

COOK THE SCIENCE

Thomas Michaels



COOK
THE
SCIENCE

ET

“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)



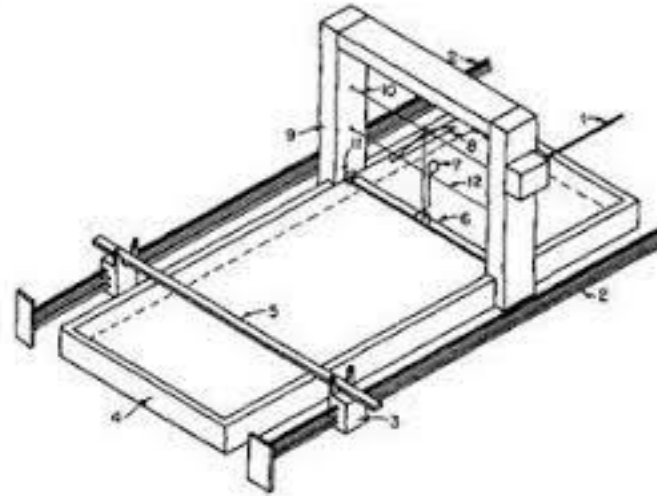
Equitable
(support minorities in STEM)

Agnes Pockels – An inspiring story



Agnes Pockels
(1862-1935)

Pockels' trough



“My Lord,

Will you excuse my venturing to trouble you ...

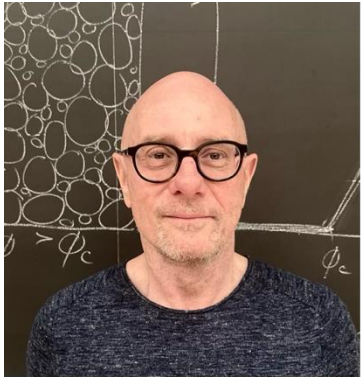
... I thought I ought not to withhold from you these facts which I have observed, although I am not a professional physicist; and again begging you to excuse my boldness, I remain with sincere respect,

*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



Dr. Alicia Smith

ETH Lecturer
Institute of Biochemistry
Science & Education outreach



Remo Gisi

Co-Founder, ETH Spinoff Tastelab
Computer Scientist
Communicator and Storyteller



Susanne Tobler

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

2024-2025 Lecture series (pilot phase) – Topics

ETH zürich

Cook the Science

Science & cooking show with Professor Thomas Michaels and Rebecca Clopath, Alpine chef at Biohof Taratsch

Heat Transfer: Charring, browning and flavour

Tuesday, 22 October 2024, 6 p.m.

ETH main building

Free tickets, registration required



www.ethz.ch/cookthescience

ETH zürich

Cook the Science

Science & cooking show with Professor Thomas Michaels and Jens Jung, owner of John Baker and Jung bakeries, Zurich

Elasticity: The wonder of bread making

Tuesday, 12 November 2024, 6 p.m.

ETH main building

Free tickets, registration required



www.ethz.ch/cookthescience

ETH zürich

Cook the Science

Science & cooking show with Professor Thomas Michaels and Markus Stöckle, Restaurant Rosi, Zurich

Gelation: Wobbly physics on your plate

Tuesday, 3 December 2024, 6 p.m.

ETH main building

Free tickets, registration required



www.ethz.ch/cookthescience

ETH zürich

Cook the Science

Scientific cooking show with Professor Thomas Michaels and Shem Leupin, roaster at Stoll Kaffee, Zurich

Granular matter: The secrets of barista coffee

Tuesday, 18 March 2025, 18:00 (doors open at 17:30)

ETH main building

Free tickets, registration from 25 February at 18:00



www.ethz.ch/cookthescience

ETH zürich

Cook the Science

Scientific cooking show with Professor Thomas Michaels and Elif Oskan, founder of Gül Restoran, Zurich

Emulsions and foams: The art of ice cream

Tuesday, 8 April 2025, 18:00 (doors open at 17:30)

ETH main building

Free tickets, registration from 18 March at 18:00



www.ethz.ch/cookthescience

ETH zürich

Cook the Science

Scientific cooking show with Professor Thomas Michaels and Patrick Marxer, founder of Das Pure, Wetzikon

Fermentation: Healthy, tasty & alive

Tuesday, 13 May 2025, 18:00 (doors open at 17:30)

ETH main building

Free tickets, registration from 22 April at 18:00

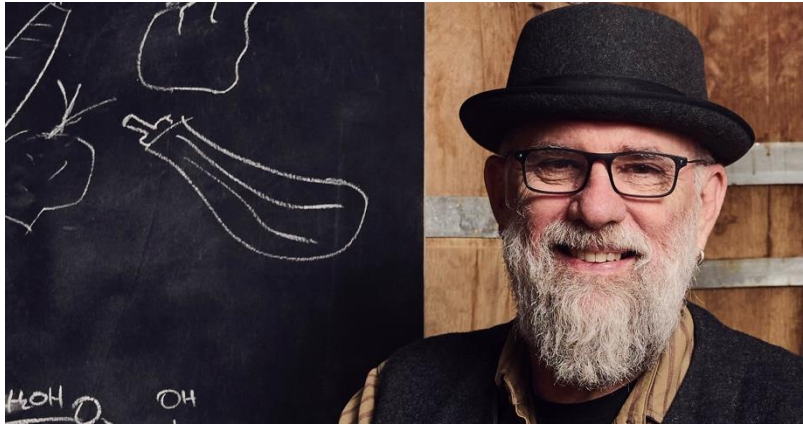


www.ethz.ch/cookthescience

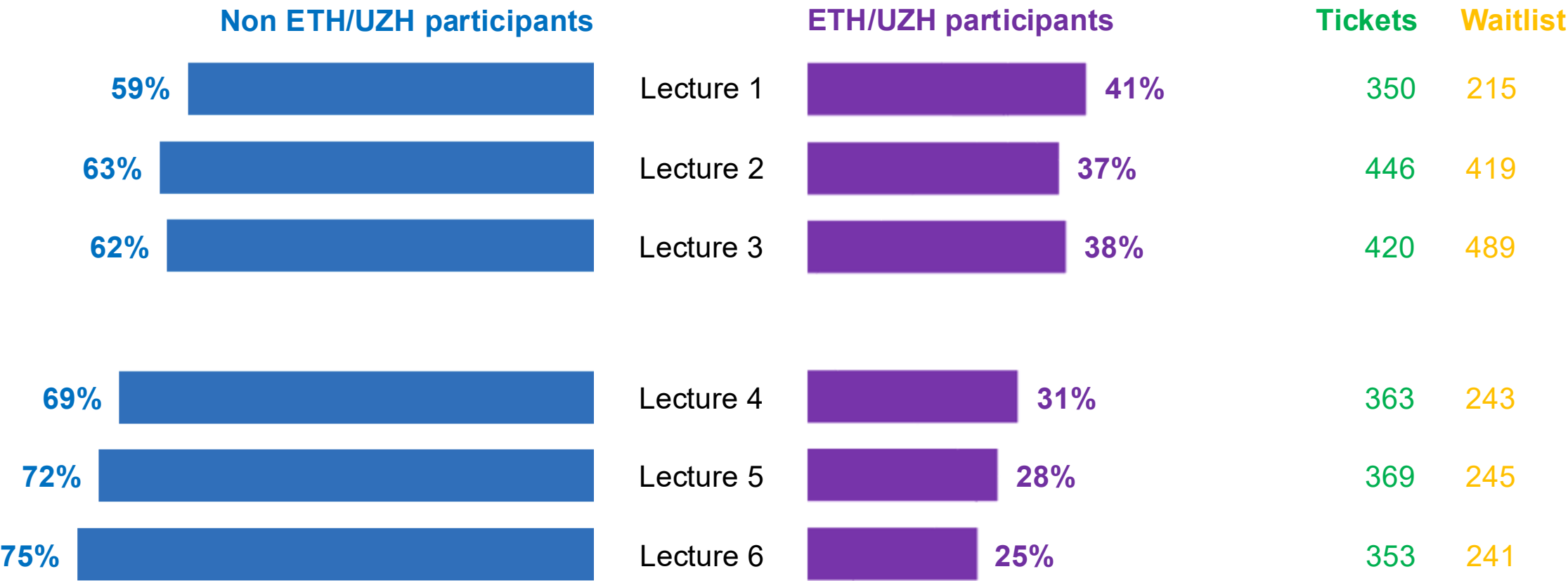
ETH zürich

COOK
THE
SCIENCE

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

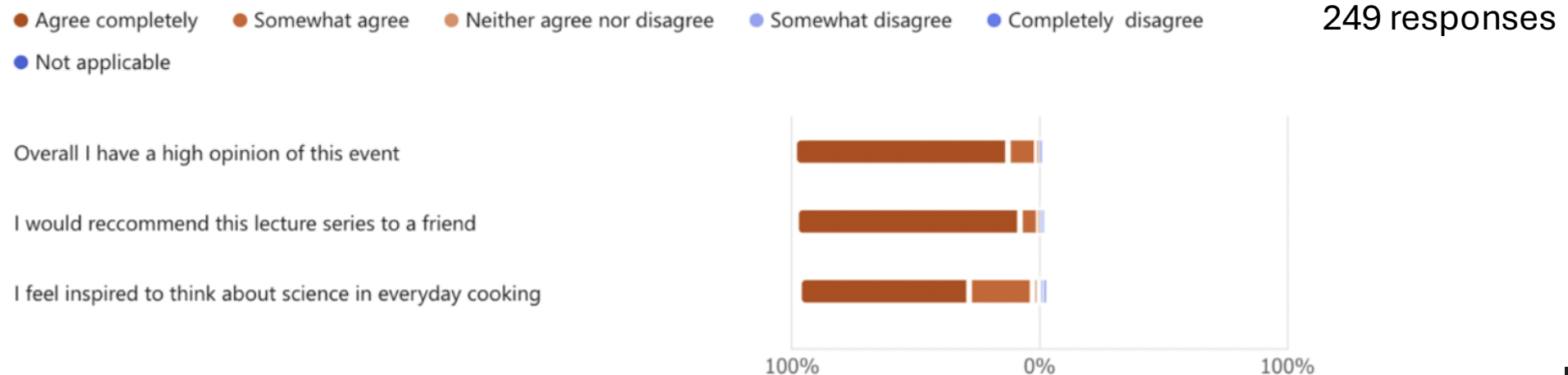


2024-2025 Lecture series (pilot phase) – Participant distribution



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%).



Chef experience (Elif Oskan, Gül Restoraan, Zurich)



Entertain without losing scientific rigor



Audience participation – Tastings



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.
- Deglaze 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 medium bowl.

Filter Coffee Recipe

Brew Ratio
1 : 17

Grind Size
slightly coarser than table salt.

Recipe
18g : 300g

Brewing Time
2:30

Temperature
96°C

COOK THE SCIENCE

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

Audience participation – Topic suggestions

Top topic suggestions



ETH zürich

Cook the Science

Scientific cooking show with **Professor Thomas Michaels** and **Laura Schältchli**, founder of laffor, Zurich

Chocolate: Delicious Phase Transitions

 Tuesday, 7 October 2025, 18:00 (doors open at 17:30)
ETH main building
Free tickets, registration from 16 September at 18:00



www.ethz.ch/cookthescience

ETH zürich

Cook the Science

Scientific cooking show with **Prof. Patrick Rühs**, **Prof. Thomas Michaels** and chef **Michaela Frank**

The Right Bite: Transforming Plant-Based Proteins

 Wednesday, 29 October 2025, 18:00 (doors at 17:30)
ETH main building
Free tickets, registration from 8 October at 18:00



www.ethz.ch/cookthescience

ETH zürich

Cook the Science

Scientific cooking show with **Professor Thomas Michaels** and cocktailian **Sarah Madritsch**

Melting, Dilution, Viscosity: The Science of Cocktails

 Tuesday, 25 November 2025, 18:00 (doors at 17:30)
ETH main building
Free tickets, registration from 4 November at 18:00



www.ethz.ch/cookthescience

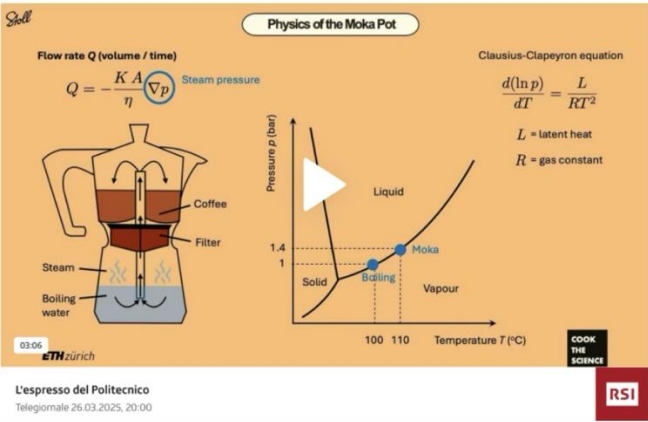
Collaborations with other initiatives



With Garcoa Chocolate



"Cook the Science" in the media



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

Schweiz
am Wochenende

Neue Zürcher Zeitung


coop
zeitung

Tages-Anzeiger

SCHWEIZER
ILLUSTRIERTE



Social media channels



Cook the Science

@CooktheScience · 877 subscribers · 7 videos

Welcome to "Cook the science", a free public lecture series at ETH Zurich on the science of food. [ethz.ch/cookthescience](#) and 1 more link

Customise channel

Manage videos

Videos

Playlists

Posts

FERMENTED FOOD:
IT'S ALIVE!

1:16:38

Cook The Science - Fermentation: Healthy, tasty and alive

2.2K views · 5 months ago

-196°C?
ICE CREAM SCIENCE
IS REALLY COOL!

1:24:46

Cook The Science - Emulsions and foams: The art of ice cream

1.7K views · 6 months ago

GRIND IT!
PERFECT BARISTA
COFFEE AT HOME

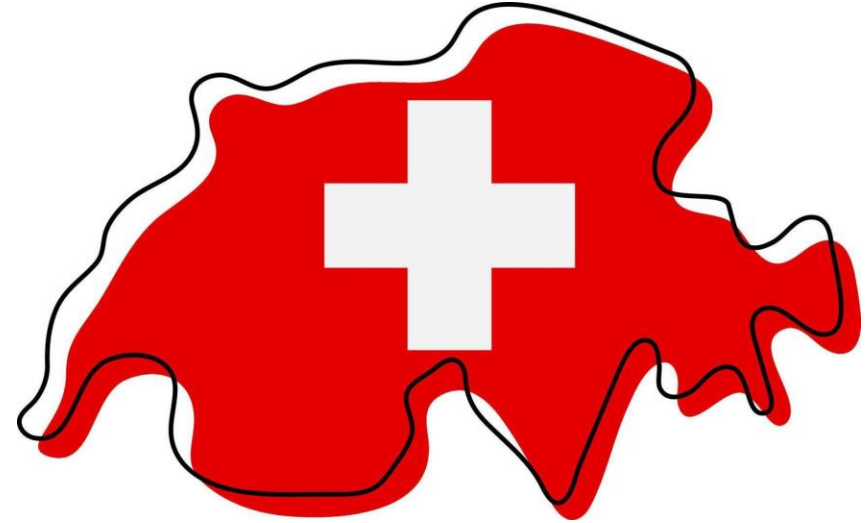
1:15:56

Cook the Science - Granular matter: The secrets of barista coffee | She...

3.1K views · 7 months ago

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

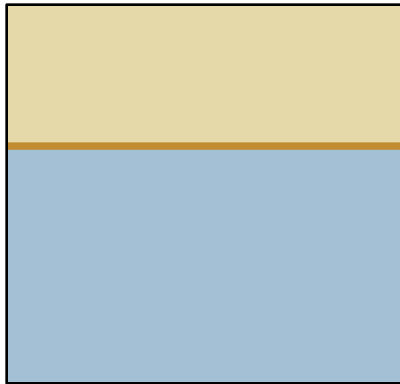
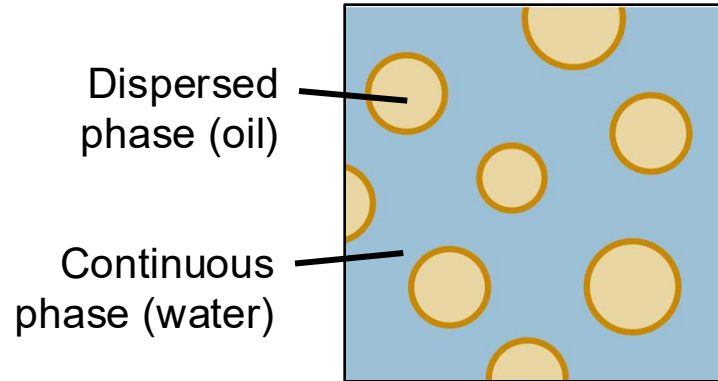


School outreach

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.

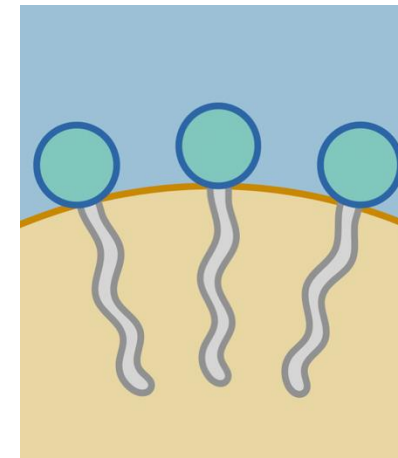
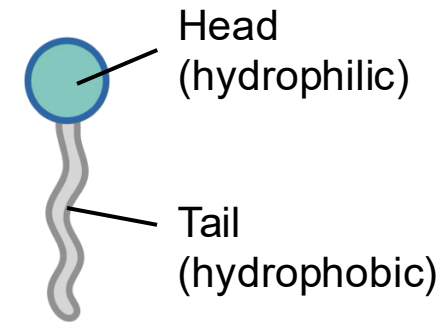
Stability of emulsions

Emulsions are unstable



- Creaming
- Coalescence
- Ostwald ripening

Emulsifiers



Viscosity of emulsions

Newton's law of viscosity

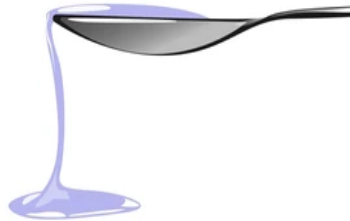
$$\sigma = \eta \dot{\epsilon}$$

σ = stress

$\dot{\epsilon}$ = strain rate

η = viscosity (resistance to flow)

Low viscosity
(e.g. water)



High viscosity
(e.g. honey)



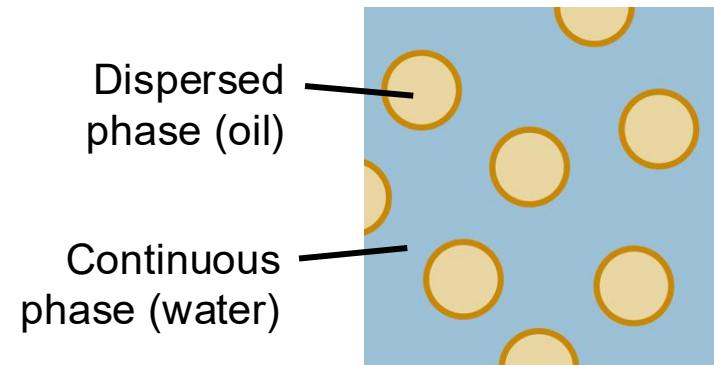
Viscosity η of dilute emulsion (**Taylor equation**)

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

η_c = viscosity of continuous phase

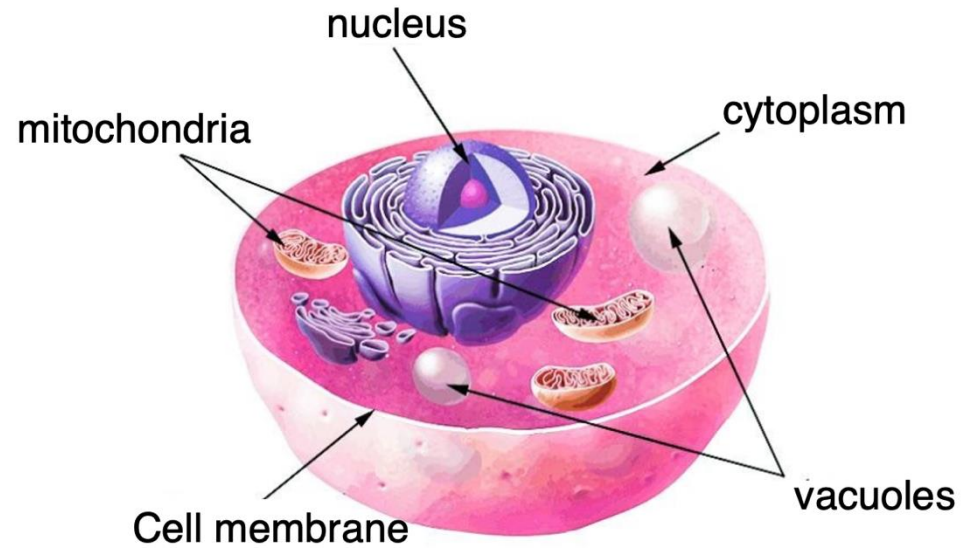
φ = volume fraction of dispersed phase

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

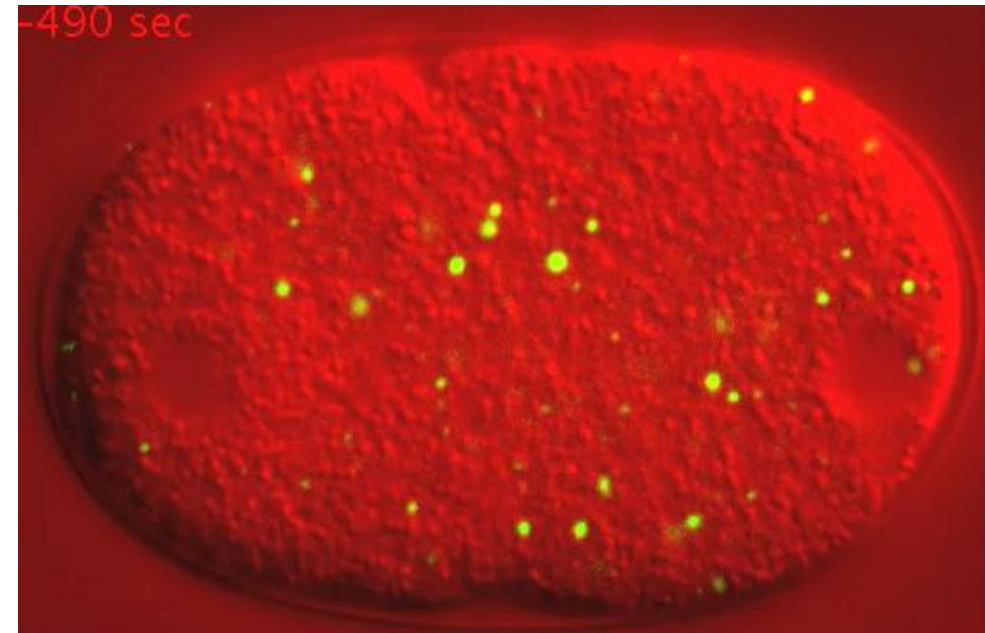


The cytoplasm of cells is an emulsion

Conventional organelles
Membrane-bound – vesicle-like



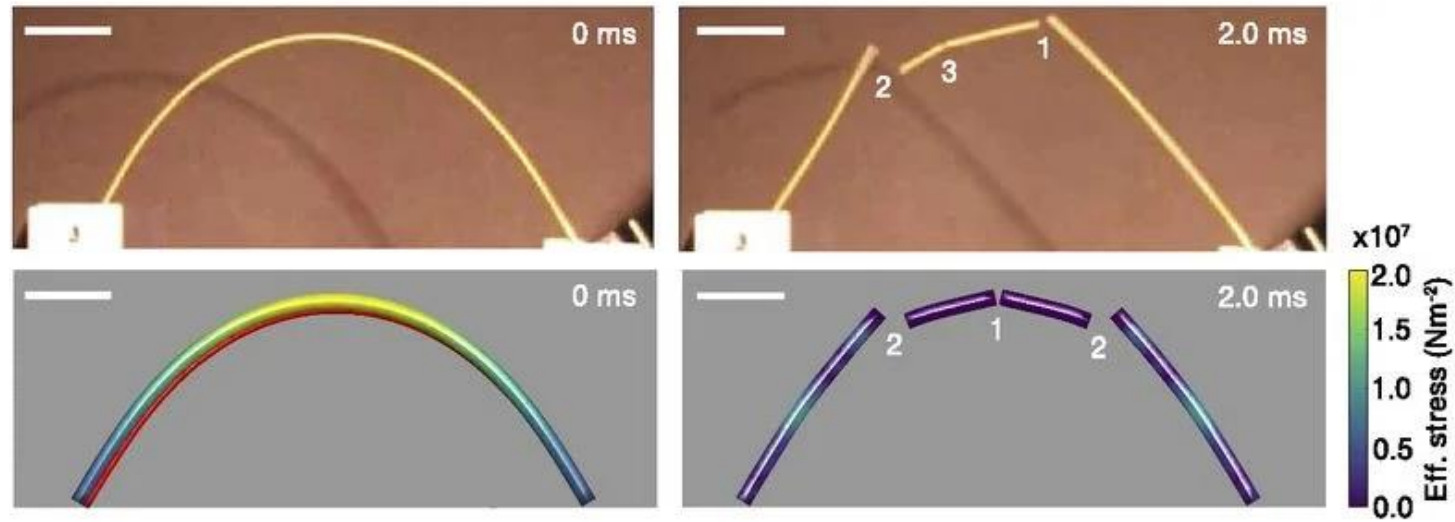
New type of organelles
Membrane-less – liquid-like



Brangwynne et al., Science (2009).

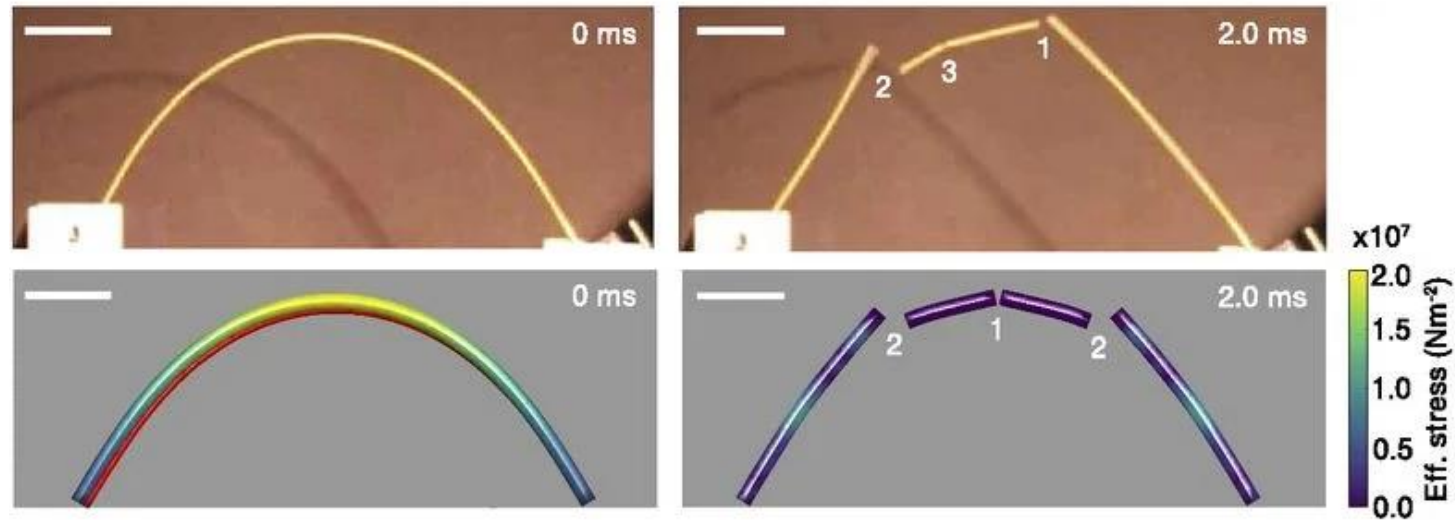
Breaking spaghetti

Normal spaghetti

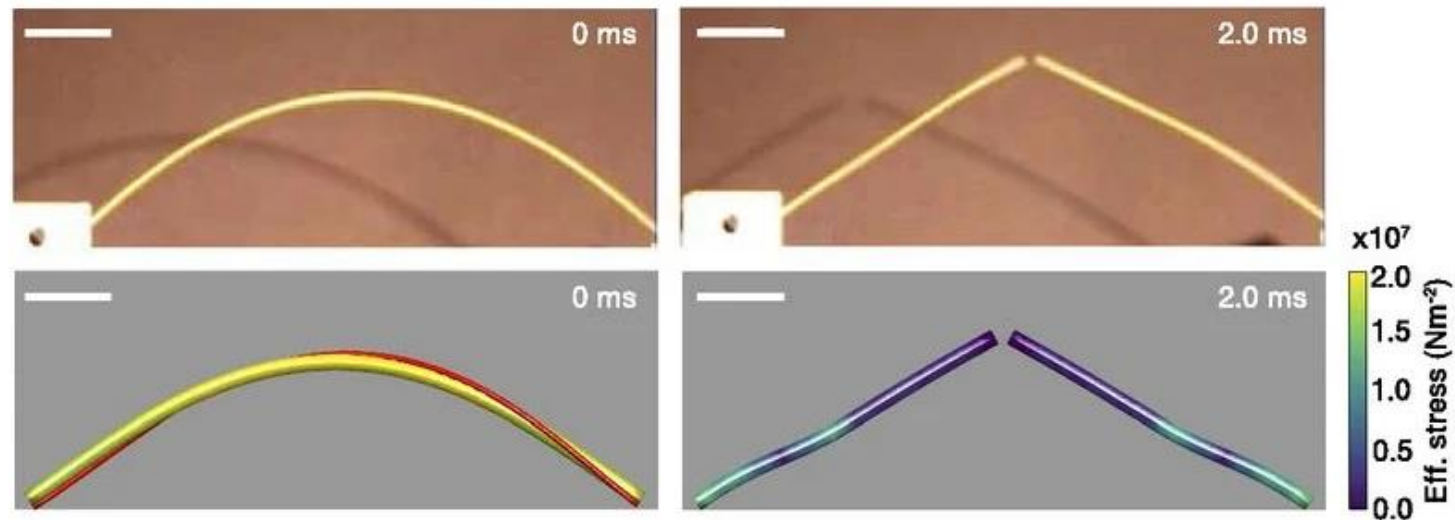


Breaking spaghetti

Normal spaghetti



Twisted spaghetti





History of cappuccino and latte art

With Shem Leupin (Stoll Kaffee)

1660

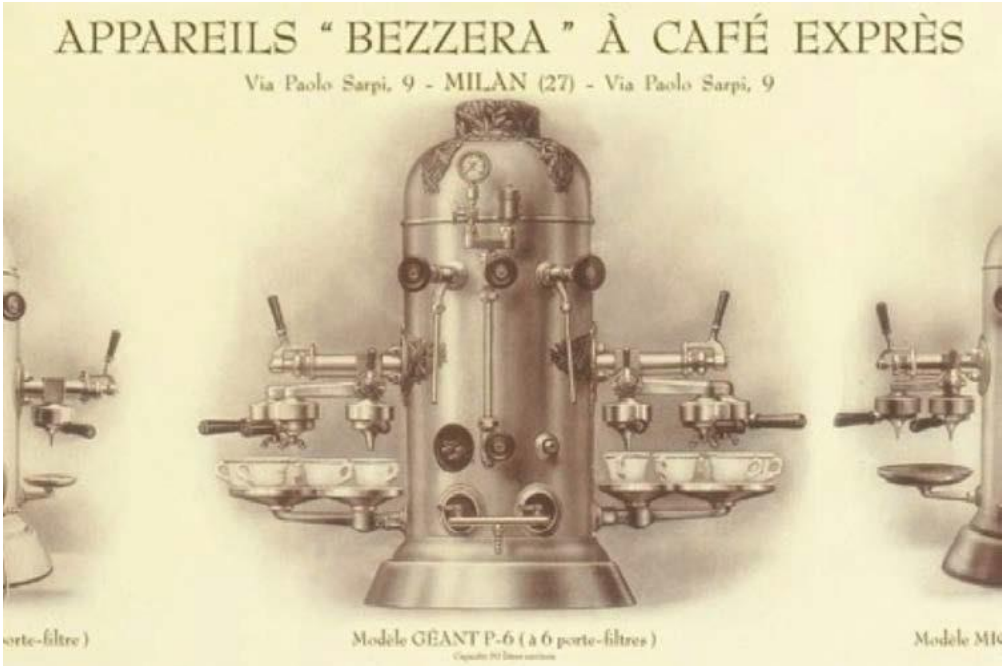


Johannes Nieuhoff (1660)



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

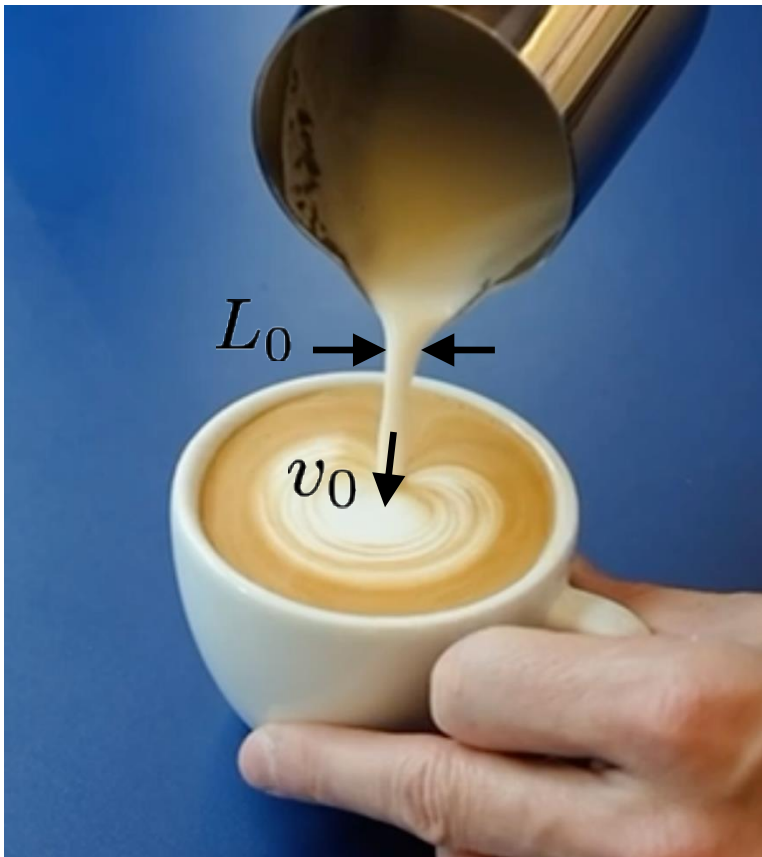


Piero Merlo invents the Tulip, first latte Art, „Cappucini Decorati“

The physics of latte art

Variables

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



Froude number

$$Fr = \frac{\text{Inertial forces}}{\text{Gravitational forces}} = \frac{v_0}{\sqrt{(\rho_c - \rho_i)gL_0/\rho_i}}$$

ρ_c = density of coffee

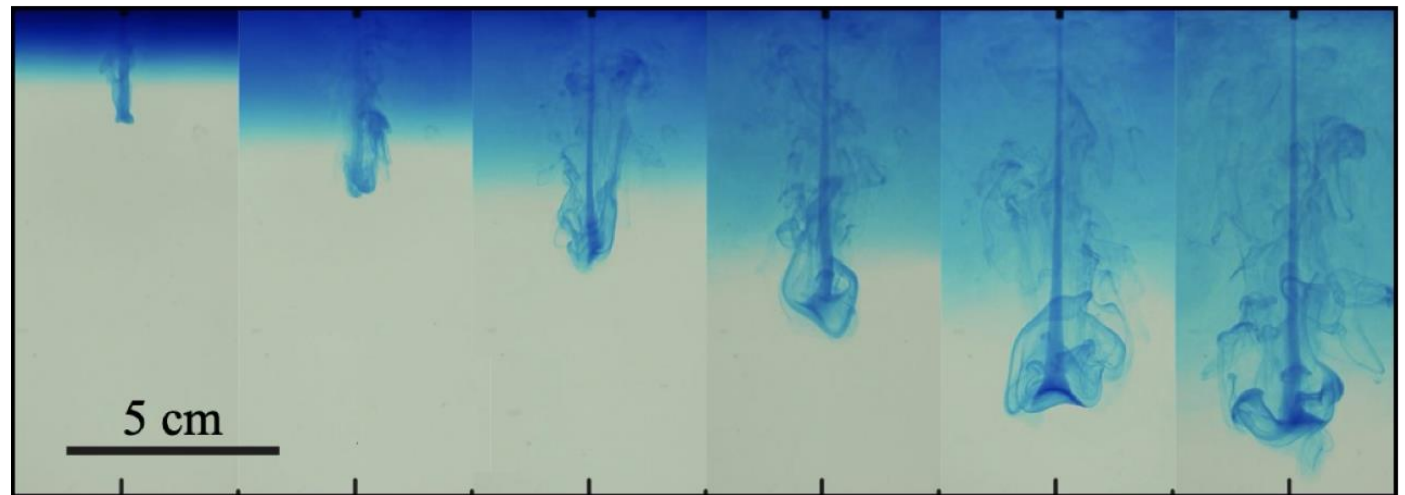
ρ_i = density of injected liquid

g = gravitational acceleration

The “rule”

Small $Fr \Rightarrow$ white foam

Large $Fr \Rightarrow$ brown foam



Increasing Fr number \rightarrow

The physics of latte art



THANK YOU FOR YOUR ATTENTION!

ETH zürich **DBIOL**



the **cogito** foundation



**Swiss National
Science Foundation**

