COOK THE SCIENCE

Thomas Michaels

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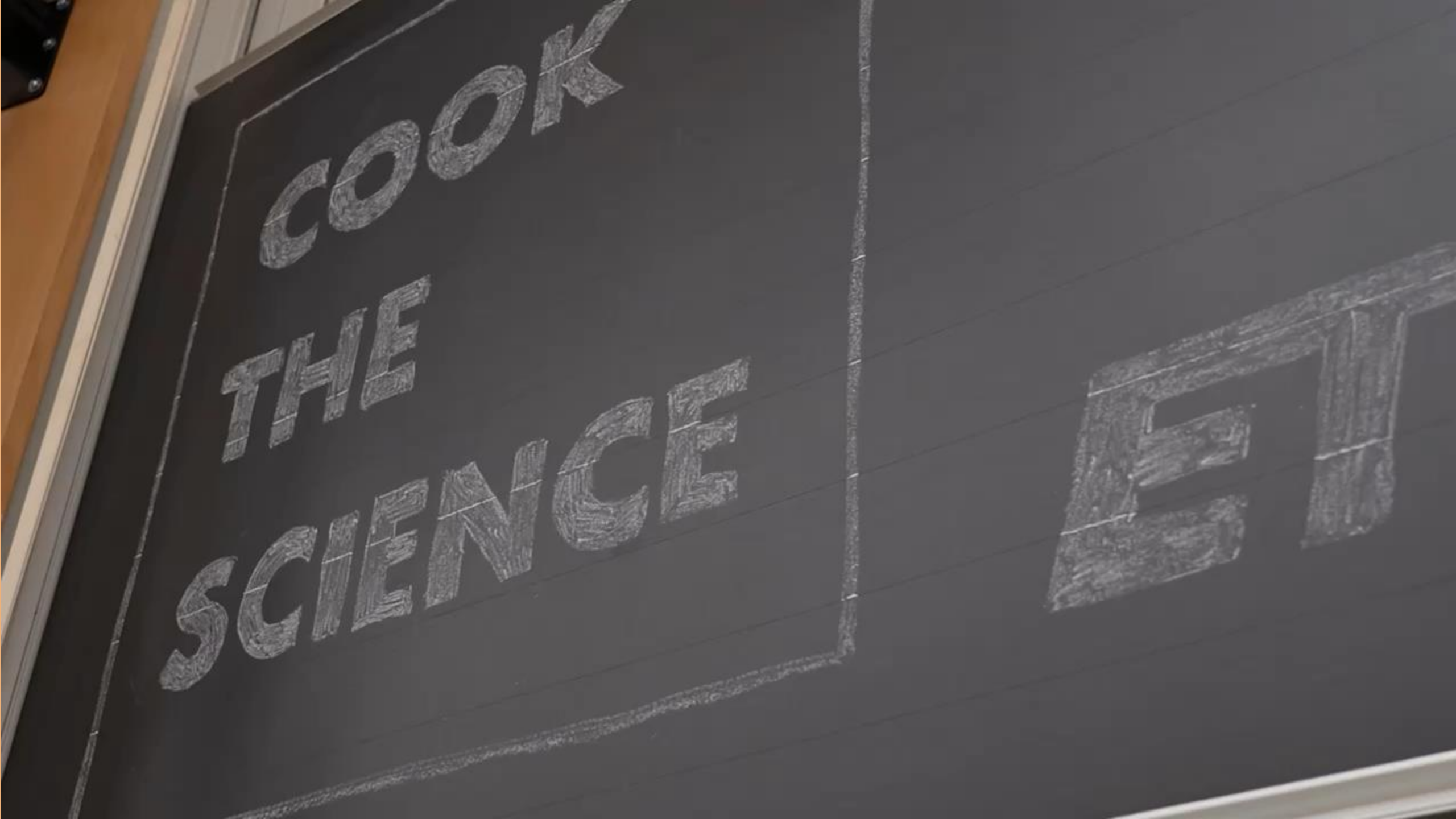
D BIOL


COOK
THE
SCIENCE

“Cook the Science” vision

All cooking is basically applied science

- Yet science behind everyday cooking is often overlooked (what a missed opportunity!)
- Bring science closer to new public audiences, spark curiosity, build trust and encourage careers in science
- Focus areas of ETH Domain

Human Health
Energy, Climate and Environmental Sustainability
Responsible Digital Transformation
Advanced Materials and Key Technologies
Engagement and Dialogue with Society

Cooking & science: A winning combination

- Cooking and science are tightly connected
- Cooking makes science observable, emotional, memorable
- Apolitical

Creative
(like scientific process)

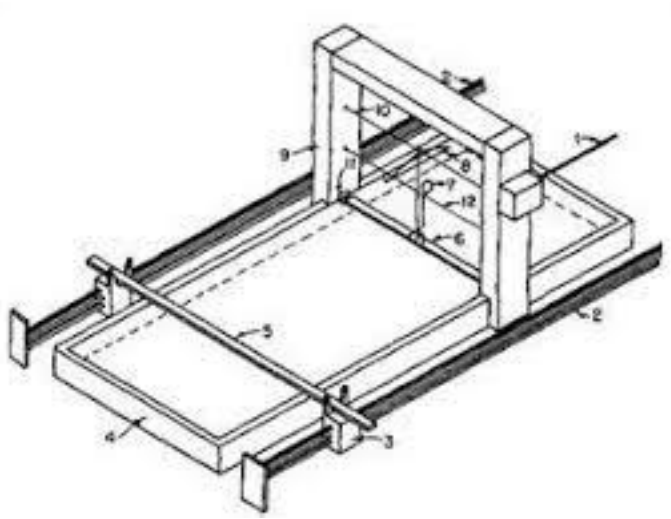
Accessible
(affordable, lowers barrier to science)

Equitable
(support minorities in STEM)

Agnes Pockels – An inspiring story

Agnes Pockels
(1862-1935)

Pockels' trough



"My Lord,

Will you excuse my venturing to trouble you …

… I thought I ought not to withhold from you these facts which I have observed, although I am not a professional physicist; and again begging you to excuse my boldness, I remain with sincere respect,

Yours faithfully
Agnes Pockels"

Letter to Lord Rayleigh (1891)

- "Surface tension", Nature 46, 437 (1891).
- "On the relative contamination of the water-surface by equal quantities of different substances", Nature 47, 418 (1892).
- "Relations between the surface tension and relative contamination of water surfaces", Nature 48, 152 (1893).
- "On the spreading of oil upon water", Nature 50, 223 (1894).

The “Cook the Science” team

Roland Baumann

Head Public Relations
ETH Zurich
Corporate Communications

Dr. Silvie Cuperus

Head of Life Science Zurich
Science communicator
and food engineer

Prof. Dr. Thomas Michaels

ETH Professor of Soft Matter Physics
Science populariser
Radio & podcast speaker

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ETH Lecturer
Institute of Biochemistry
Science & Education outreach

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Computer Scientist
Communicator and Storyteller

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Co-Founder, ETH Spinoff Tastelab
Physicist
Culinary & Creative Lead

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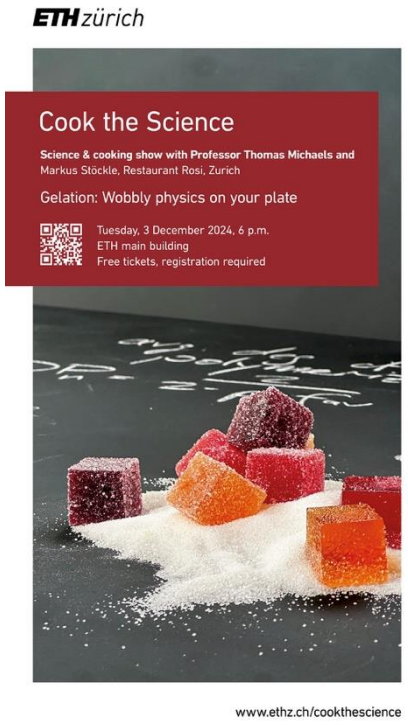
2024-2025 Lecture series (pilot phase) – Topics



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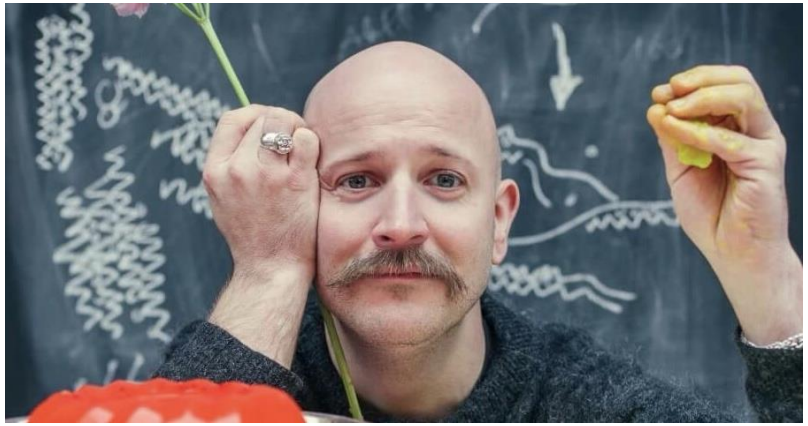
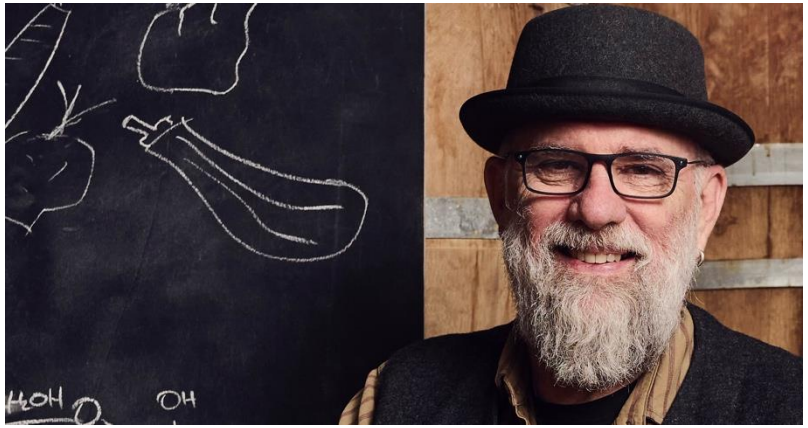
2024-2025 Lecture series (pilot phase) – Our chefs





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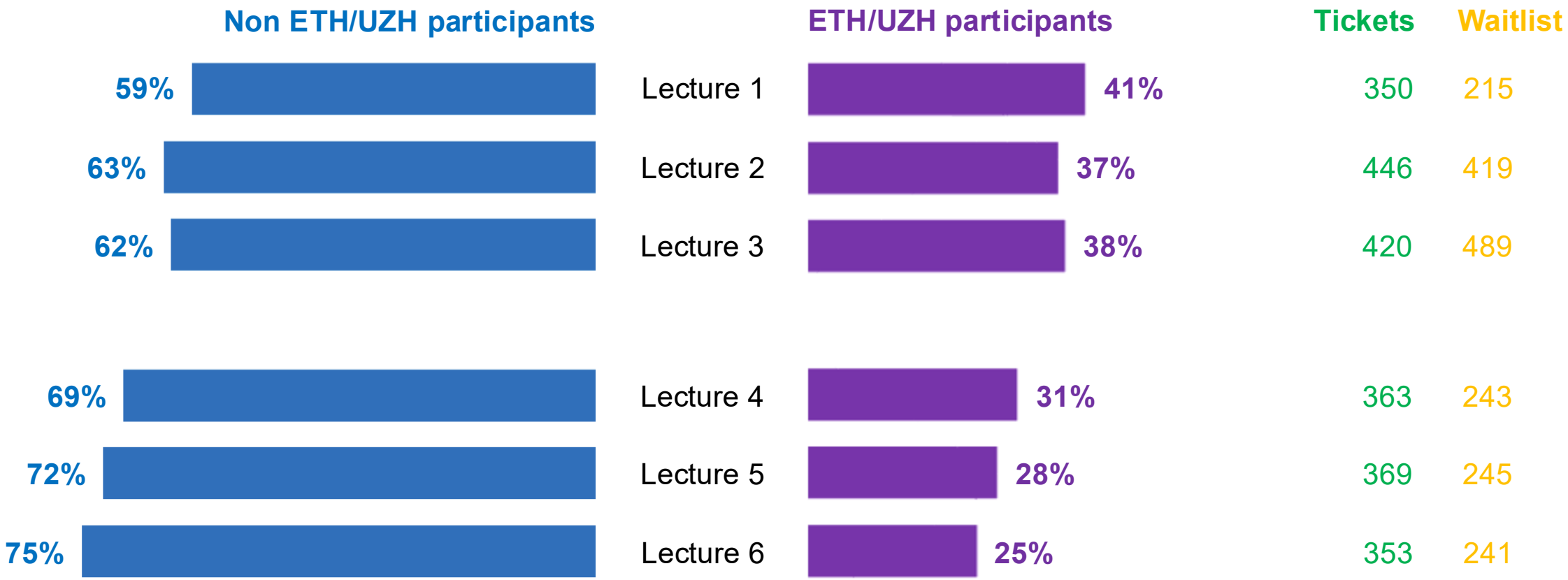
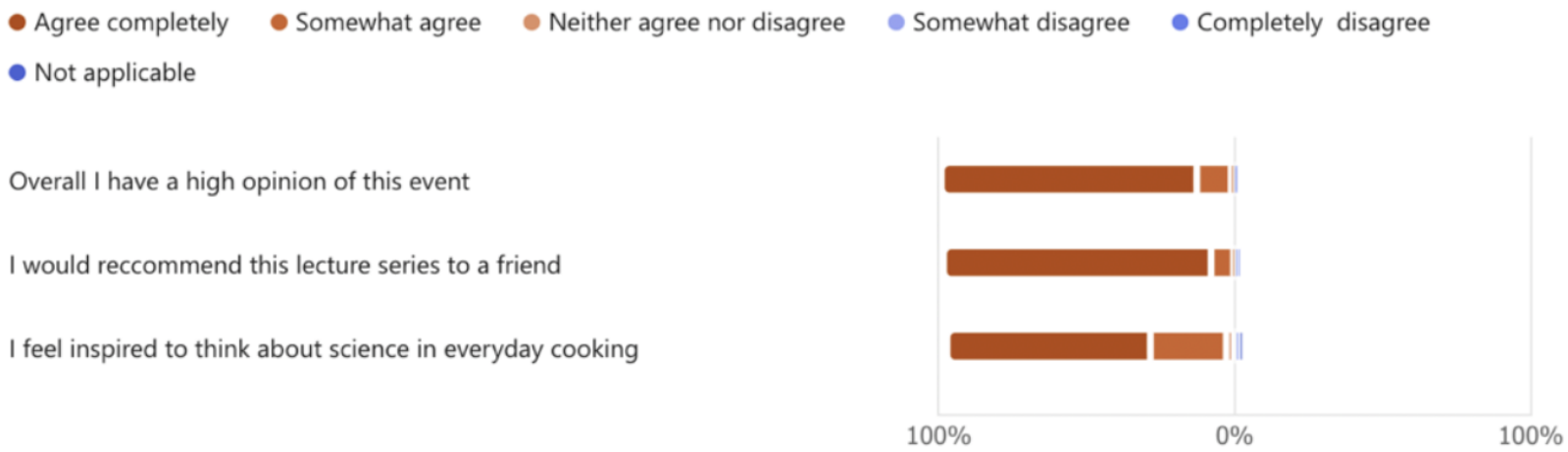
2024-2025 Lecture series (pilot phase) – Participant distribution



2024-2025 Lecture series (pilot phase) – Feedback surveys

- Participants rated the events as highly favorable (86%) or favorable (12%).
- Most participants would recommend the event to others completely (90%) or somewhat (8%).
- A majority of participants agreed they felt inspired to think about science in everyday cooking (69%) or somewhat inspired (26%).



249 responses

Chef experience (Elif Oskan, Gül Restaoran, Zurich)

Entertain without loosing scientific rigor

Audience participation –Tastings

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Audience participation – Invitation to experiment at home

Take-away recipes

Mushroom Ragout with Braised Onions and Einkorn Fillini Pasta (Rebecca Clopath)

Porcini cream

Quantity	Unit	Ingredients	Preparation
1	kg	Fresh porcini mushrooms	Diced
200	g	Rapeseed oil	
20	g	Salt	
450	g	Heavy cream	
100	g	Light, mild miso	
50	g	Birnel (pear syrup)	
		Water	(to adjust consistency)

Instructions:

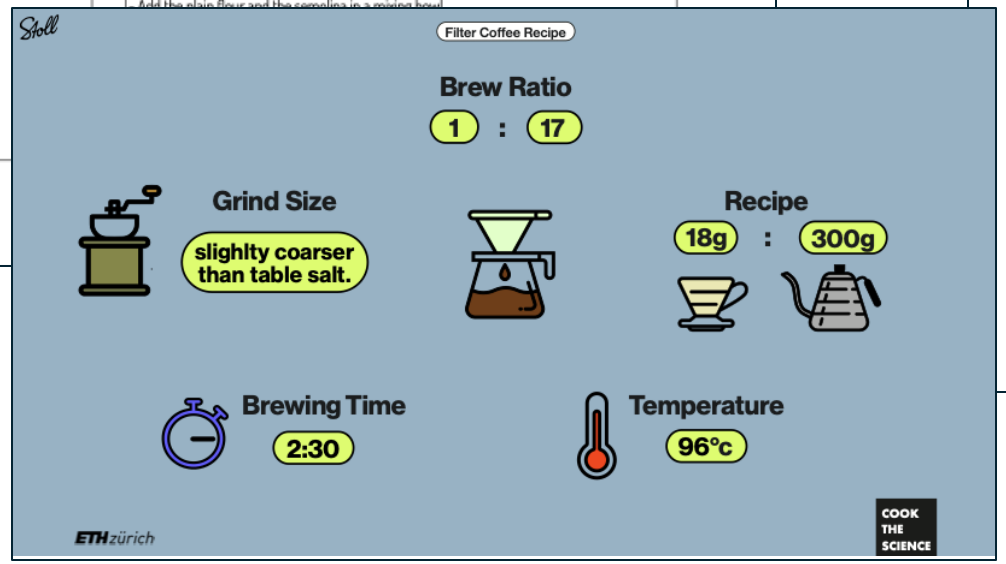
- Sauté the mushrooms in hot oil.
- Add salt.
- Deglase with the heavy cream and bring to boil.
- Add miso and lightly heat.
- Stir in the Birnel.
- Puree the mixture into a fine cream using a blender.
- Add water if needed for a smooth consistency.
- Season with salt or miso to taste.

Optionally, add some spice for heat.

Einkorn fillini pasta

Quantity	Unit	Ingredients	Preparation
500	g	Plain flour	
500	g	Einkorn semolina	
240	g	Eggs (whole)	
240	g	Egg yolks	
50	g	Oil	
50	g	Hot water	

Instructions:
For the dough:
- It's best to knead the dough using a dough hook.
- Add the plain flour and the semolina in a mixing bowl



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JOHN BAKER for OUR DAILY BREAD

Tangzhong

100 g	Flour	14.3%
300 g	Water	42.9%
300 g	Milk	42.9%

Add flour and water to a pan **stir until smooth**.

Heat while stirring and simmer until a thick, **pudding-like** mixture forms.

Let the pre-dough **cool** and cover it, then refrigerate for about **3 hours**.

Milk bread dough

500 g	Flour	47.2%
200 g	Milk	18.9%
40 g	Eggs	3.8%
50 g	Sugar	4.7%
20 g	Yeast	1.9%
200 g	Tangzhong	18.9%
40 g	Butter	3.8%
10 g	Salt	0.9%

Mix everything (*save 40g milk for later) together and mix it in first gear for 8 min then **knead** it for approx. 3 min (*add rest of milk)
Best dough-temperature: 22°C

Let dough **rest** for 30min to relax

Divide in 100g & make boules

Proof 60-90min in a warm surrounding (covered) and glaze it with eggwash
Bake at 190°C for 12min with humidity

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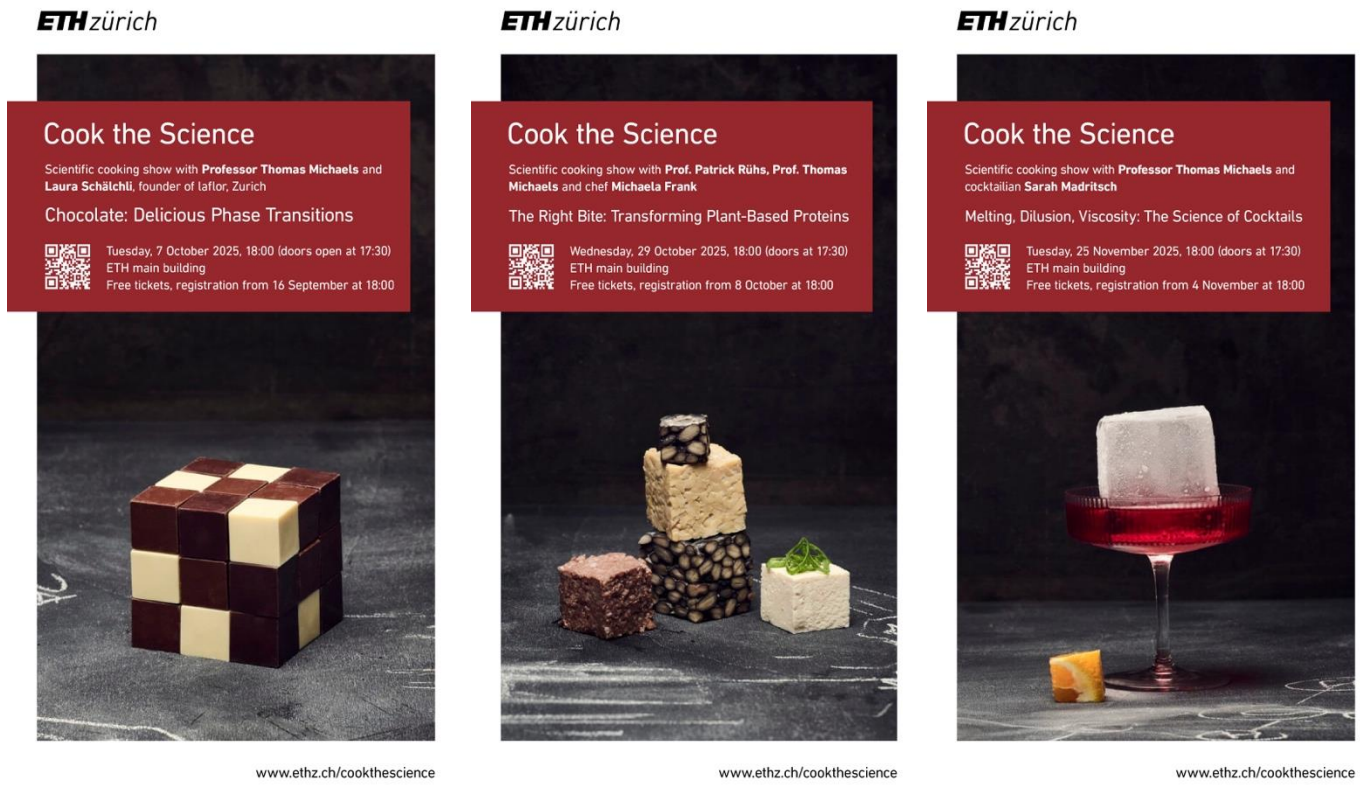
Audience participation – Topic suggestions

Top topic suggestions



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Collaborations with other initiatives

TREFFPUNKT SCIENCE CITY

World Food System Center

With Garcoa Chocolate

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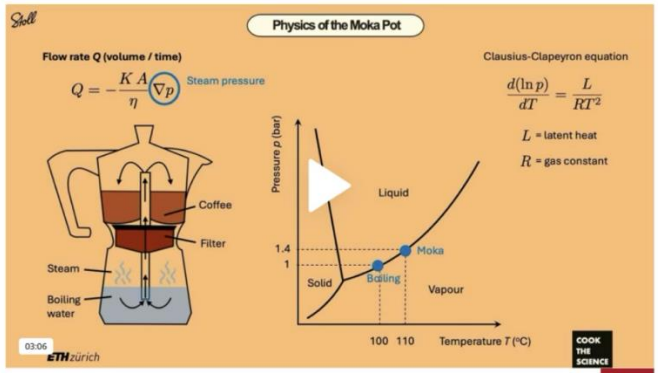
”Cook the Science” in the media



L'espresso del Politecnico
Telegiornale 26.03.2025, 20:00
RSI

Schweiz am Wochenende

Neue Zürcher Zeitung

coop zeitung

Tages-Anzeiger

SCHWEIZER ILLUSTRIERTE

LA PULCE IN CUCINA

Trasferimento del Calore

Con Thomas Michaels, professore di biofisica e fisica della materia soffice vivente

26.10.2024 • 25 min • Elena Caresani e Maria Pia Belloni • iStock

LA PULCE IN CUCINA

La fisica del panettone

Con Thomas Michaels, professore di biofisica e fisica della materia soffice vivente

21.12.2024 • 25 min • Elena Caresani e Sarah Tognola • Ti-Press / Gabriele Putzu

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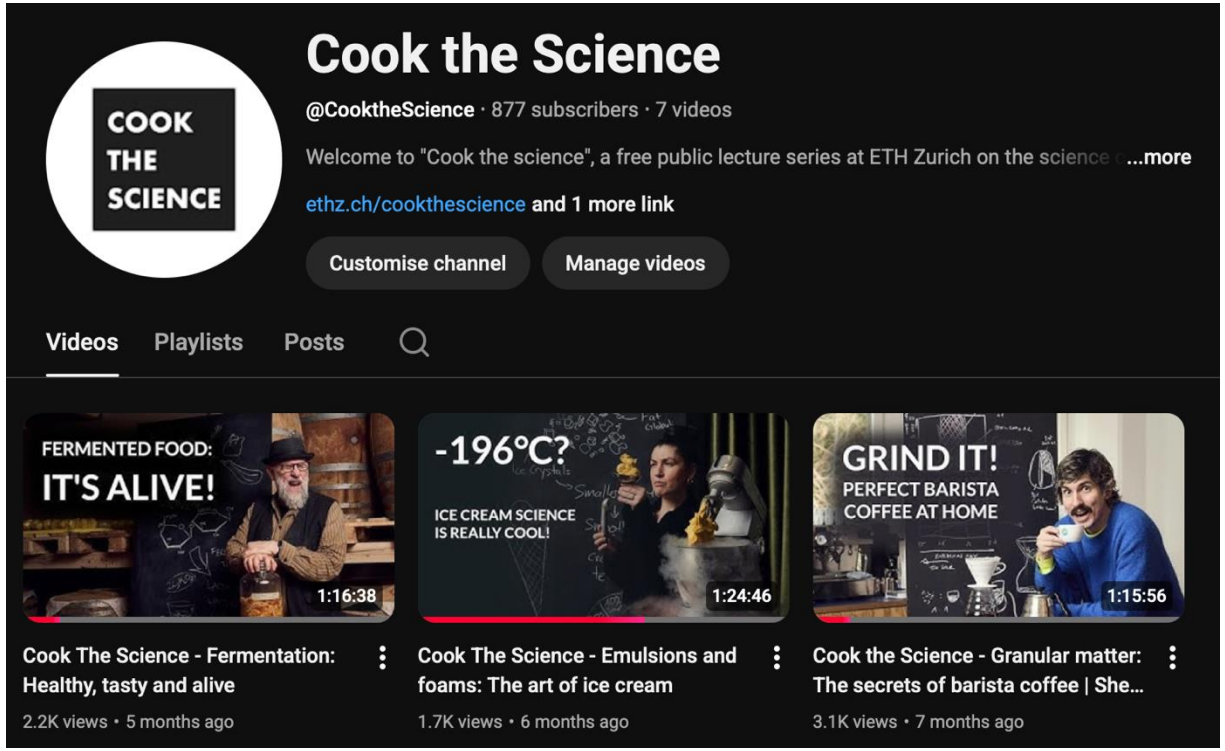
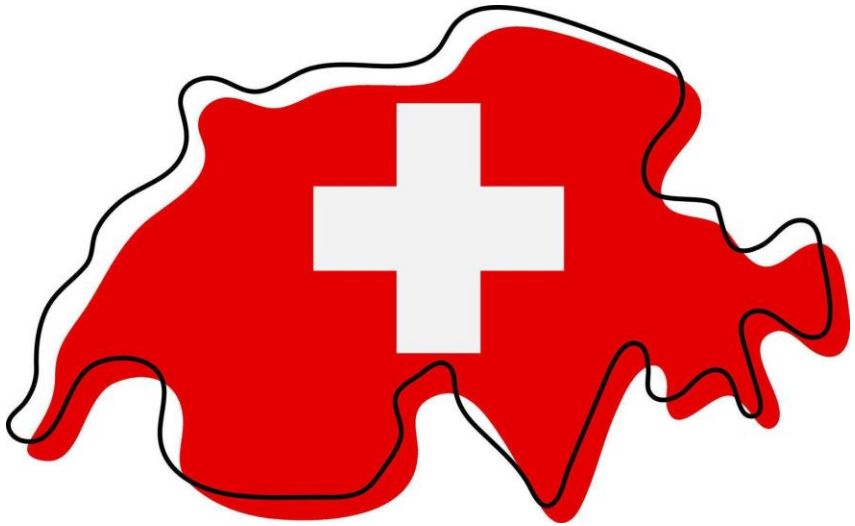
Social media channels



Next phases in “Cook the Science” project

- Take “Cook the Science” to other regions of Switzerland through collaborations with local chefs and educational institutions
- Events in national languages



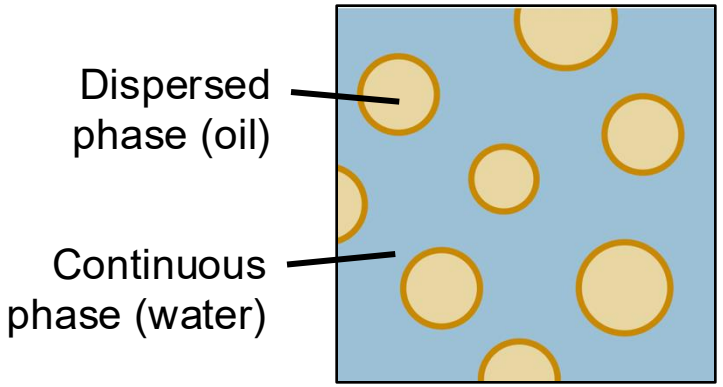
- School outreach: Offer events for school classes

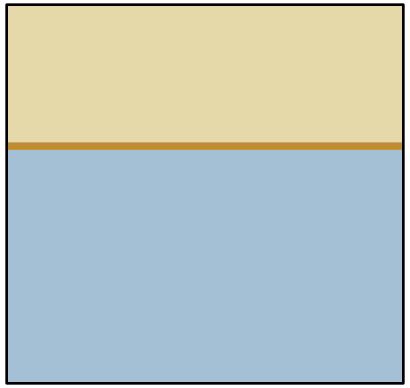
School outreach

Love "Cook the Science"? We are currently working to bring "Cook the Science" to primary and secondary schools. For information please contact us at cook-the-science@ethz.ch.

Stability of emulsions

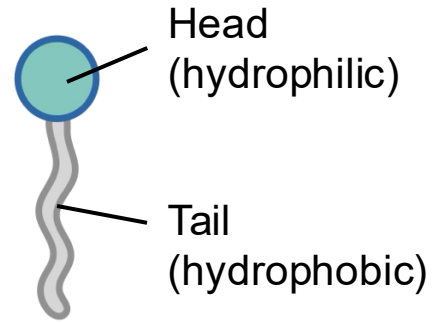
Emulsions are unstable

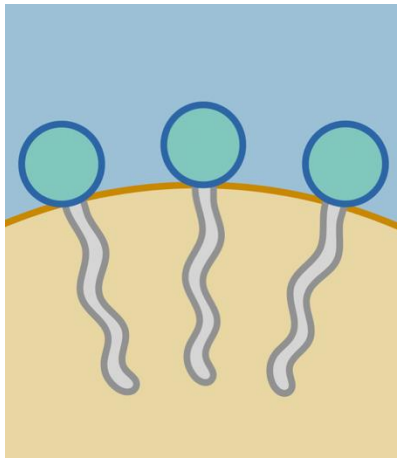




- Creaming
- Coalescence
- Ostwald ripening

Emulsifiers





Viscosity of emulsions

Newton's law of viscosity

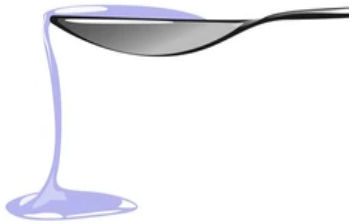
$$\sigma = \eta \dot{\epsilon}$$

σ = stress

$\dot{\epsilon}$ = strain rate

η = viscosity (resistance to flow)

Low viscosity
(e.g. water)



High viscosity
(e.g. honey)

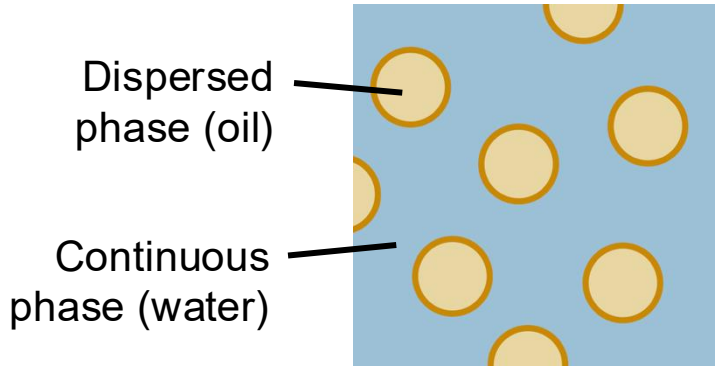
Viscosity η of dilute emulsion (**Taylor equation**)

$$\eta = \eta_c \left(1 + \frac{2 + 5\lambda}{2 + 2\lambda} \varphi\right)$$

η_c = viscosity of continuous phase

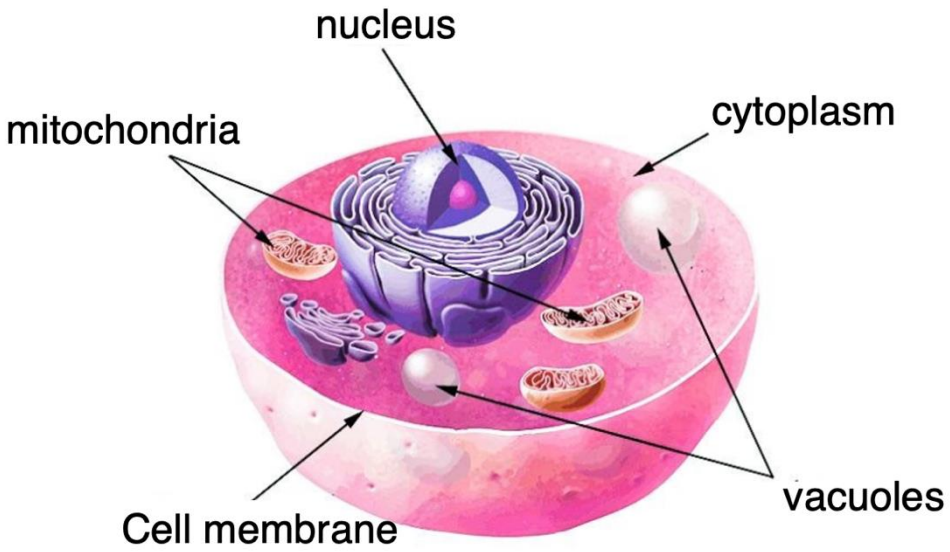
φ = volume fraction of dispersed phase

$$\lambda = \frac{\text{viscosity of dispersed phase}}{\text{viscosity of continuous phase}}$$

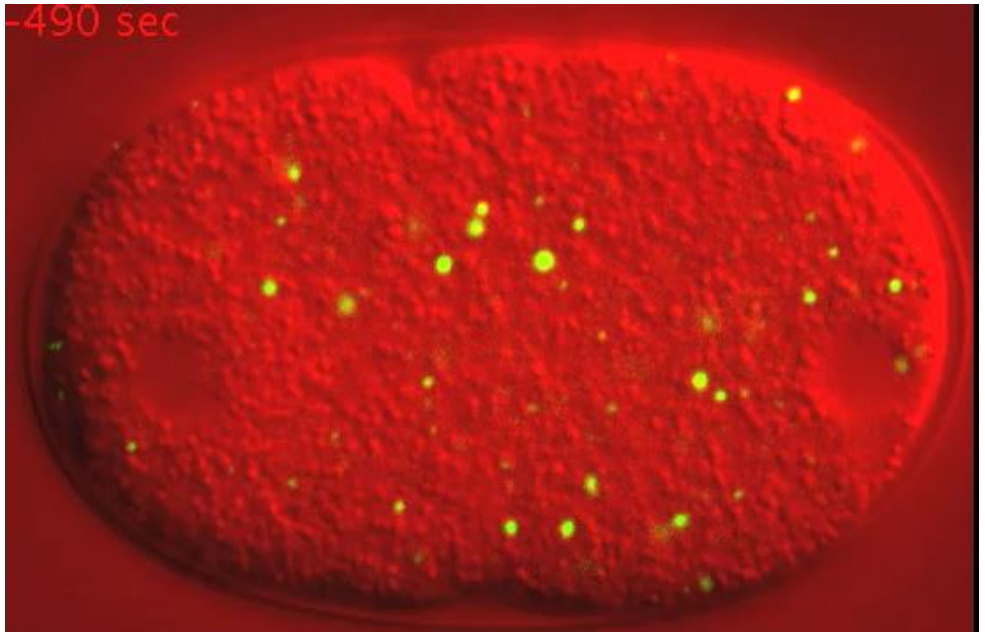


The cytoplasm of cells is an emulsion

Conventional *organelles*
Membrane-bound – vesicle-like



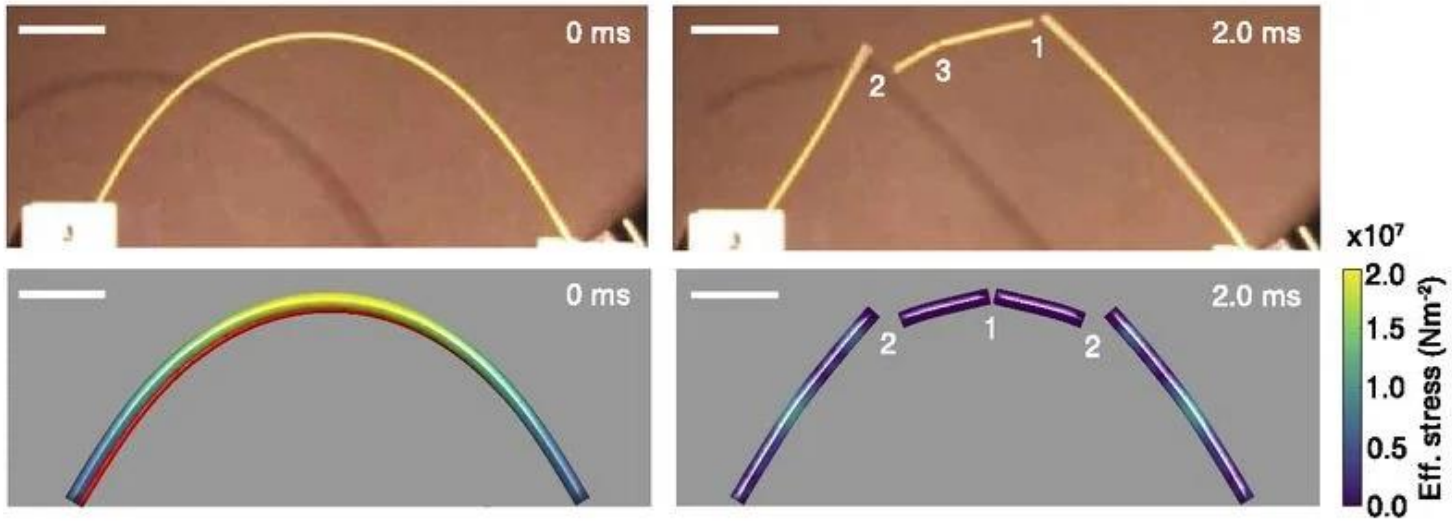
New type *of organelles*
Membrane-less – liquid-like



Brangwynne et al., Science (2009).

Breaking spaghetti

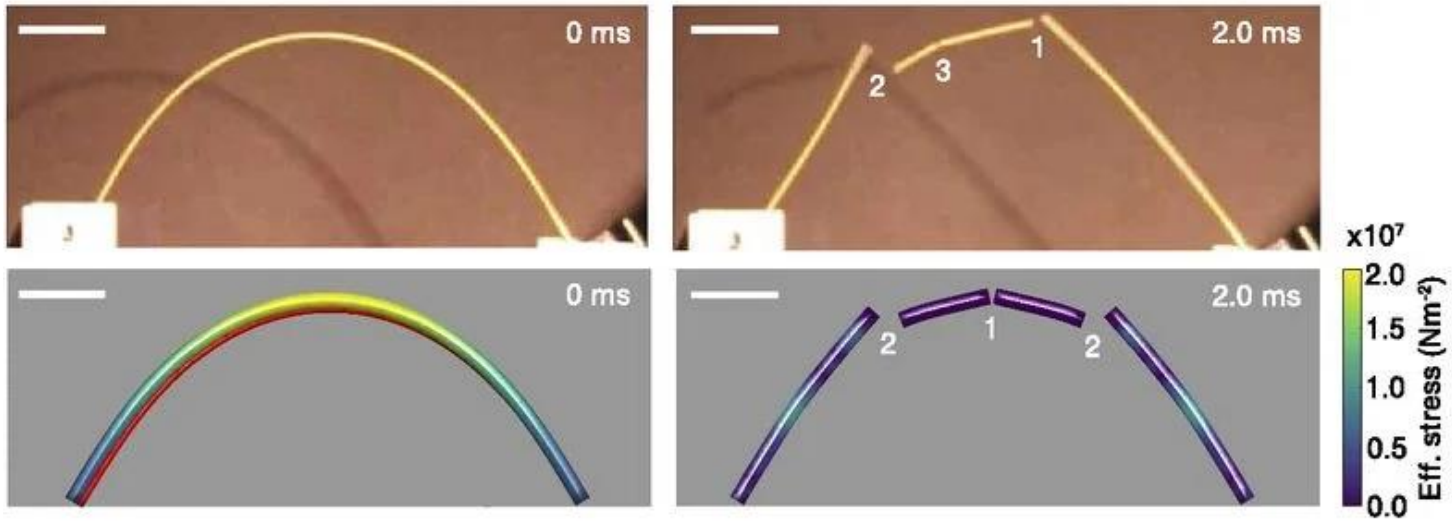
Normal spaghetti



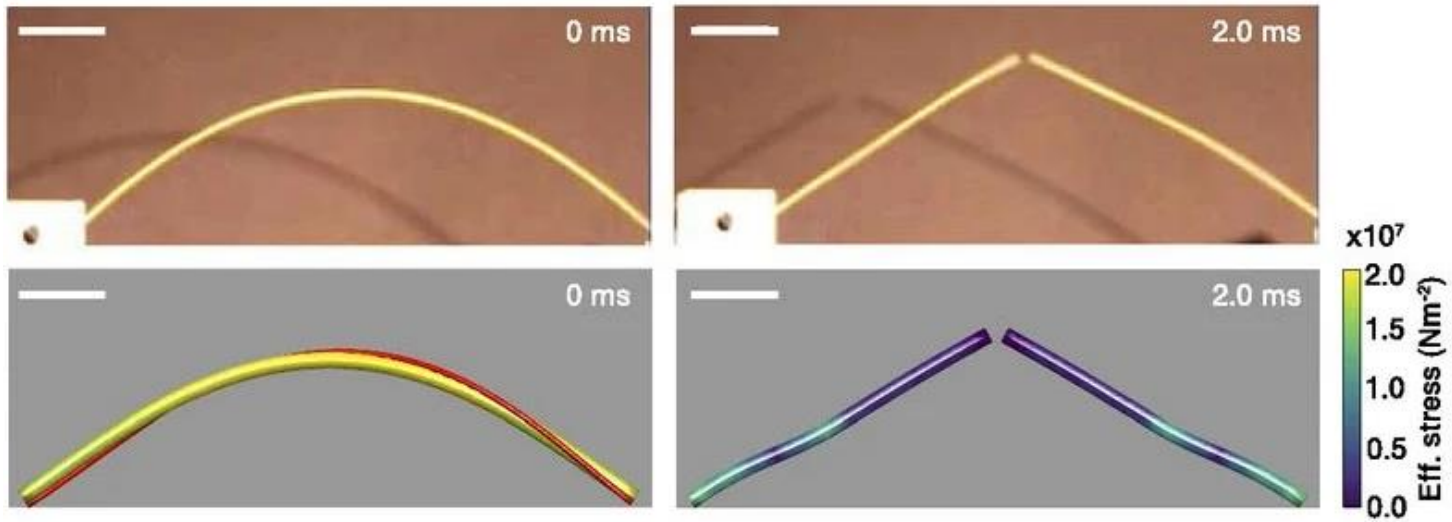
Heisser et al., PNAS (2018)

Breaking spaghetti

Normal spaghetti



Twisted spaghetti



Heisser et al., PNAS (2018)

History of cappuccino and latte art

With Shem Leupin (Stoll Kaffee)

1660

Johannes Nieuhoff (1660)

The Fort by the Port at Tientsin, China (1665)

1901

The first steam wand included on an espresso machine was in 1901, when Luigi Bezzera developed one for his prototype machine.

1992

Piero Merlo invents the Tulip, first latte Art, „Cappucini Decorati“

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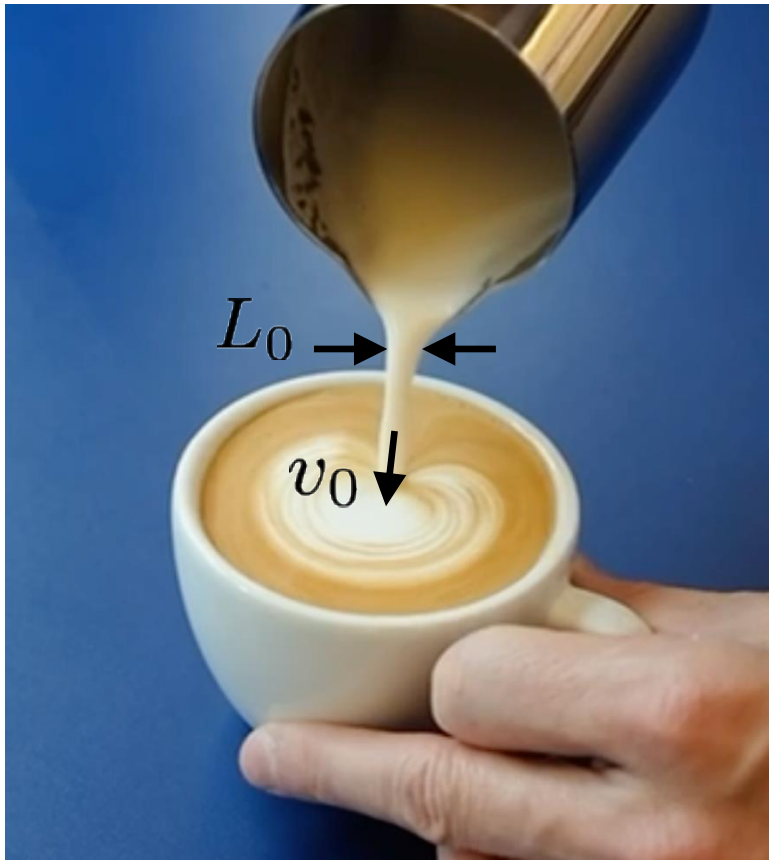
The physics of latte art

Variables

- velocity of pouring (v_0)
- width of the milk jet (L_0)



Froude number

$$\mathrm{Fr} = \frac{\text{Inertial forces}}{\text{Gravitational forces}} = \frac{v_0}{\sqrt{(\rho_c - \rho_i) g L_0 / \rho_i}}$$

ρ_c = density of coffee

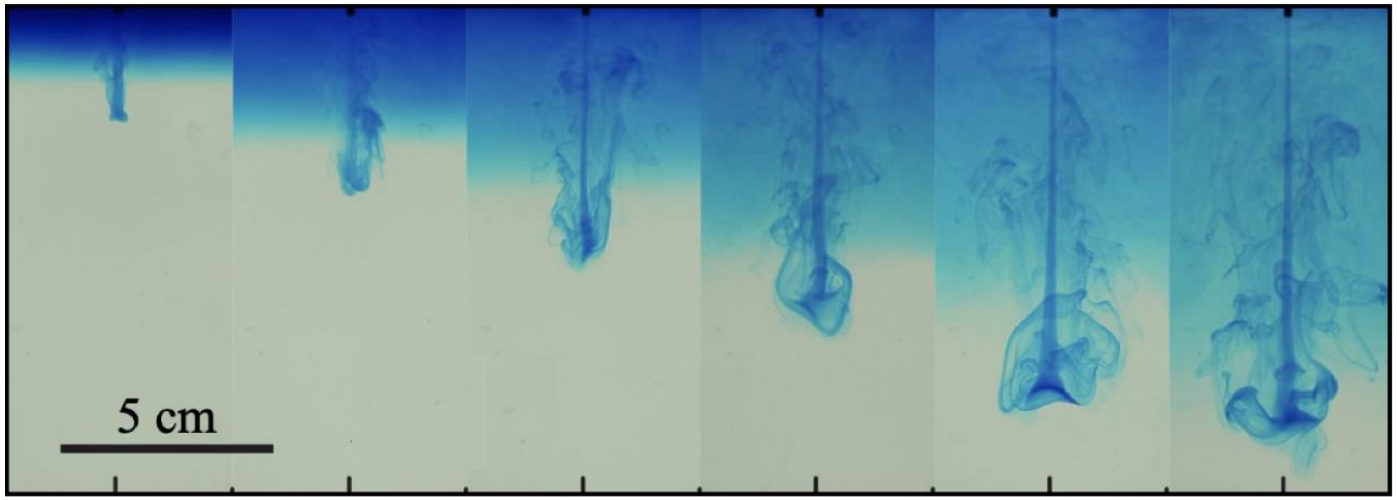
ρ_i = density of injected liquid

g = gravitational acceleration

The "rule"

Small *Fr* $\Rightarrow$ white foam

Large *Fr* $\Rightarrow$ brown foam



Increasing *Fr* number $\rightarrow$

Xue et al., Phys Rev Fluids (2019)

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The physics of latte art

THANK YOU FOR YOUR ATTENTION!

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D BIOL

Bringing Materials to Life | BML

World Food System Center

the cogito foundation

Swiss National Science Foundation