understanding Concepts

- When a polymer is deformed, its polymer chains are forced out of alignment. Crosslinking pulls the polymer chains back together, returning the lens to its original shape.