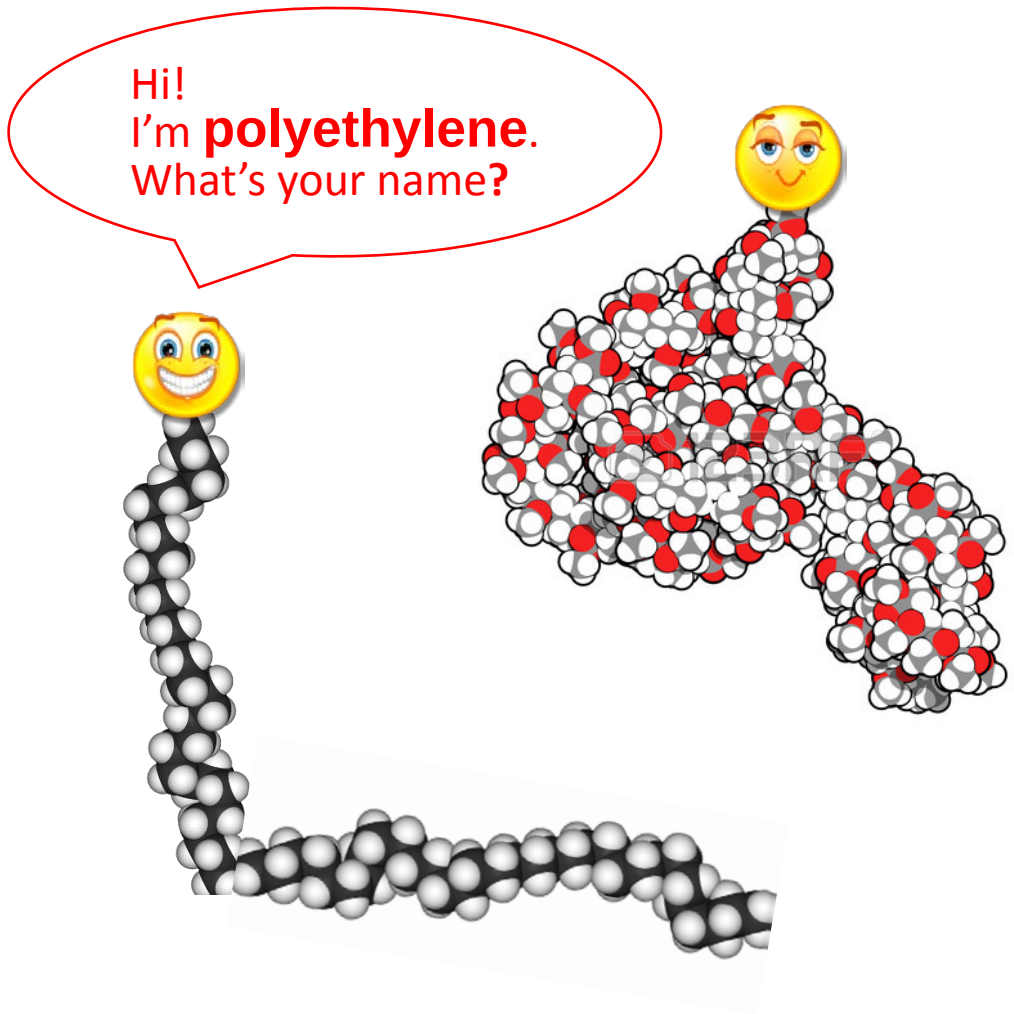
International Union of Pure
and Applied Chemistry

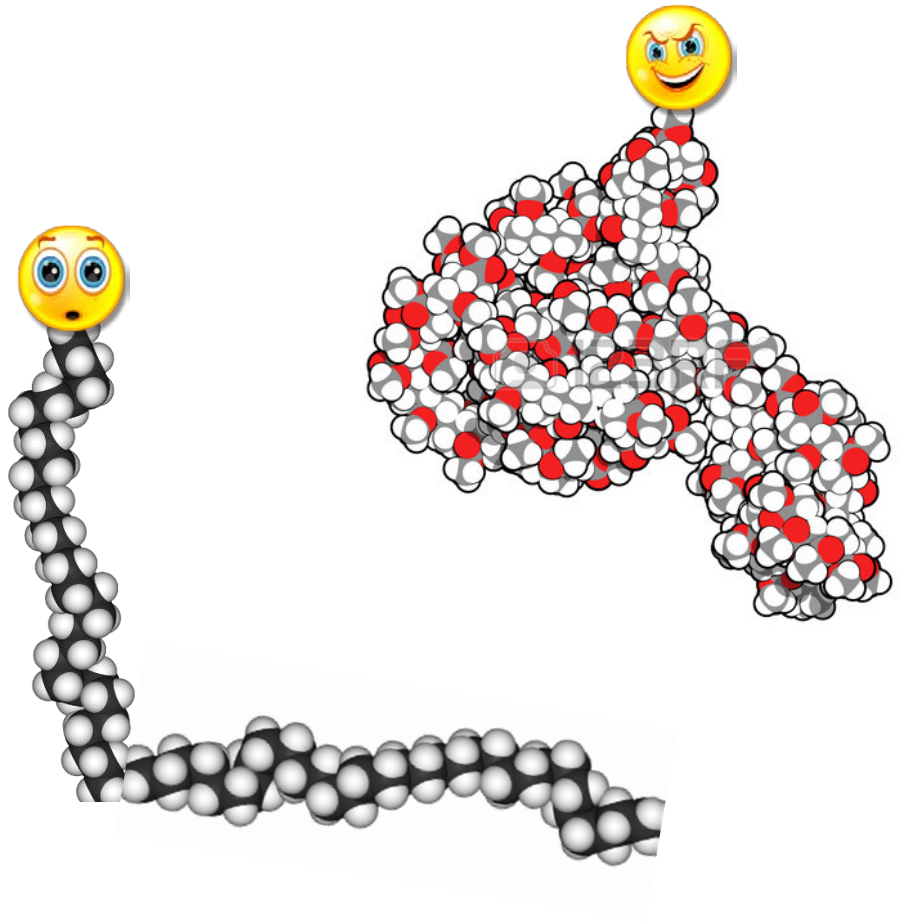


Naming Polymers:

buy one get one free

Dick Jones
IUPAC - Polymer Division

poly[1-(methoxycarbonyl)-1-methylethane-1,2-diyl] !!



Naming Polymers:

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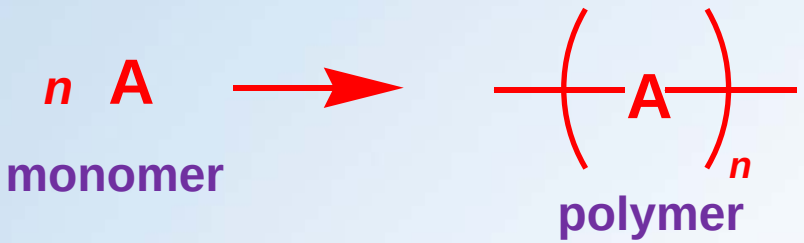


Source-based nomenclature:

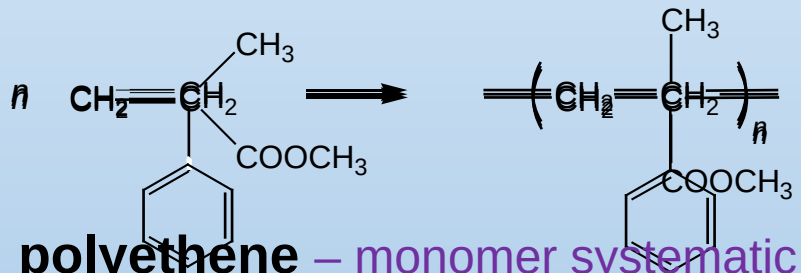
the polymer is named after the monomer (**A**) from which it is sourced.

Structure-based nomenclature:

the rules of IUPAC organic nomenclature are adopted for naming the constitutional units (-**A**-) of the polymer.

SOURCE-BASED NOMENCLATURE

- The name of a polymer is made by prefixing the monomer name with ‘poly’.
- The monomer names used are the systematic or retained names presently recommended by the IUPAC rules of organic nomenclature as found in the ‘Blue Book’.



polyethene – monomer systematic name

poly(ethyl methacrylate) – monomer retained, name retained,

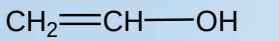
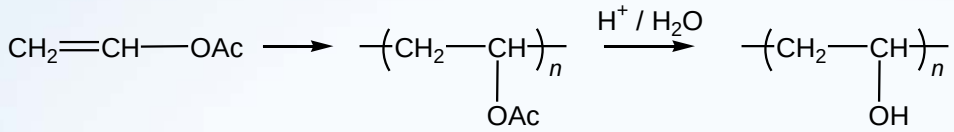
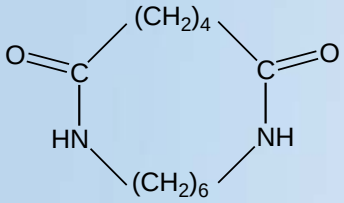
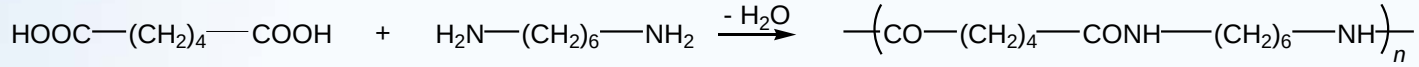
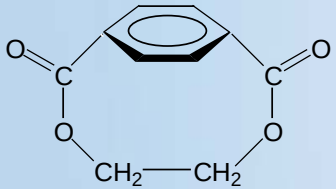
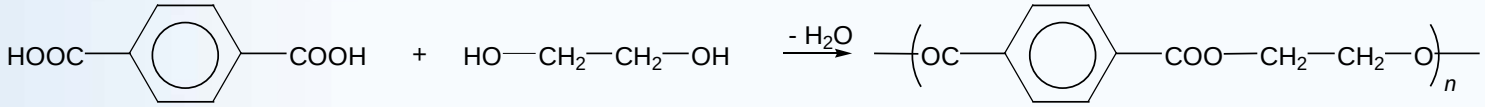
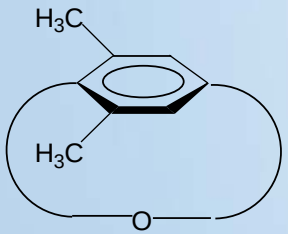
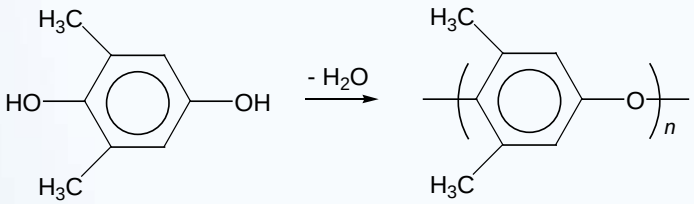
poly(methyl 2-methylpropenoate) – monomer systematic name

What about **Traditional Names**?

Based on obsolete monomer names that are not retained in organic IUPAC nomenclature, some traditional polymer names are allowed.

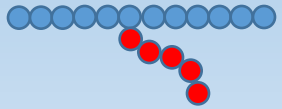
Source-based polymer name	Traditional polymer name
polyethene	polyethylene
polypropene	polypropylene
poly(2-methylpropene)	polyisobutene
polytetrafluoroethene	polytetrafluoroethylene
polyaziridine	polyethyleneimine
poly(10-norborn-2-ene)	polynorbornene

- A polymer with a structure that appears to result from the polymerization of a particular monomer but which has actually been synthesized by a different route is named as if it had been prepared from the apparent monomer.

Apparent monomer	Source-based name	Synthetic procedure
	poly(vinyl alcohol)	
	poly[*N*,*N*′-(hexane-1,6-diyl) hexanediamide]	
	poly(ethylene terephthalate)	
	poly(2,6-dimethyl-1,4-phenylene oxide)	

Copolymers and **complex structures**

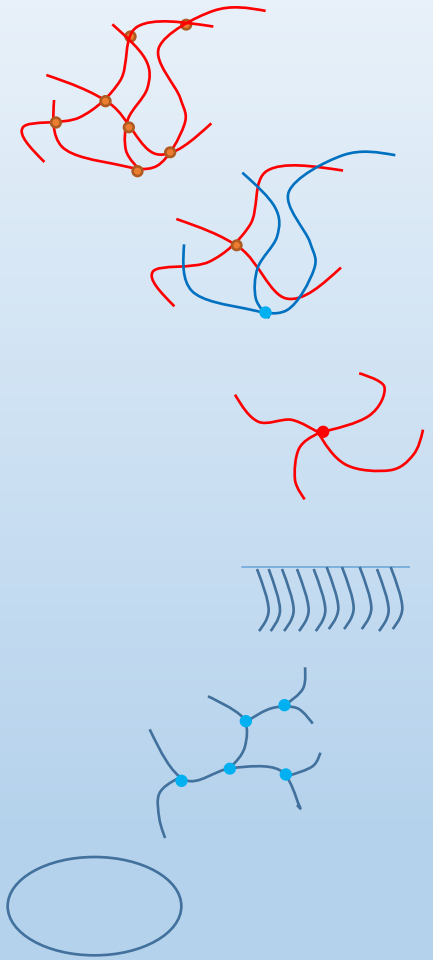
Italicized connectives or prefixes used alone or in combination.

COPOLYMERS			FORMAT
-co-	*sequential arrangement unknown*	??	poly(ethylene-*co*-propylene)
-stat-	*statistical*		poly[styrene-*stat*-(α-methylstyrene)]
-ran-	*random*		poly[ethene-*ran*-(vinyl acetate)]
-alt-	*alternating*		poly[styrene-*alt*-(maleic anhydride)]
-per-	*periodic*		poly(methanal-*per*-oxirane-*per*-oxirane)
-block-	*block polymers*		polystyrene-*block*-poly(methyl methacrylate)
-graft-	*graft polymers*		polyethene-*graft*-poly(butyl acrylate)

Copolymers and complex structures

TOPOLOGICAL PREFIXES and CONNECTIVES

net-	*network polymer*
ipn-	*interpenetrating network*
star-	*star-shaped polymer*
comb-	*comb-shaped polymer*
branch-	*branched polymer*
cyclo-	*cyclic polymer*



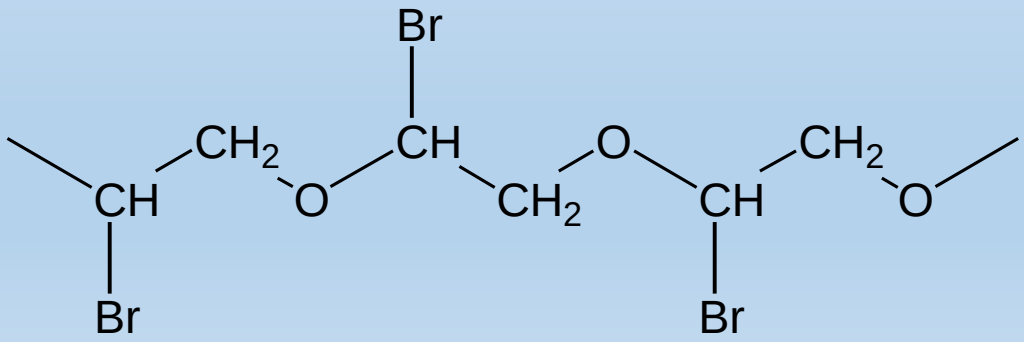
STRUCTURE-BASED NOMENCLATURE

- The name of a polymer is made by prefixing the name of the **preferred** constitutional repeating unit (CRU) with ‘poly’.

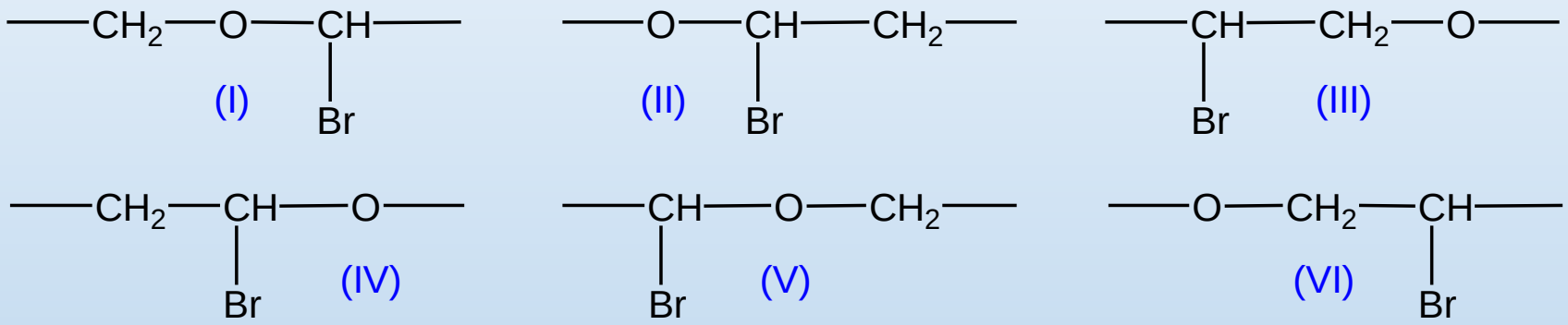
- The names of CRUs are those recommended by the IUPAC rules of organic nomenclature, so back to the ‘Blue Book’.

- Determining the **preferred** CRU is just a matter of **process**.

(1) Write out a large enough portion of the polymer chain as to show the structural repetition……



(2) The smallest repeating portion is a CRU so identify all the possibilities…..



(3) Next, in accordance with the IUPAC rules of organic nomenclature, name the divalent subunits that comprise the polymer chain starting with the largest ……

….. they are the bromo-substituted ethylenic, - CH_2 - CH_2 - , and the oxy, - O - , subunits found in CRUs II, III, IV and VI

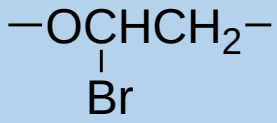
(4) Call up ‘seniority rules’ …..

Rule 1, tells us that the basic order of seniority of subunits is:

heterocyclic rings and ring systems > heteroatom chains >
carbocyclic rings and ring systems > acyclic carbon chains

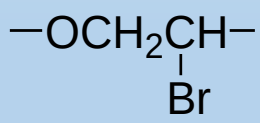
The heteroatomic oxy, - O - , subunit is senior to the acyclic carbon chain bromo-substituted ethylenic, - CH_2 - CH_2 - , subunit…..

…. so the preferred CRU will be either



CRU II

or

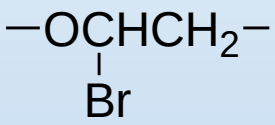


CRU VI

(5) Back to the **Rule Book**, *No. 10d* …..

The chain having substituents with the lowest locants is the preferred chain;

the 1-bromoethylene unit of CRU II beats the 2-bromoethylene unit of CRU VI and



is the preferred CRU,
which is then named from left to right …..

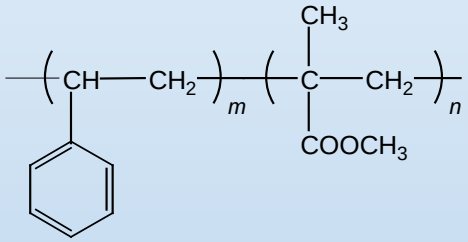
oxy(1-bromoethane-1,2-diyl) or oxy(1-bromoethane-1,2-diyl)

…. so the polymer is

poly[oxy(1-bromoethylene)]

Copolymers and other **complex structures** in Structure-based Nomenclature

- No connectives or prefixes such as *-co-*, *-stat-*, *-ran-*, *-block-*, *net-*, *star-* etc.
- Only makes use of commas (,) and oblique strokes (/).



which was polystyrene-*co*-poly(methyl methacrylate) in source-based nomenclature is now

poly{(1-phenylethylene) , [1-(methoxycarbonyl)-1-methylethylene]}

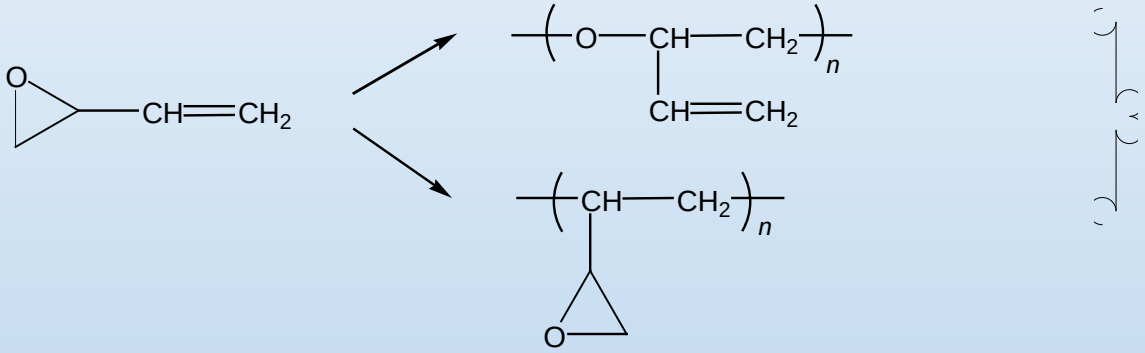
…. and polystyrene-*block*-poly(methyl methacrylate) is

poly(1-phenylethylene) / poly[1-(methoxycarbonyl)-1-methylethylene]

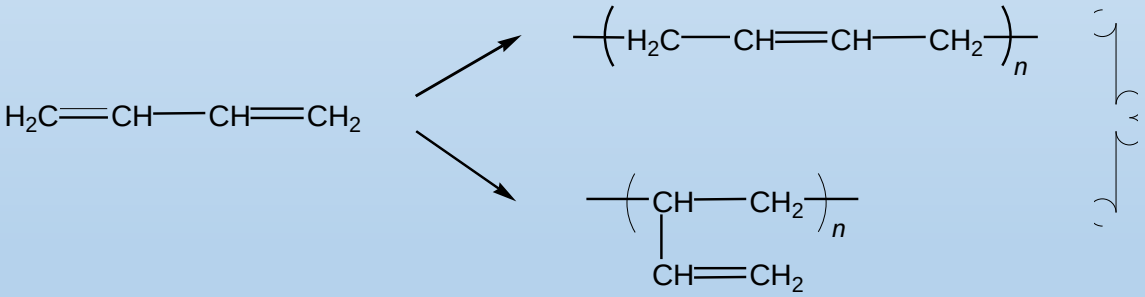
- Simpler but much longer names with increasing complexity.

Other limitations or advantages?

Source-based Nomenclature

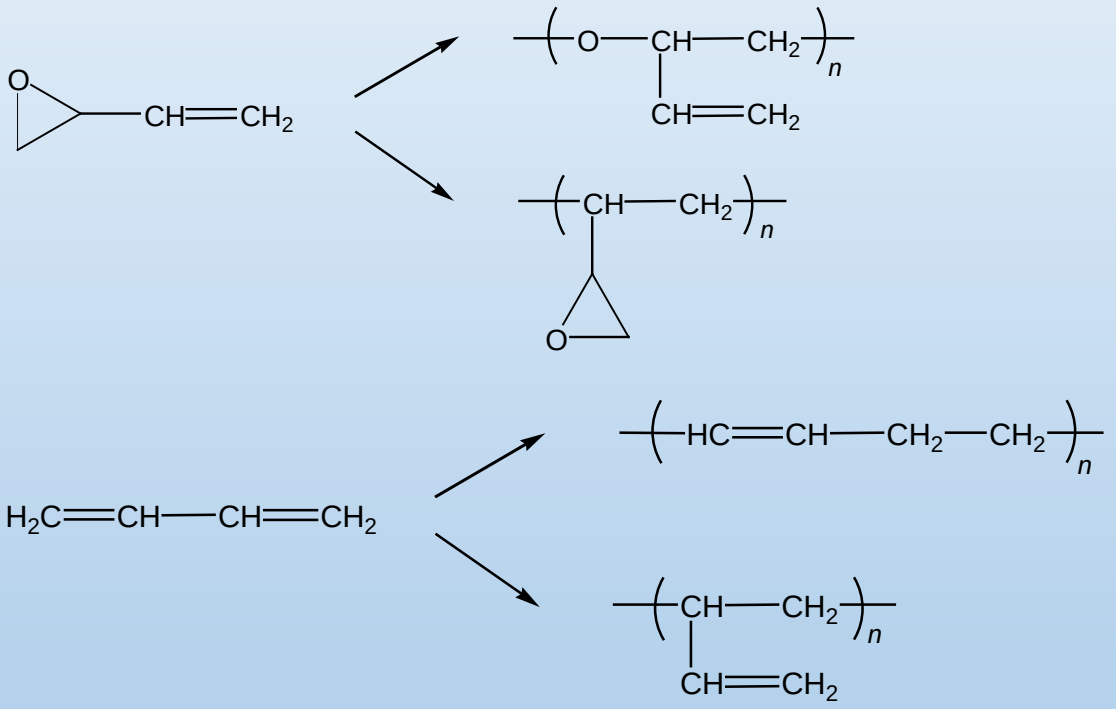


poly(vinyloxirane)



poly(buta-1,3-diene)

Other limitations or advantages?



Structure-based Nomenclature

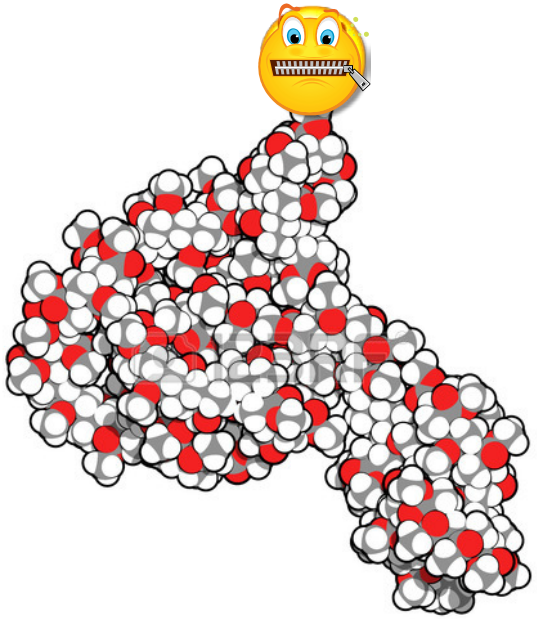
poly{oxy(1-vinylethylene)}

poly(1-oxiranylethylene)

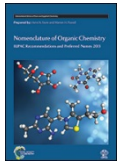
poly(but-1-ene-1,4-diyl)

poly(1-vinylethylene)

Actually, my friends call me Perspex*!*



‘The Blue Book’



Nomenclature of Organic Chemistry
IUPAC Recommendations and Preferred IUPAC Names 2013
Edited by H A Favre and W H Powell.
RSC Publishing, Cambridge, UK [ISBN 978-0-85404-182-4]

‘The Purple Book’

Compendium of Polymer Terminology and Nomenclature
IUPAC Recommendations 2008
Edited by R G Jones, J Kahovec, R Stepto, E S Wilks,
M Hess, T Kitayama and W V Metanomski.
RSC Publishing, Cambridge, UK [ISBN 978-0-85404-491-7]

A Brief Guide to Polymer Nomenclature