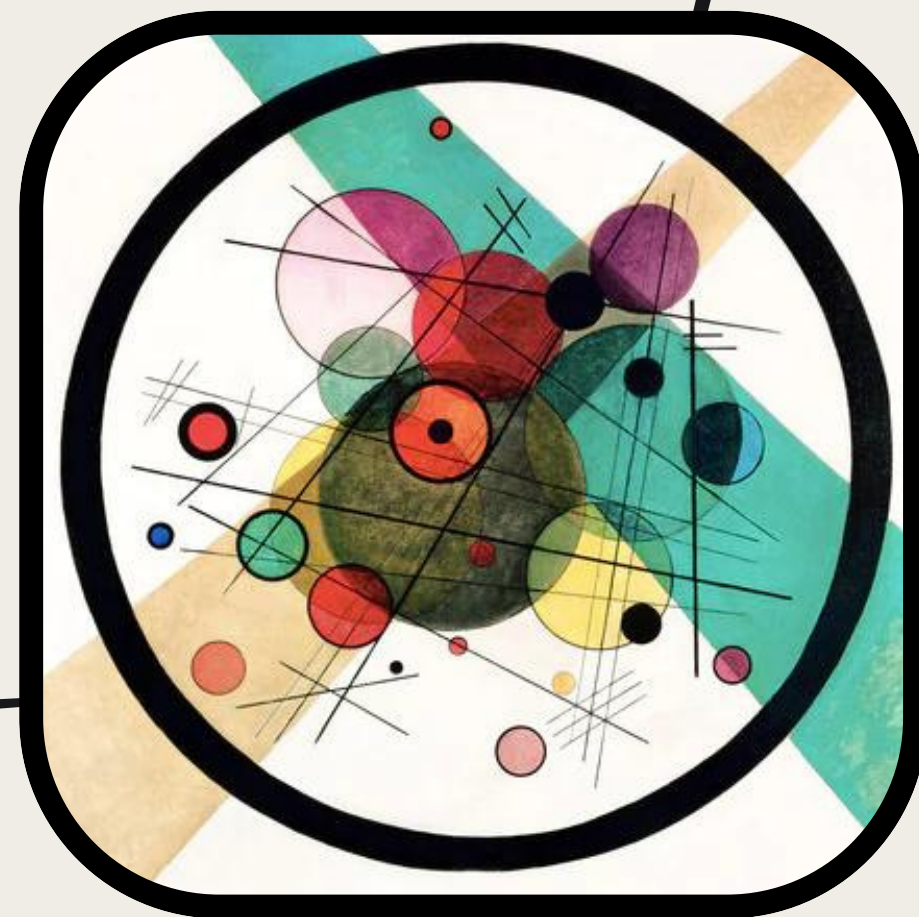
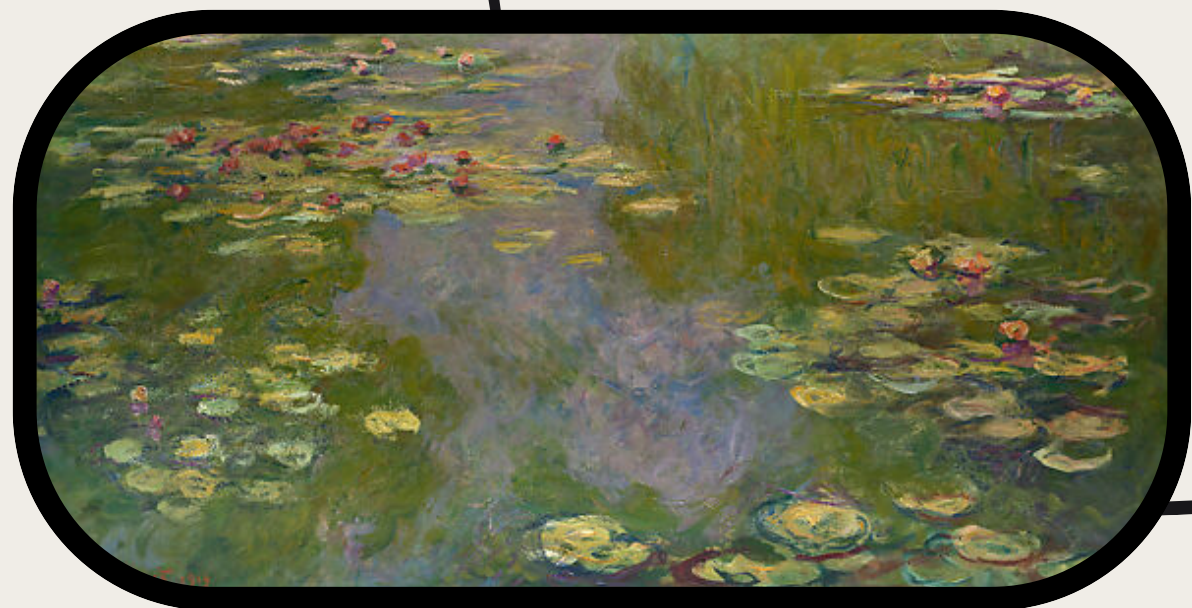
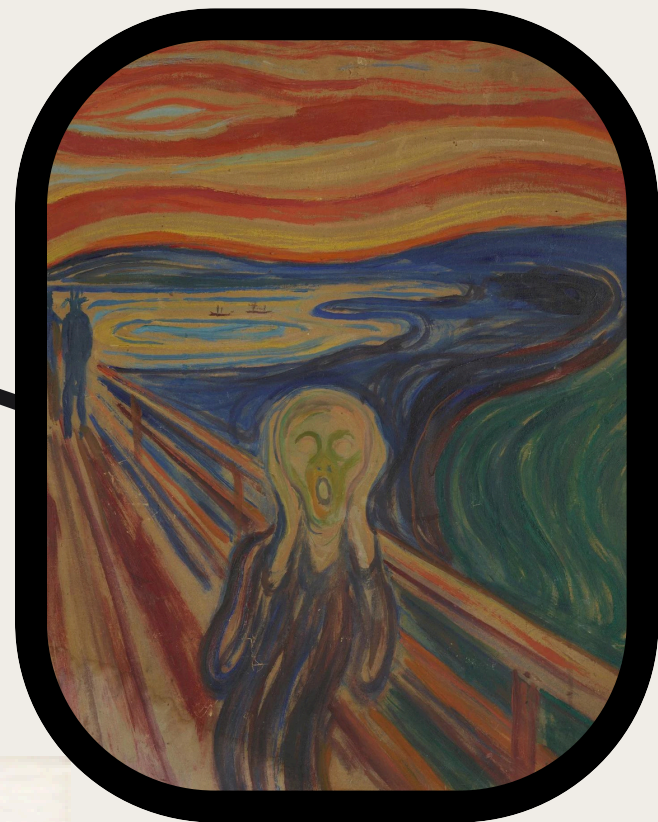
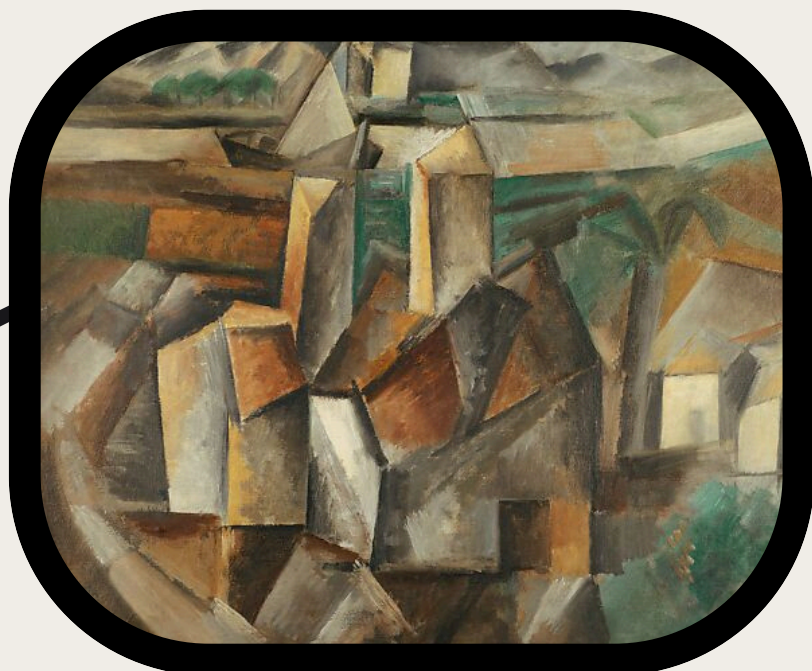


Bioprocesses: the heART of circular economy



Bioprocesses: the heART of circular economy



Image created with AI referring to fermentation processes.

- What is **Circular Economy, Biotechnology, Fermentation**?
- In what ways **ART** is related to all the above?



Erasmus+



Co-funded by
the European Union

Bioprocesses: the heART of circular economy

- According to European Parliament (<https://www.europarl.europa.eu>) the circular economy is a model of production and consumption, which involves sharing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.
- Biotechnology involves using living organisms or their systems to develop products and processes for industries like medicine, agriculture, and environmental management. Fermentation is a specific biotechnological process where microorganisms convert organic compounds, such as sugars, into simpler substances like alcohols, gases, and acids, commonly used in food, beverages, and biofuel production. These processes are integral to the circular bioeconomy, which aims to reduce waste and make efficient use of resources by recycling biological materials and creating sustainable products, thus promoting environmental sustainability and economic growth.
- The Artful Thinking program (<http://pzartfulthinking.org/>) designed by Harvard University aiming at fostering critical thinking skills. The program developed a model approach for integrating art into regular curricula and different disciplines.

It has two broad goals:

(1) To help teachers create rich connections between works of art and curricular topics; (2) to help teachers use art as a force for developing students' thinking dispositions.

In this action famous artworks are related to Circular Economy, Biotechnology, Fermentation in order to develop students' thinking skills, to foster learning and understanding of these topics and to enhance the sustainability of the SKILLS project.

Bioprocesses: the heART of circular economy



Women picking olives, Vincent Van gogh, Metropolitan Museum of Art

- What is this painting about?
- Why is this activity important for human beings?

Bioprocesses: the heART of circular economy

The harvesting of olives has been an important process since ancient times. In ancient Greece, the goddess Athena won the city of Athens over Poseidon by gifting the people the olive tree.

Olives and olive oil are vital for their:

-->nutritional --> economic --> cultural --> environmental benefits.

They are rich in

- healthy monounsaturated fats
- antioxidants
- essential nutrients.

Economy

- Provide significant income,
- Global trade support
- Jobs creation, especially in Mediterranean regions.

Culture

- Central products of the Mediterranean diet
- Culinary traditions

Environment

- Biodiversity support
- Promotion of sustainable farming
- Contribution to carbon sequestration



Harvest olives, Greek amphora,
British museum



Harvesting olives, Theophilos, Mytilene



Bioprocesses: the heART of circular economy

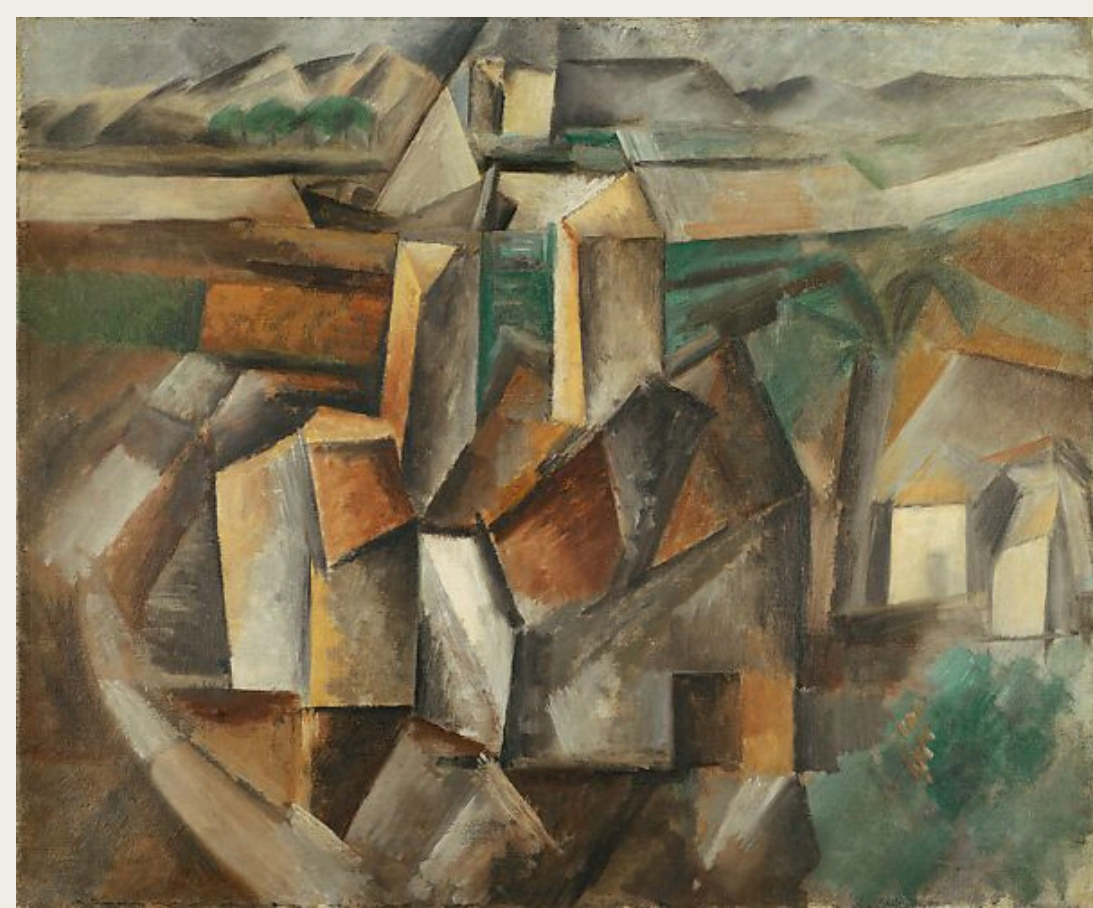


The oil mill, Pablo Picasso, Metropolitan Museum of Art

How the environment could be
destroyed by an olive mill?

Bioprocesses: the heART of circular economy

- Olive oil processing produces around 30 million m³/per year of olive mill wastewaters globally, posing a serious environmental threat.
- Olive mill wastewaters are the major effluent deriving from the industrial production of olive oil.
- It is considered as one of the most challenging agro-industrial wastes to treat.
- OMW is produced in vast volumes, seasonally and geographically scattered and is characterized by extremely high organic load.



Bioprocesses: the heART of circular economy



The scream, Edvard Munch, Munch museum

This artwork is the *Scream* by Edvard Munch.

- Why is this man shouting?
- How does his screaming relate to the circular economy?



Erasmus+



Co-funded by
the European Union

Bioprocesses: the heART of circular economy

The high volumes of olive mill wastewaters that are produced annually, having tremendously high organic load, are toxic and they are conventionally being deposited directly in land and aquatic ecosystems, leading to the increased organic charge and phytoxicity of land, air and water.

It has been reported that OWM could create 200–400 times more pollution than urban wastewaters. OMW has dark color, strong odor and (phyto-)toxic properties, mainly attributed to high quantities of phenolic compounds that it contains.

In practice:

- If olive mill wastewaters end up on land, the soil macro- and microorganisms and the local ecosystem are seriously disturbed.
- If olive mill wastewaters end up on aquatic ecosystems, the available dissolved oxygen of water is depleted.
- No more oxygen is available for aquatic organisms.

This is the reason we should

SCREAM

about such facts.



Bioprocesses: the heART of circular economy



Everyday I pray for love, Yayoi Kusama, Yayoi Kusama museum

What is depicted in this image?

Bioprocesses: the heART of circular economy

Find the art

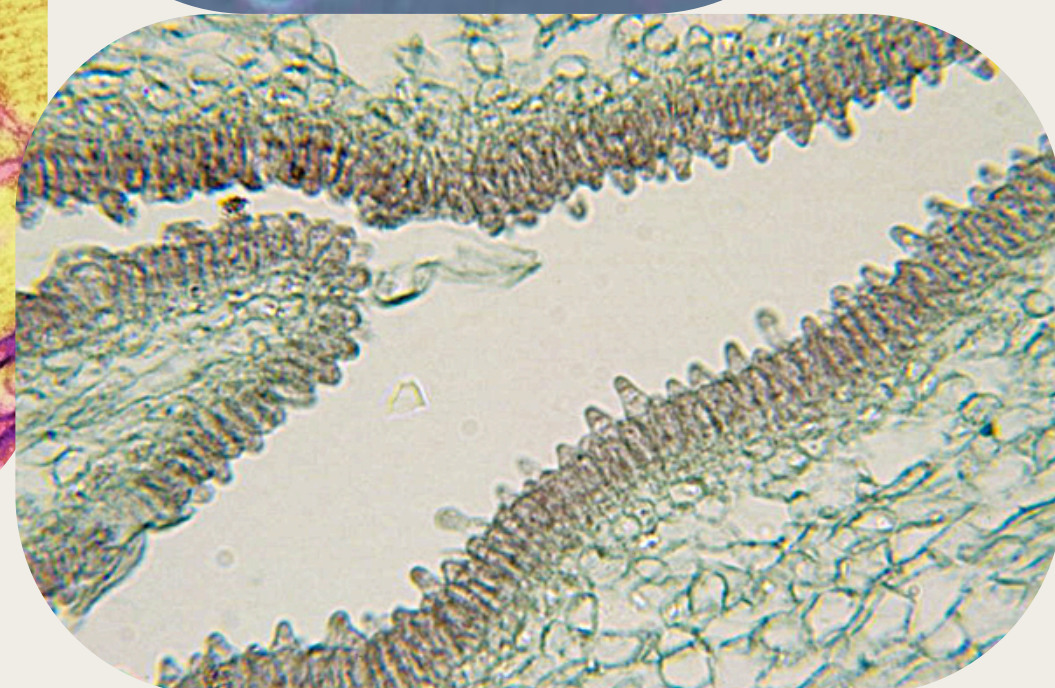
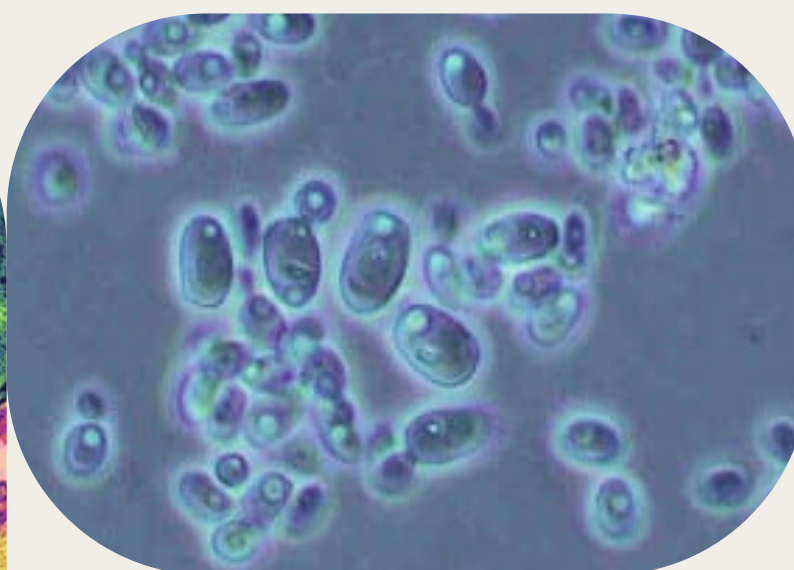
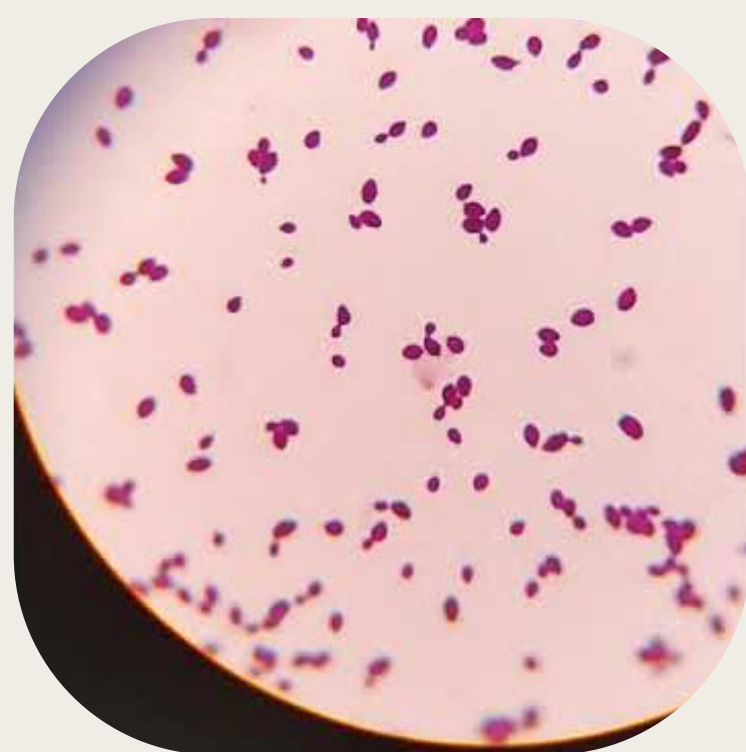


Photo sources:

<https://www.labmanager.com/deepest-look-yet-at-brewer-s-yeasts-reveals-the-diversity-harnessed-by-humans-662>

<https://www.genengnews.com/news/novel-insights-into-mitochondrias-role-in-cancer-uncovered/>

<https://www.youtube.com/watch?v=9e460qHFU1g>

<https://www.sserc.org.uk/health-safety/biology-health-safety/microbiological-techniques/enumerating-micro-organisms/counting-yeast-cells-using-a-colorimeternephelometer/>

<http://sciences.usda.edu/biology/zelmer/122/fungi/basidio/>

<https://www.arcanabooks.com/catalog/book/I00210304/>

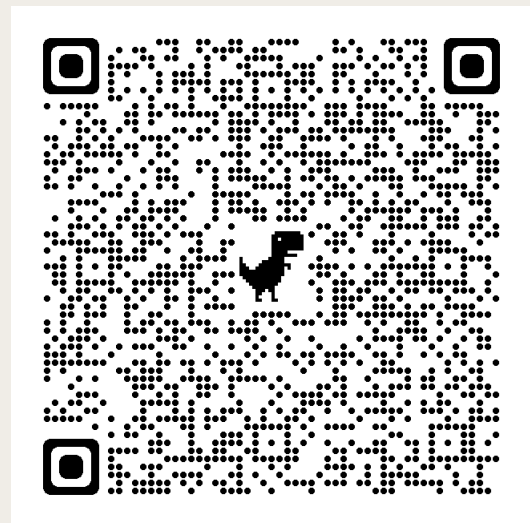
Bioprocesses: the heART of circular economy

Several strategies have been explored for the value-added valorization of such waste streams, with microbial bioconversion being among the most promising.

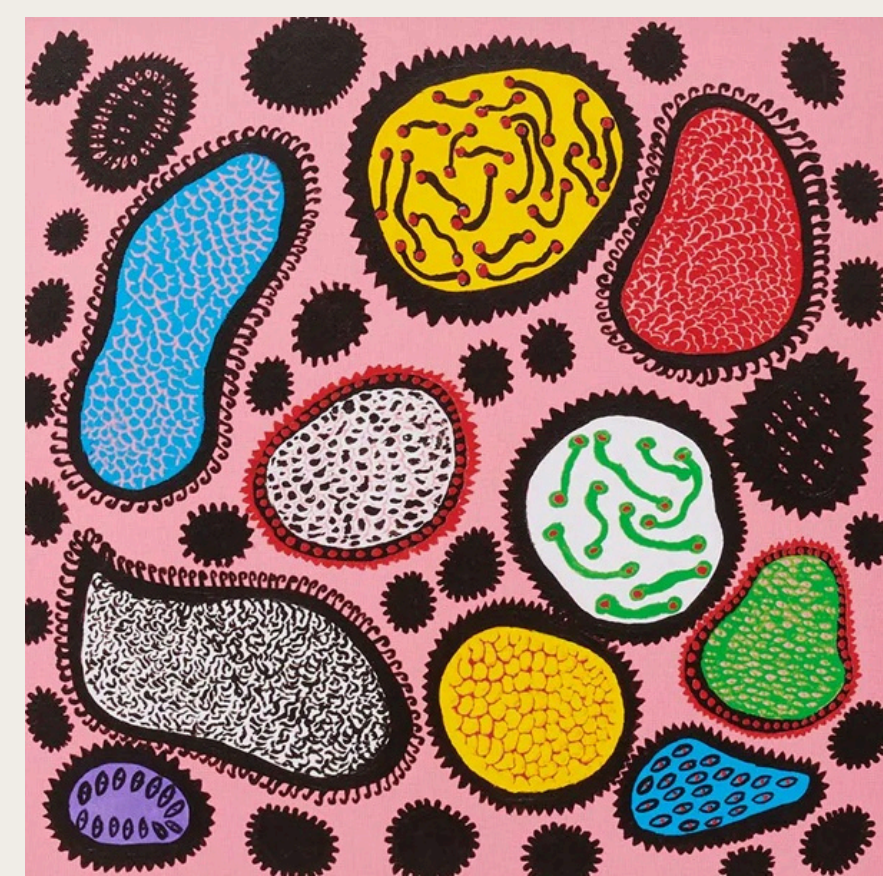
Bioprocesses (especially white/industrial biotechnology) includes the use of biological systems (microorganisms) for the production or the development of a high-added value bio-based compounds.

Microorganisms use waste streams as carbon/energy source, forming colonies and growing in vast amounts leading in the accumulation of microbial products.

Such compounds could be biofuels, nutraceuticals, pharmaceuticals, chemical precursors that can potentially fully substitute respective fossil fuels derived products.



Images sources: see the previous page



Bioprocesses: the heART of circular economy



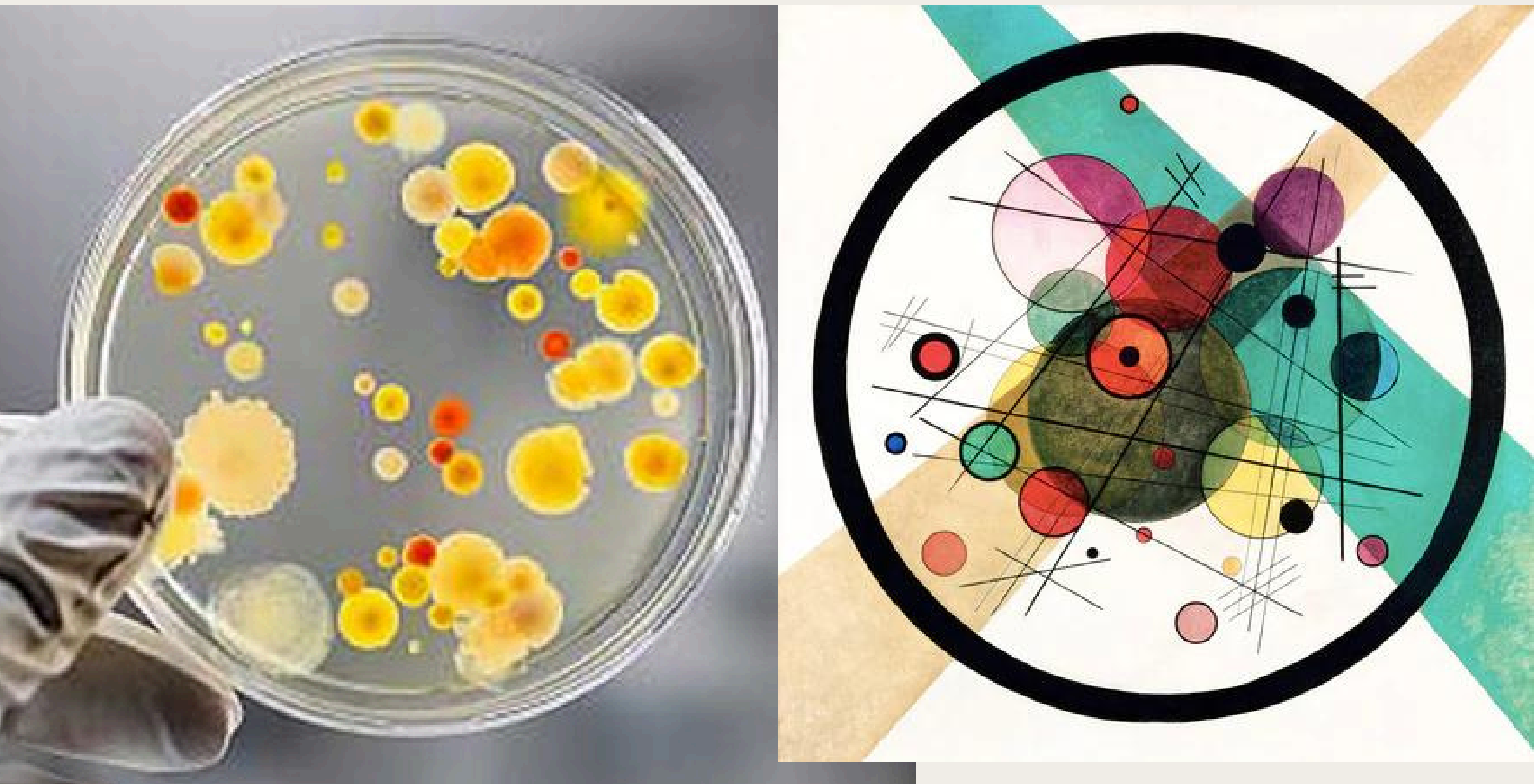
Circles in a Circle, Wassily Kandinsky, Philadelphia Museum of Art

Can a circle be cultivated within a circle?

How the circular economy could be cultivated into a circle?

Bioprocesses: the heART of circular economy

Compare the photos



microorganisms in a petri dish VS artwork by Kandinsky

Like microorganisms may form circle colonies in a round petri dish, circular bioeconomy operates within circular economy, being its heART.

Bioprocesses: the heART of circular economy

Microorganisms are everywhere. From deepest oceans and mines to frozen lakes and acidic environments. We may isolate strains of uncountable species and keep them amongst others in collections on petri dishes.

Petri dishes include selective substrates that can differentiate microorganisms for isolation purposes.

Different microorganisms can be incubated in petri dishes under various conditions such as substrate carbon source, temperature, pH, presence of oxygen etc., growing and forming colonies of different shapes, colors and properties (depending on the species).

Under the microscope may be observed in the form of cocci and rods for bacteria and lemon-shaped and hyphae for yeasts.

Various microbial strains are capable of using waste streams (such as olive mill wastewaters) as substrate/energy source, through fermentations, thus being the workhorse of bioprocesses.

Cellular biomass is grown within the wastes and the production of a wide variety of high-added value bio-based compounds occurs.



Bioprocesses: the heART of circular economy



Water Lilies, Claude Monet, Metropolitan Museum of Art

In what way Olive Mill Waste
could be influence
Monet painting?



Erasmus+



Co-funded by
the European Union

Bioprocesses: the heART of circular economy

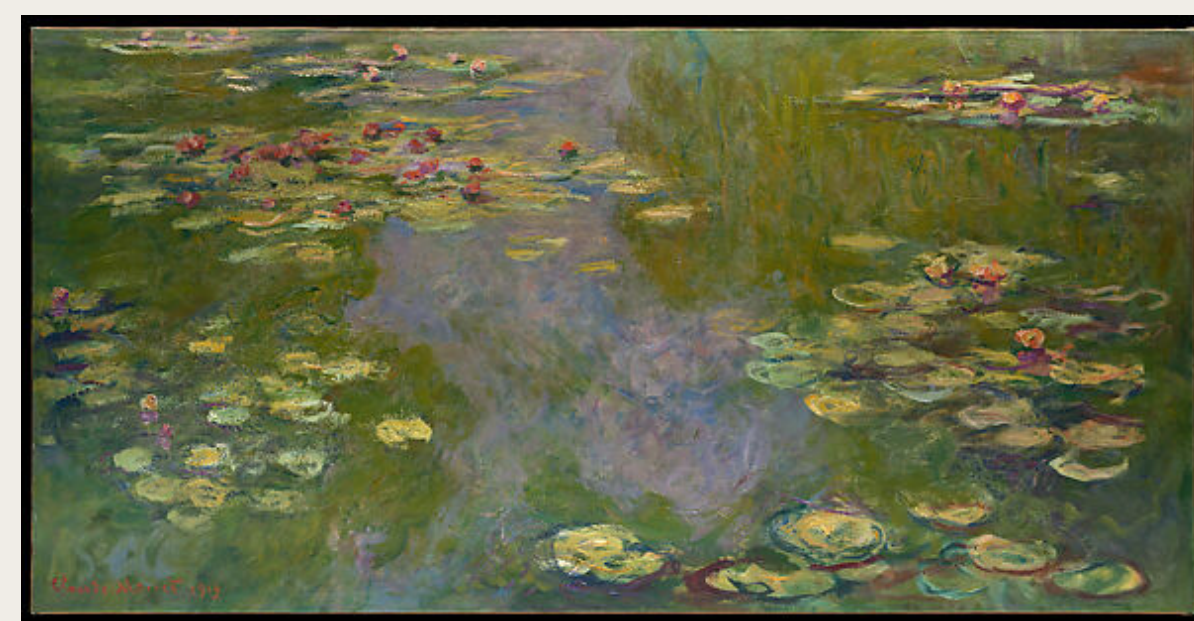
Olive mill waste waters are considered as heavy environmental pollutant, contaminating land and water. This can be eliminated through biotechnology.

Bioprocesses, could be the solution for the transition from the linear to circular model era.

The use of microorganisms for the treatment and simultaneous valorization of waste streams is of significance importance including serious environmental and financial impact for a cleaner and safer environment and society.

In an environment where water lilies, animals and humans can thrive in harmonia.

The aim is to eliminate environmental pollution through a circular economy so that water lilies can bloom forever and everywhere.



Bioprocesses: the heART of circular economy



Dove of Peace, Pablo Picasso, <https://www.pablocicasso.org>

How is peace related with circular economy?



Erasmus+



Co-funded by
the European Union

Bioprocesses: the heART of circular economy

Valorizing the properties of microorganisms, under a biorefinery mode rationale, we may utilize wastes as renewable resources and transform them into energy, food, medicines, materials, supporting the transition into the era of circular bioeconomy.

Peace is related with circular (bio-)economy through the promotion of sustainability, resource efficiency and social equity.

By promoting and implementing:

- Sustainable Resource Management
- Environmental Protection
- Economic and Social Equity
- Food Security
- Waste and Pollution Reduction
- Building of cooperative networks

If societies eliminate the issue of energy and malnutrition and use local resources to produce their own energy and compounds from wastes, we will be one step closer to the peaceful coexistence of humanity.





Erasmus+



Co-funded by
the European Union

Bioprocesses: the heART of circular economy

“SKILLS” Project Result 5 (PR5)
Digital course in circular agriculture

Artful Thinking Material

Created by

University of the Aegean team:

Dr. Dimitris Sarris, Associate Professor

Dr. Marina Kandroudi, Educator

The European Commission's support for the production of this publication (skills.info) does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.