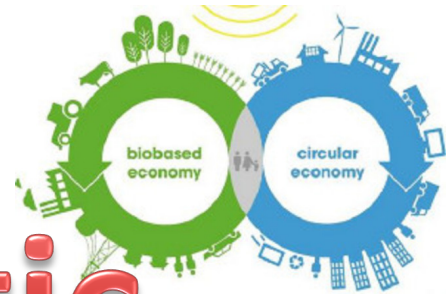


Practical activity

Circular Bioeconomics Stories:

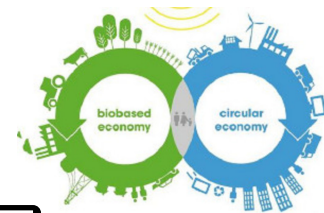


Make bioplastic from MILK





Learning Scenario

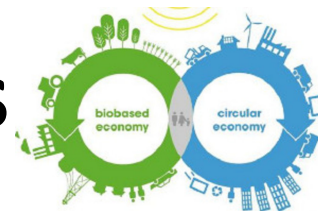


Purpose and Methodology

- **Combine Circular Bioeconomy concepts with STEM disciplines**
- **Student Centred Learning:** the student is the learning process center, will work with minimal guidance and take initiative
- **Collaborative Learning:** promote effective teamwork
- **Project-Based Learning:** the student is offered an activity based on: identification and problem solving



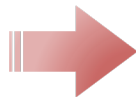
Circular Bioeconomy Concepts underlying the course



BIOMASS



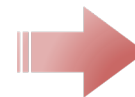
Expired milk



BIORAFFINERY



Casein extraction
process



TRANSFORMATION



Bioplastic



UrBIOfuture

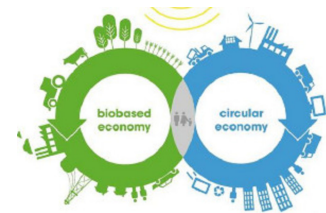
careers, education & research



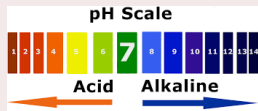
Consiglio Nazionale
delle Ricerche



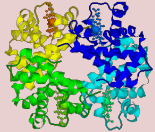
Connection with STEM disciplines



Biology– Chemistry– Tecnology



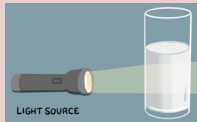
Acid-base reactions



Proteins



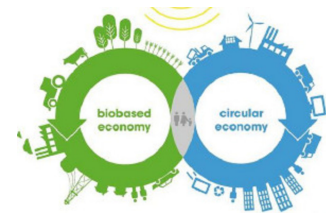
Polymers



Colloidal solutions



Introduzione al problema plastica



Resource extraction

Production

Distribution

Consumption

Disposal

waste



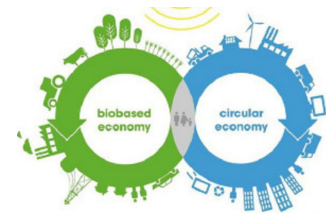
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Introduzione al problema plastica



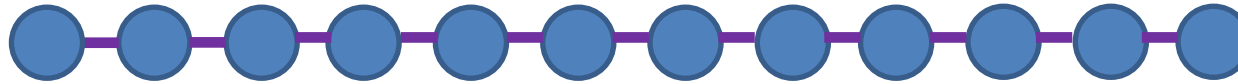
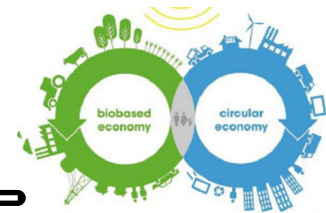
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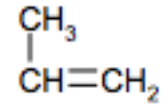


How is plastic made?

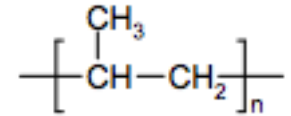


monomer

polymer



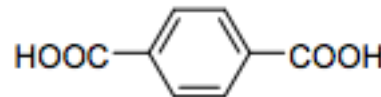
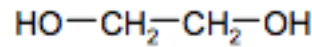
monomero
(propilene)



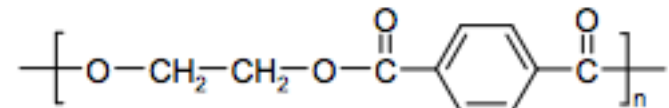
polimero
(polipropilene)



monomers



monomeri
(etilenglicole)
(acido tereftalico)



poli(etilenglicole tereftalato) (PET)



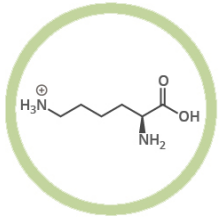
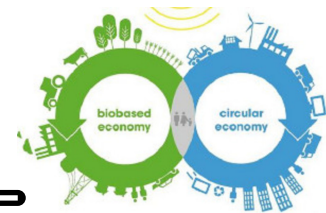
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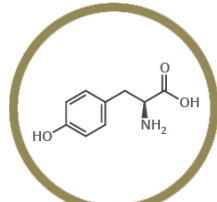




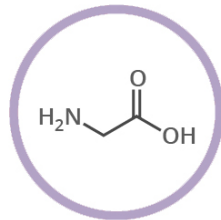
Biopolymers



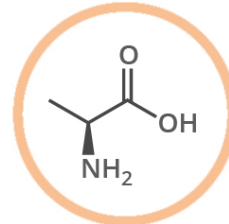
lysine



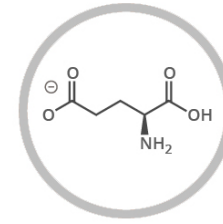
tyrosine



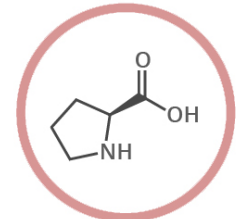
glycine



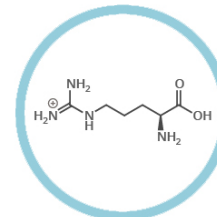
alanine



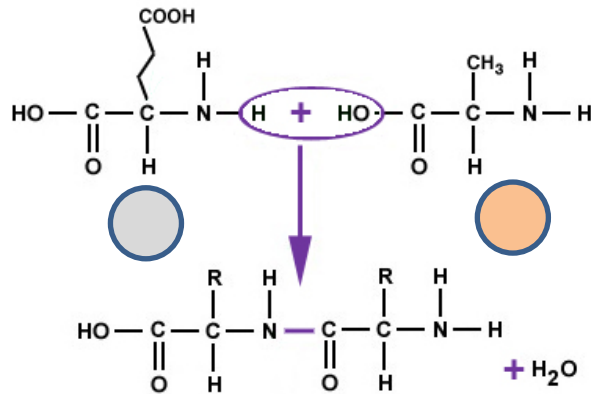
Glutamic acid



proline



arginine



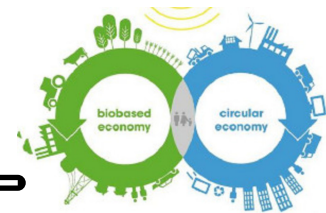
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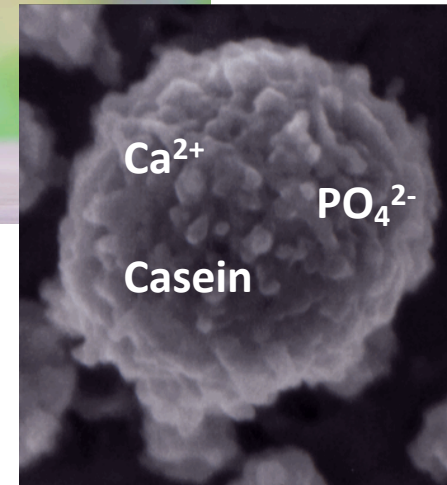


Milk



Chemical composition:

WATER	87,5%
FAT	3,9%
PROTEINS	3,4%
LACTOSE & MINERALS	5,2%

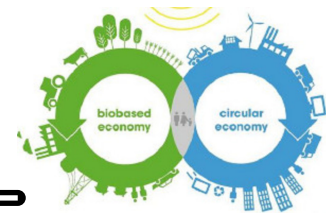


80%

Casein

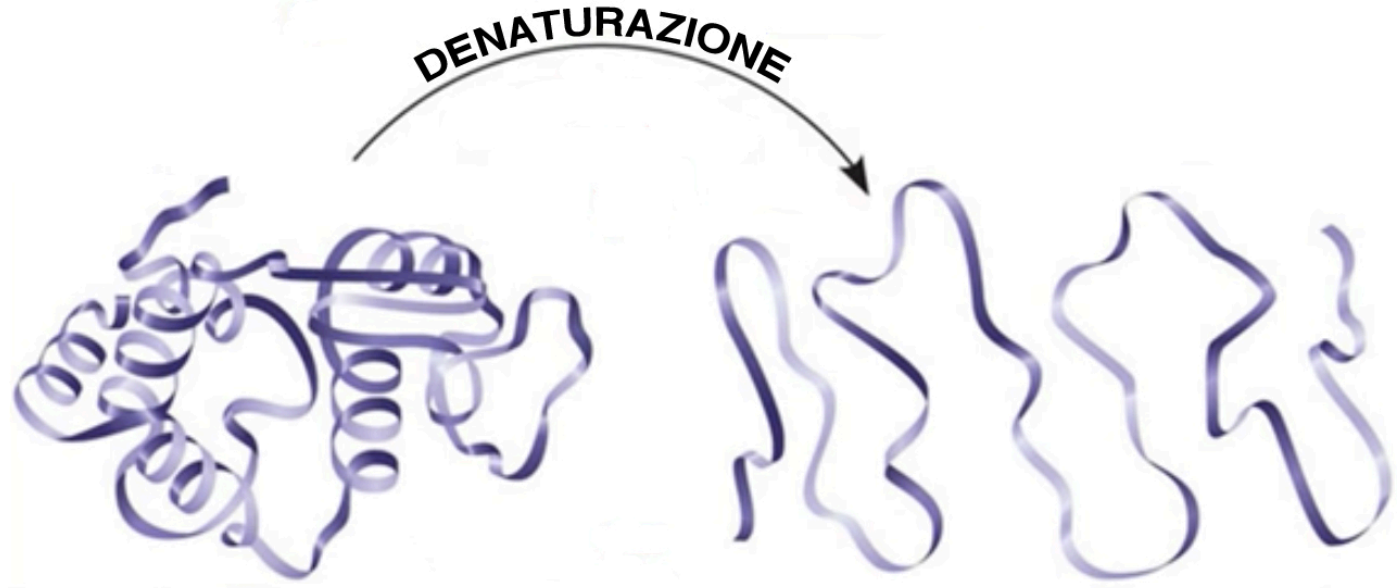
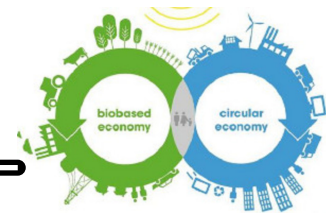
Micelles

Tyndall Effect





CASEIN Chemistry



Main methods:

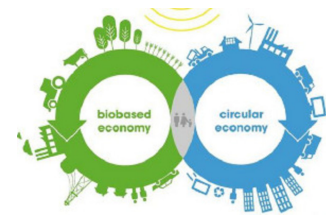
Chemical denaturation: treatment with chemical substances (acids, alcohol, salts...).

Thermal denaturation: by heat or cooling

Mechanical denaturation: by agitation



CASEIN Chemistry coagulation

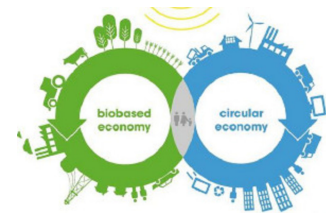


MATERIALS LIST

Skim Milk 80 mL	Tablespoons
White vinegar 8 mL (acetic acid 5%)	Bunsen burner or hot plate
Becker (100 mL)	strainer
Thermometer	Measuring cup



CASEIN Chemistry coagulation

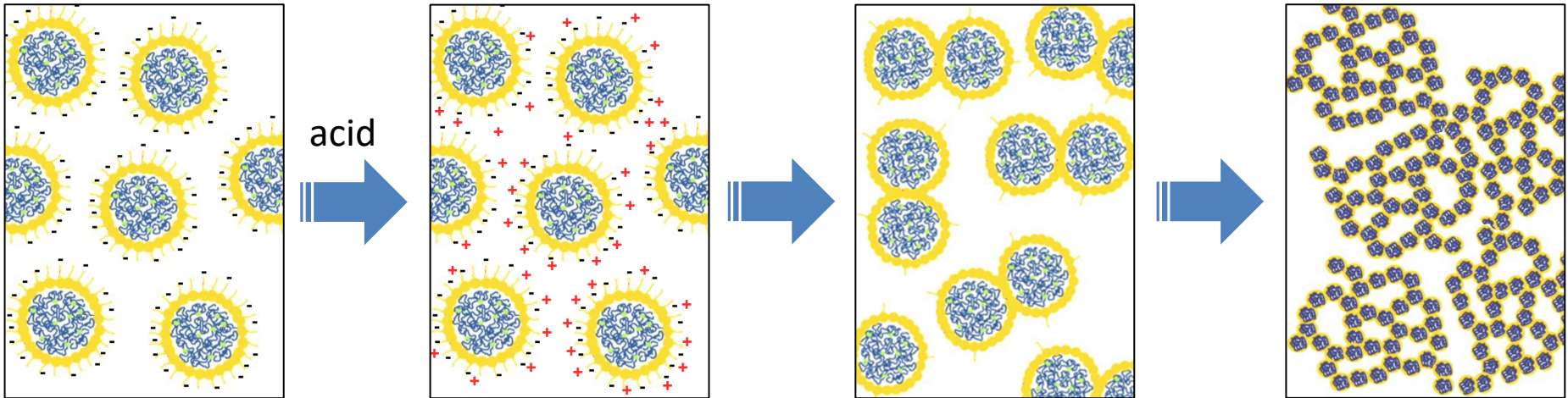
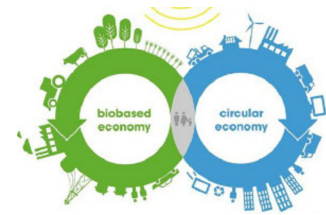


heat up the milk
until 50° 60°C

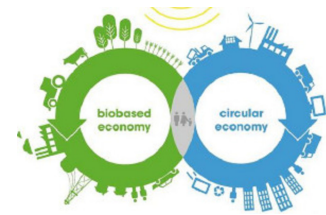




CASEIN Chemistry coagulation what happened?

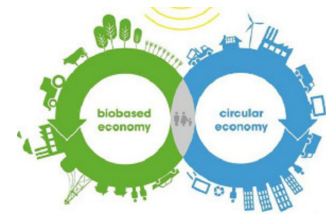


Casein processing

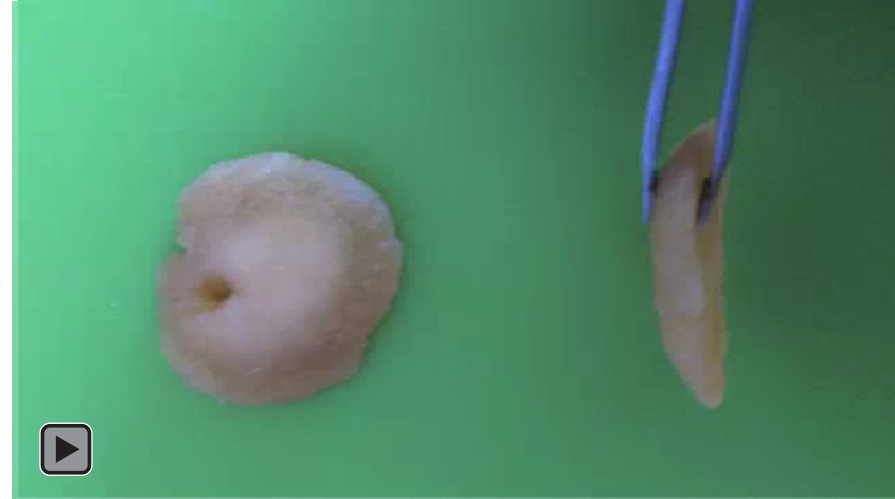
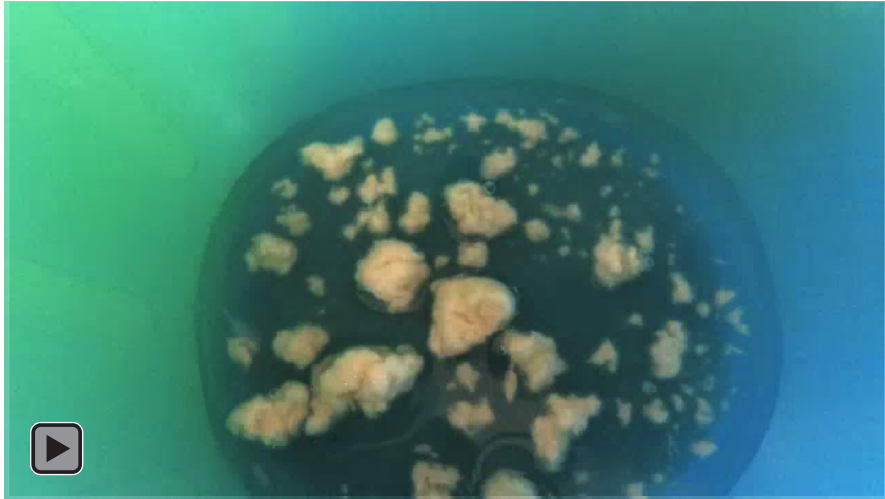




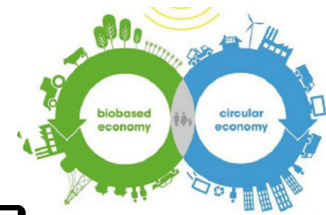
CASEIN film preparation



Dry time: 2 days



Bioplastic vs Plastic



BIOPLASTIC

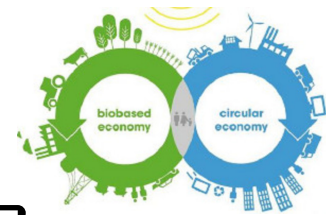
VS

PLASTIC

- ❖ obtained from renewable sources
- ❖ biodegradable
- ❖ biodegradation produces non-toxic products
- ❖ Is new

- obtained from **NO**-renewable sources
- degrades in a very long time
- the degradation produces toxic products and microplastics that enter into the food chain.

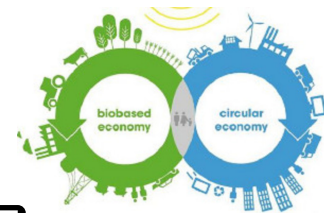
Galalith



- one of the first plastics
- invented in 1897
- was made insoluble by the formaldehyde treatment
- was used until the 1930s to produce buttons, white piano keys.



Not only bioplastics



- In the 1937 LANITAL
- wool-like protein fiber
- not susceptible to moths
- currently used for allergic or very sensitive skin such as early childhood

