

Innovations and Developments in Yeast

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ADVANCING FERMENTATION. CULTIVATING COMMUNITY.



A Little Bit About White Labs



Why I'm Standing Here in Front of You

White Labs Motto – *“Committed to being the best yeast company in the world”*

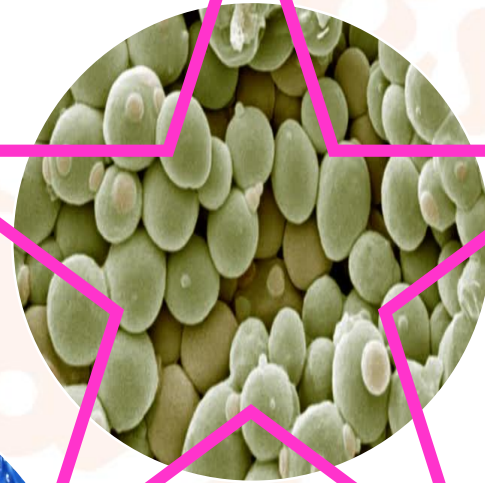
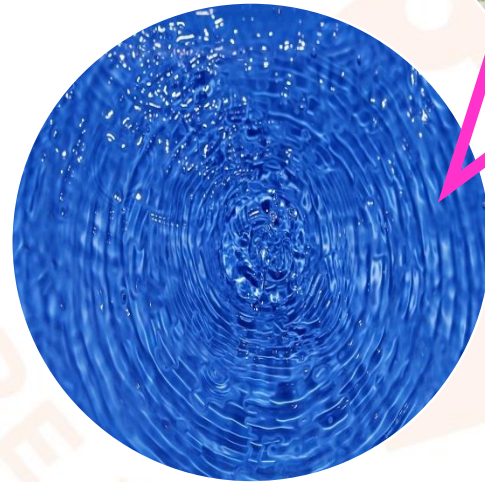


Outline

- Introduction to my favorite microbe
- A bit of cool science done at WL
- The new frontier of yeast

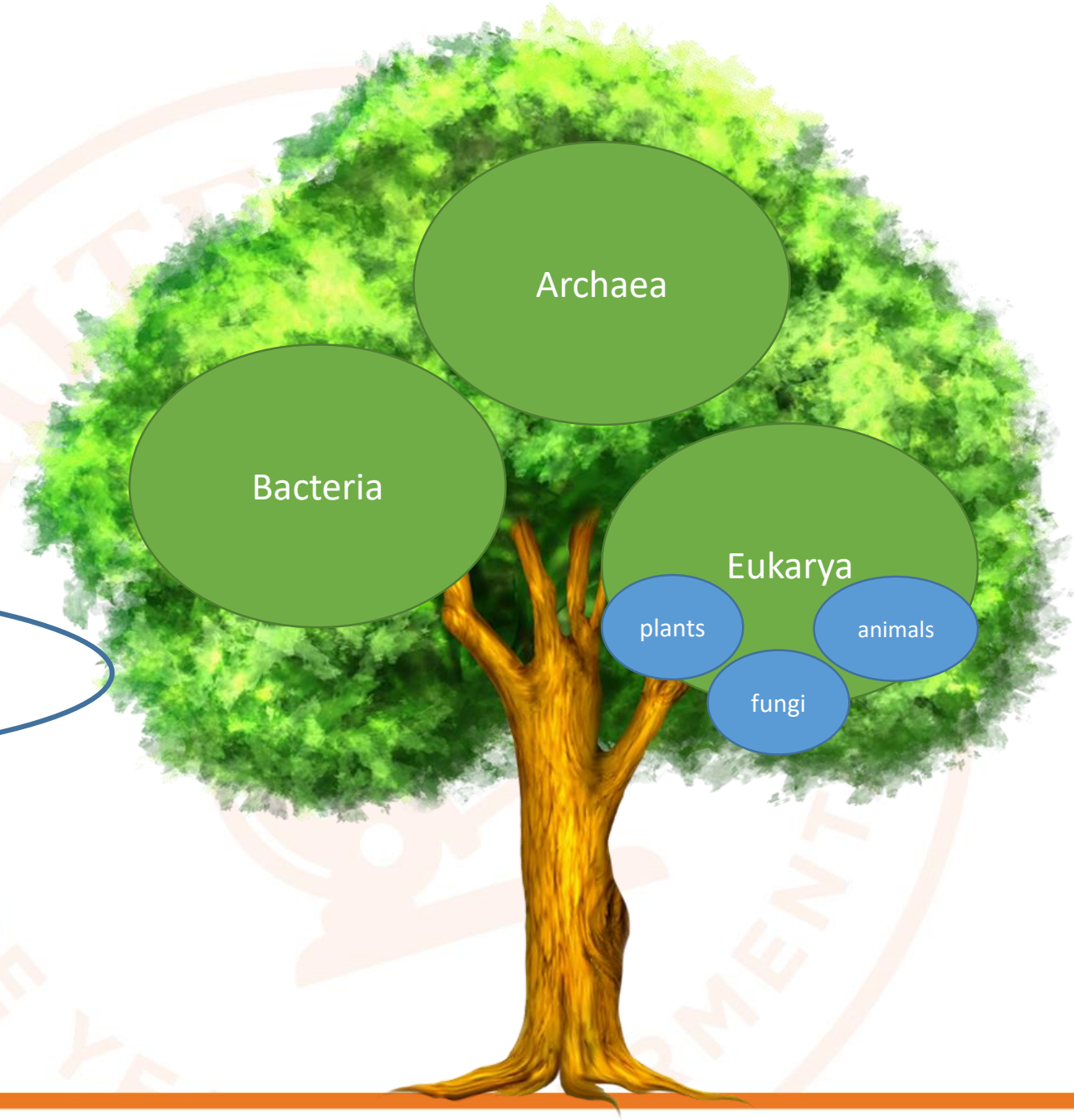


Brewing Raw Materials



Yeast

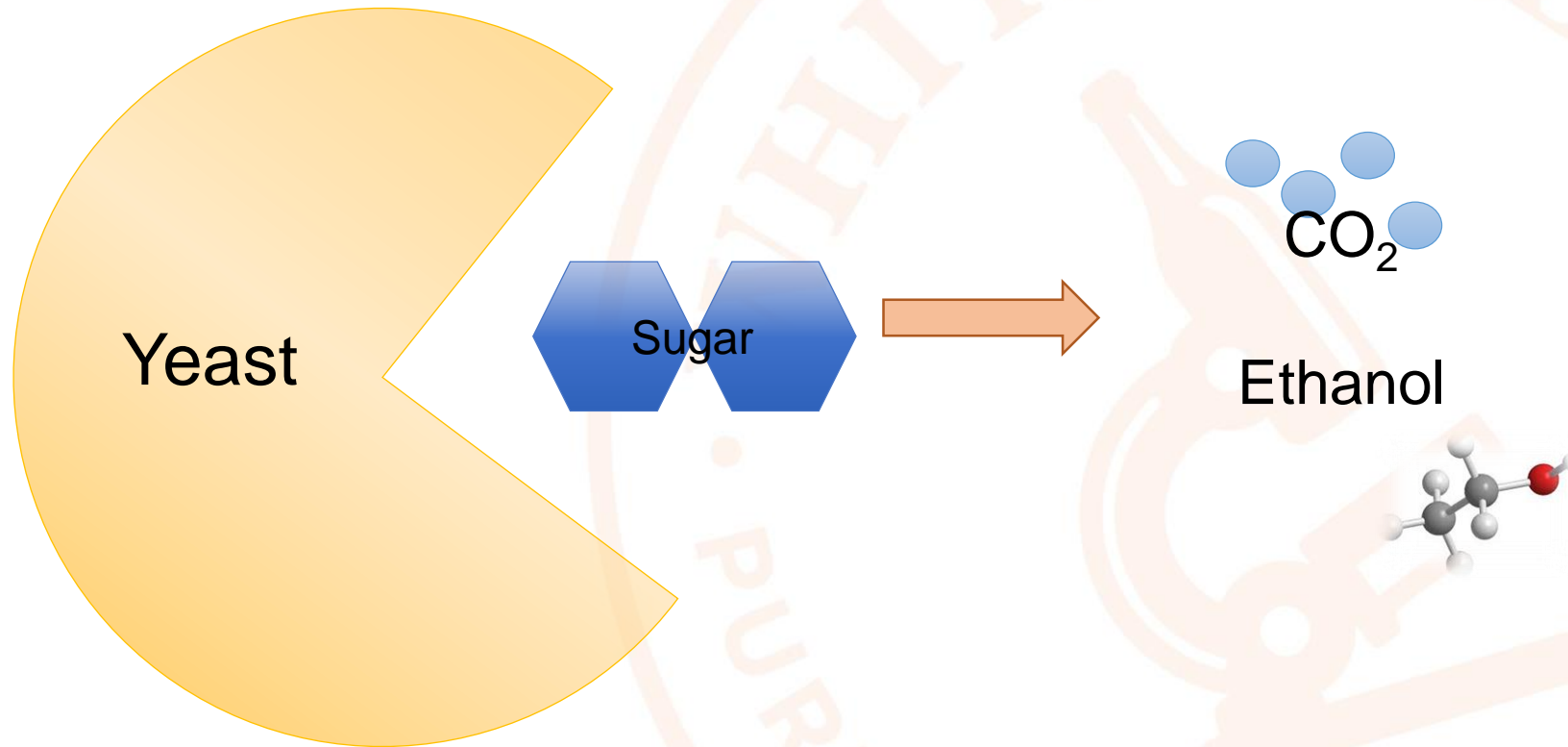
- Morphological term meaning “single celled organism”
- In everyday language, yeast is synonymous with *Saccharomyces cerevisiae*
 - There are over 1500 species of yeast
- Ubiquitous in nature
 - Yeast are found in every biome and continent
 - Especially on fruits and vegetables



Saccharomyces cerevisiae

- One of the oldest domesticated organisms
 - Used for brewing beer in Sumeria and Babylonia around 6000 BC
- *Saccharomyces* = sugar fungus; *cerevisiae* = Roman Goddess of crops – Ceres
- Used as a eukaryotic model organism
 - Unicellular, doesn't need a lot of room to grow, eukaryotic → can be applicable to humans
 - 1st genome to ever be sequenced in 1996

Yeast in Fermentation



Species of Brewing Yeasts

Saccharomyces cerevisiae

- Ale yeast
“Top fermenting”

Saccharomyces pastorianus

- Lager yeast
“Bottom fermenting”

Saccharomyces carlsbergensis

Saccharomyces uvarum

Saccharomyces bayanus

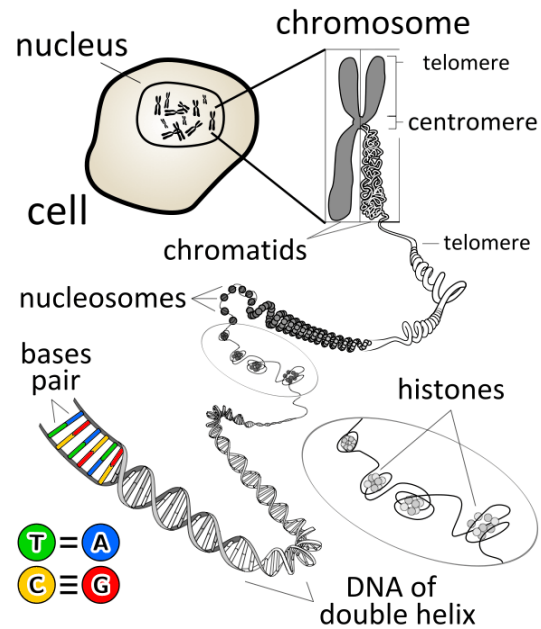
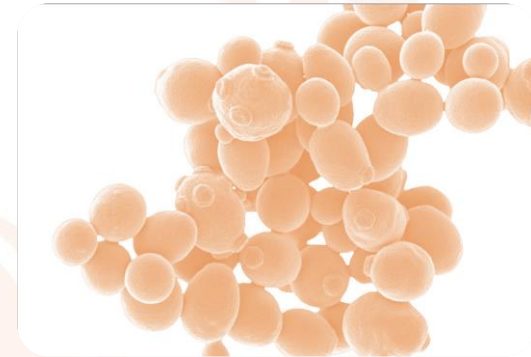
Saccharomyces eubayanus

S. cerevisiae + S. eubayanus

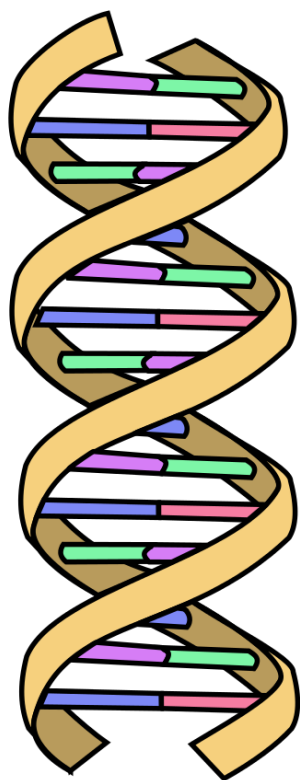
Other Hybrids?

All yeast used in brewing worldwide are non-GMO

The Yeast Cell



Bite Sized Bio



DNA

-  = Adenine
-  = Thymine
-  = Cytosine
-  = Guanine
-  = Phosphate backbone

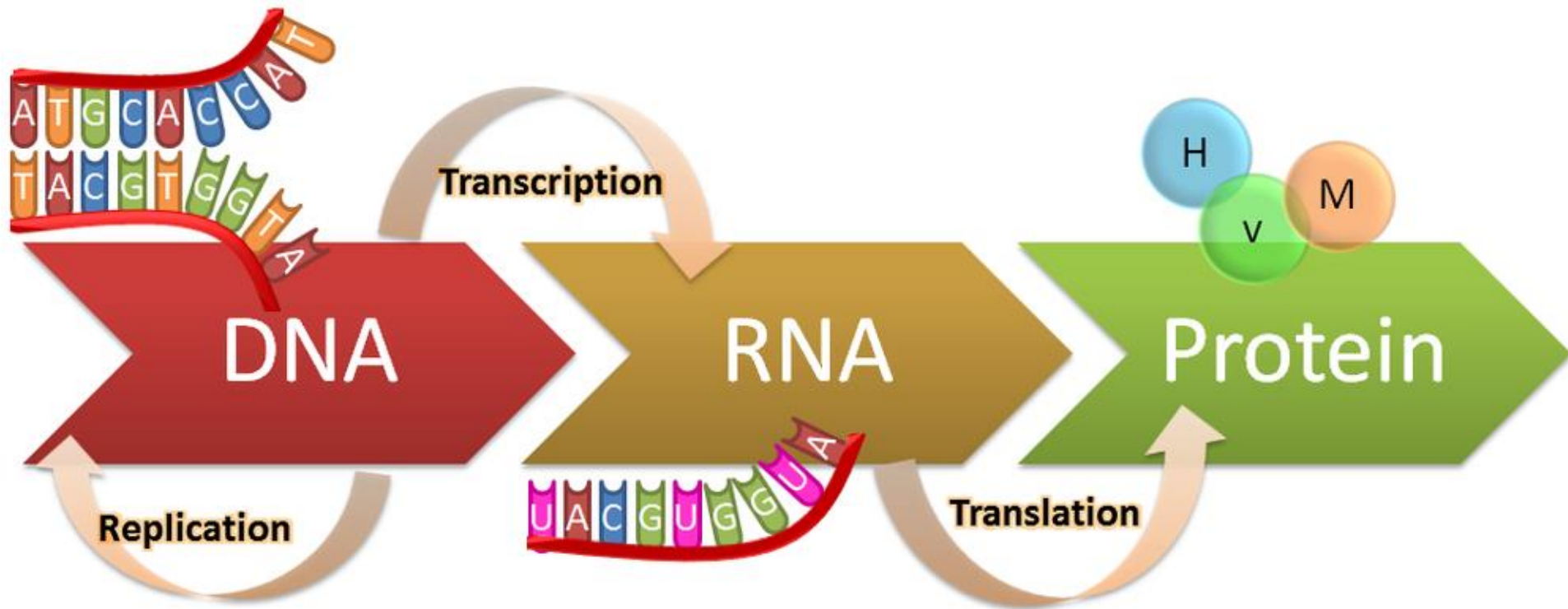
- DNA is made of chemical building blocks called nucleotides.
- These building blocks are made of three parts: a phosphate group, a sugar group and one of four types of nitrogen bases.

Impress All Your Friends With Science

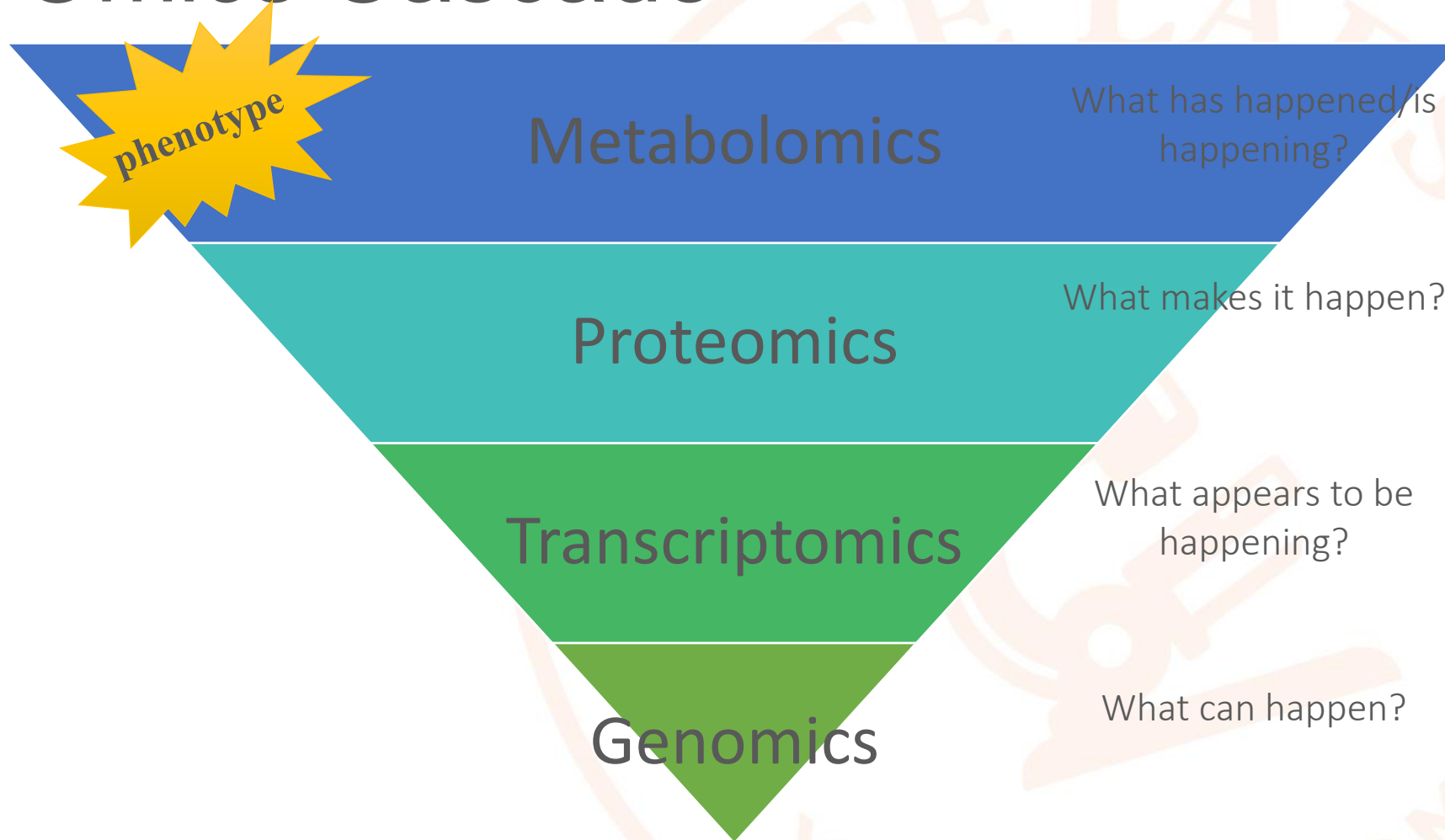
- Human genome = 46 chromosomes
 - Approximately 3 billion base pairs in human genome
 - One base pair = .0000000000034 meters
 - Humans have more than 10 trillion cells

So if you were to line all of the DNA found in every cell of a human body it would stretch from the earth to the sun 100 times!

Central Dogma



The Omics Cascade



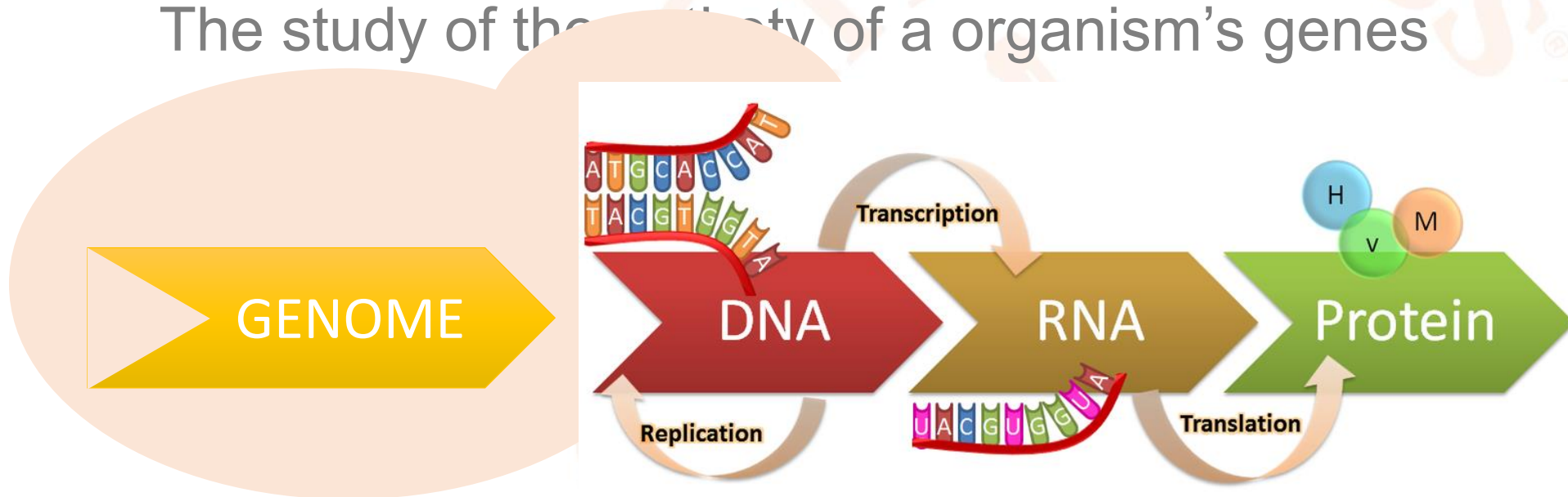
Genomics

The study of the identity of an organism's genes



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AATTTGGGACGCTAAT
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Genomics

- Goal of collaborative project was to sequence 96 of our yeast strains
- Formed even bigger collaborative group to sequence over 200 yeast strains!
- Focused on *Saccharomyces cerevisiae* – 157 yeast strains

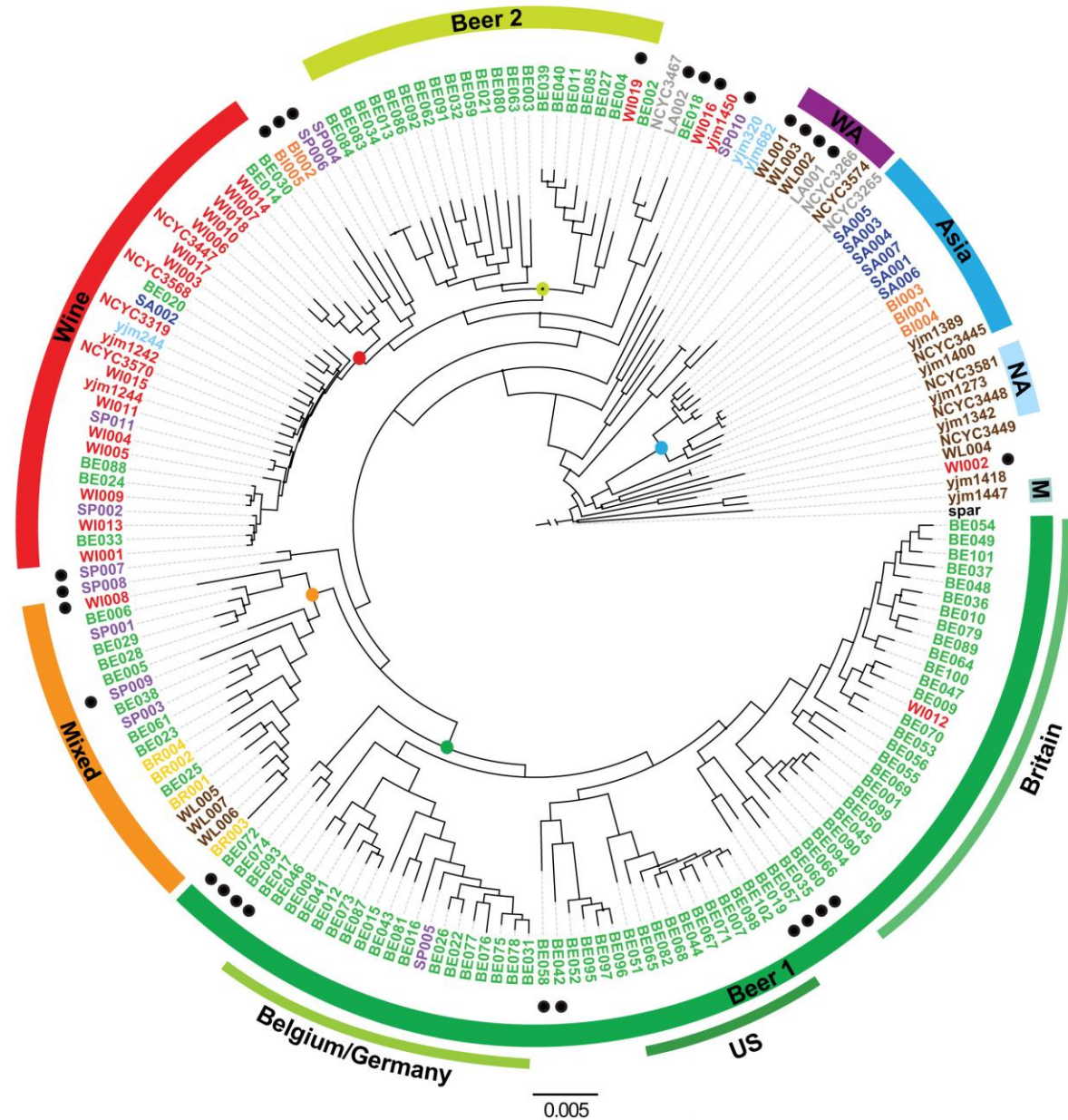
Genomics

Origin

- Beer
- Wine
- Spirits
- Saké
- Wild
- Bio-ethanol
- Bread
- Laboratory
- Clinical
- S.paradoxus*

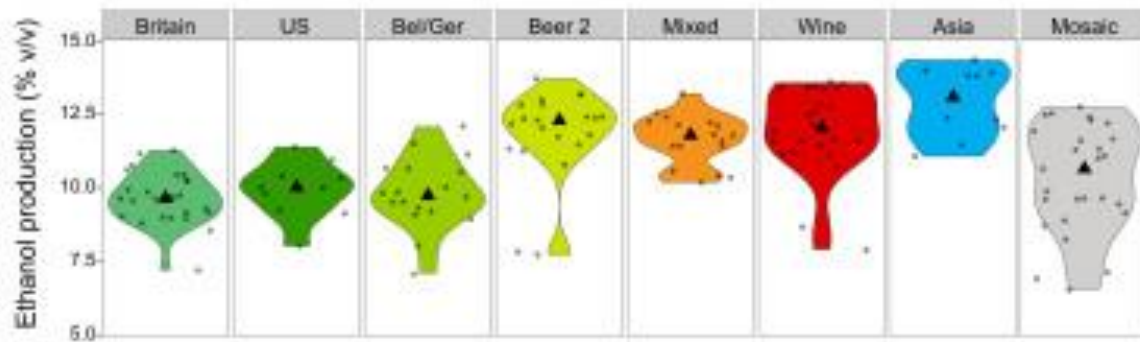
Lineage

- Beer 1
- Britain
- US
- Belgium/Germany
- Mixed
- Wine
- Beer 2
- West Africa (WA)
- Asia
- North America (NA)
- Malaysia (M)
- Mosaic

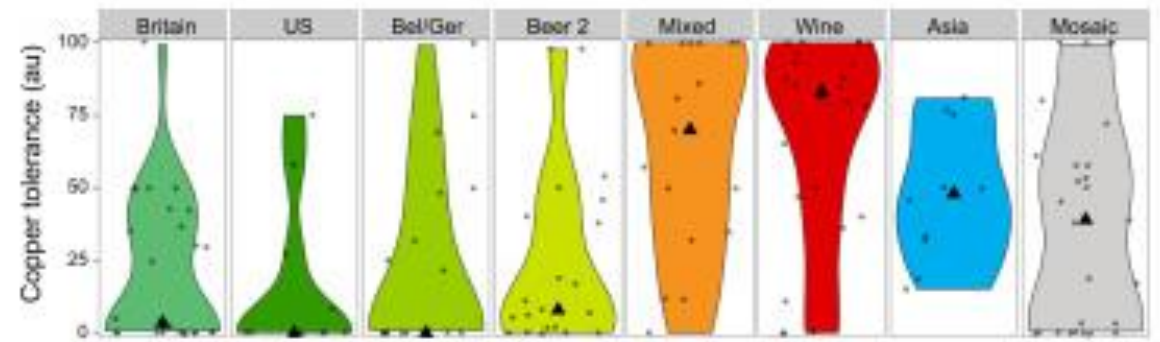


Exploring the Phenome

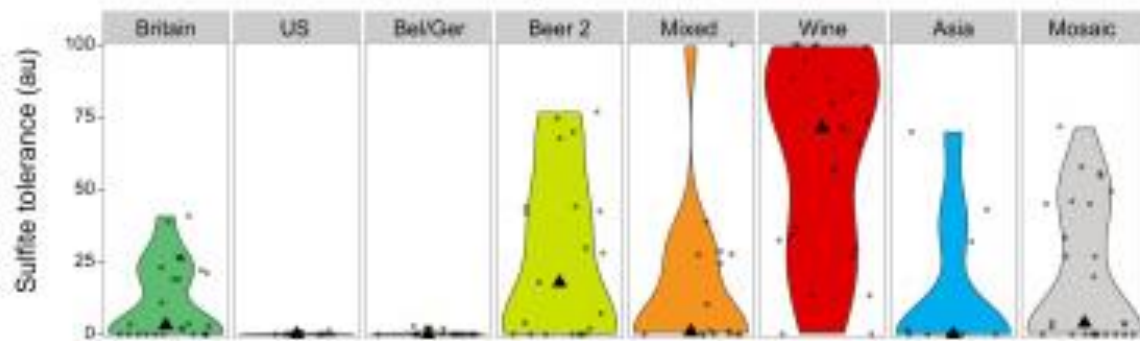
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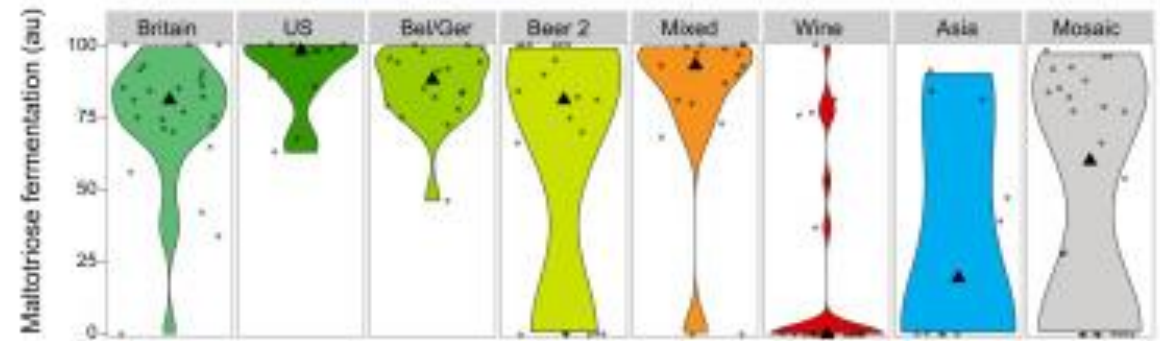
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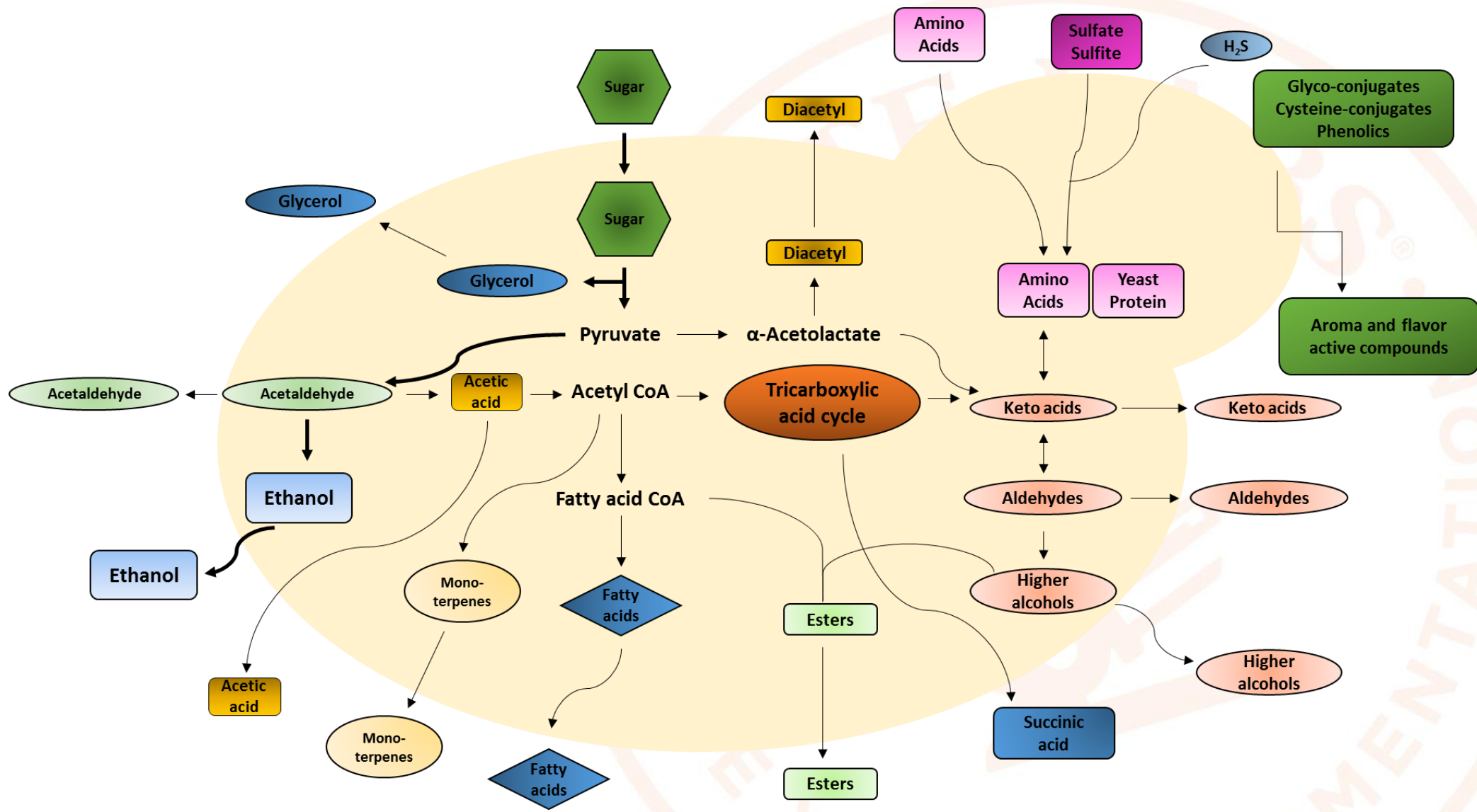
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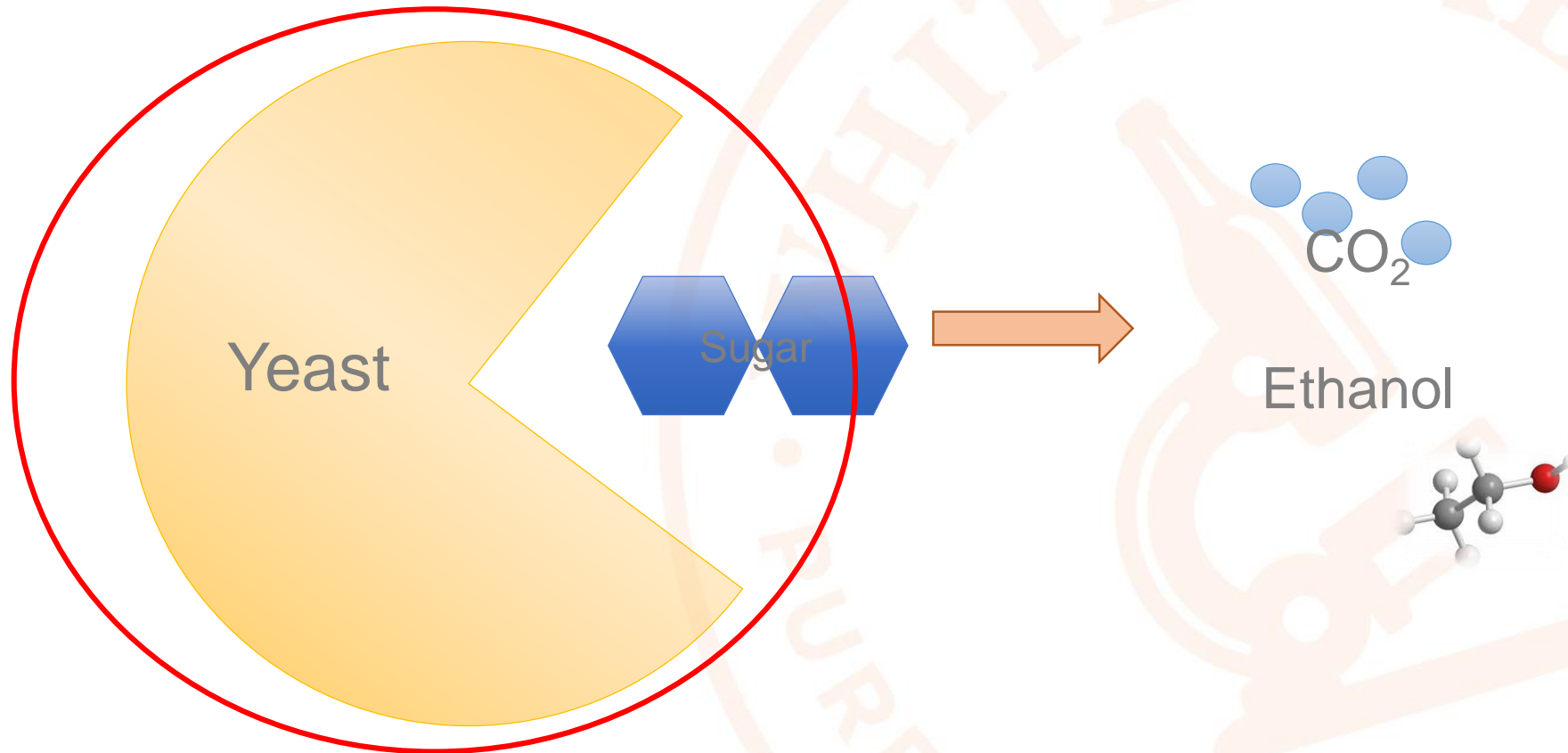
What Does This Mean for the Average Brewer?

- KNOWLEDGE = POWER





Yeast in Fermentation



“Alternative” Yeast

- Non-*Saccharomyces* yeast
- *Brettanomyces* – well known and used but others?
- *Pichia kluyveri*, *Candida tropicalis* (shehate), *Saccharomycodes ludwigii*, *Torulasporea delbrueckii*, *Zygosaccharomyces rouxii*
- And more to come!



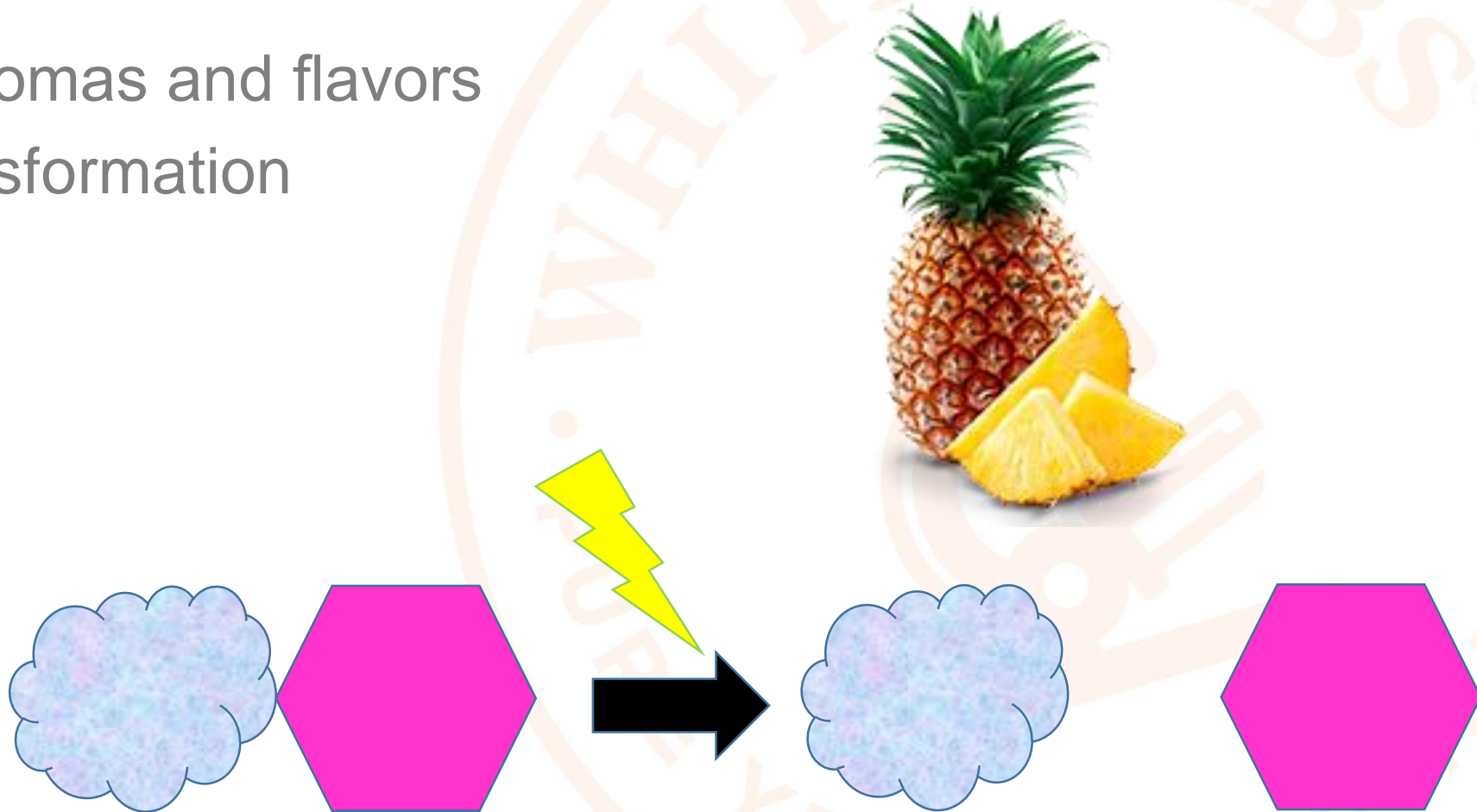
Why Non-*Saccharomyces* Yeast

- Conventional beer is losing consumers to other innovative beverages.
- Brewers have explored different hop varieties, specialty malts, blends
- Yeast adds over 500 different flavor and aroma compounds
 - Why not turn to non-conventional yeast?



Benefits of Non-*Saccharomyces* Yeast

- New aromas and flavors
- Biotransformation



Cons of Non-*Saccharomyces* Yeast

- Risk of cross-contamination
- Some non-*Saccharomyces* yeasts can produce phenolic compounds
 - Generally unwanted in beer
- Some cannot metabolize maltose
 - Could be used in mix culture fermentation
- Some will make acetic acid in the presence of oxygen

How to Use Non-*Saccharomyces* Yeast

- Mix culture will be the easiest way 😊
- If not make sure to set up screening test:
 - Sugar
 - Hop tolerance
 - Ethanol tolerance and production
- Get from yeast supplier 😊

The New Frontier

- Harnessing non-*Saccharomyces* yeast in fermentations
- Just beginning to explore the “wild” side
- Adapt and embrace the unknown
- Do small scale experiments, before diving in 😊



Interested in Learning More?

- Experiment!
- Domestication and Divergence of *Saccharomyces cerevisiae* Beer Yeasts; Gallone et al., Cell (2016)
- Review: Pure non-*Saccharomyces* Starter Cultures for Beer Fermentation; Michel et al., JIB (2016)

Thank you for listening!

Questions?

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