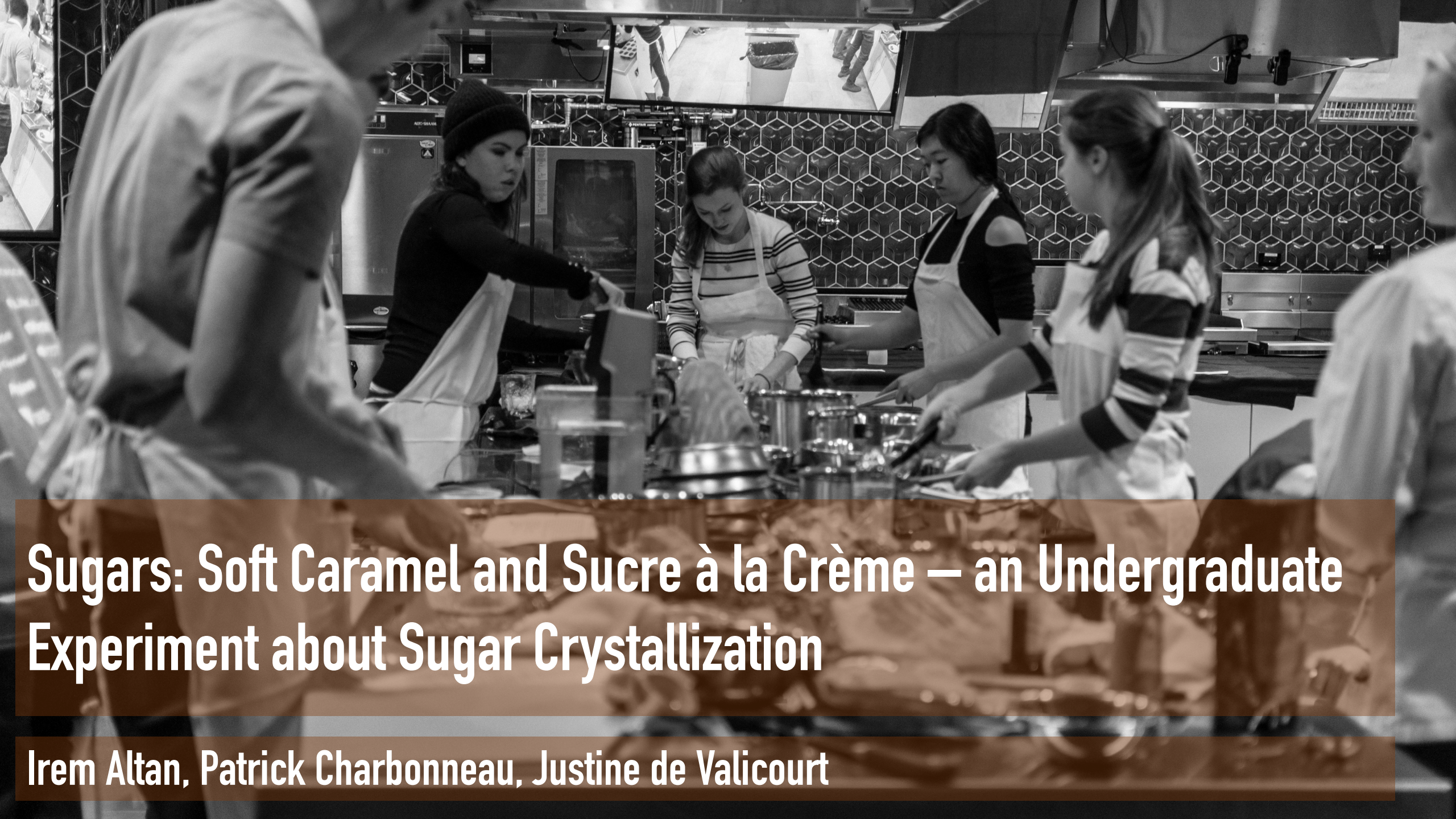


# Sugars: Soft Caramel and Sucre à la Crème – an Undergraduate Experiment about Sugar Crystallization

Irem Altan, Patrick Charbonneau, Justine de Valicourt


# The Chemistry and Physics of Cooking Class at Duke University

- Introduce soft matter science to first-year students
- Explore laboratory tools and technologies
- Demystify cooking and educate taste
- Learn basic nutrition
- Arouse science interest
- Provide unique on-campus experience
- Use as platform for community outreach

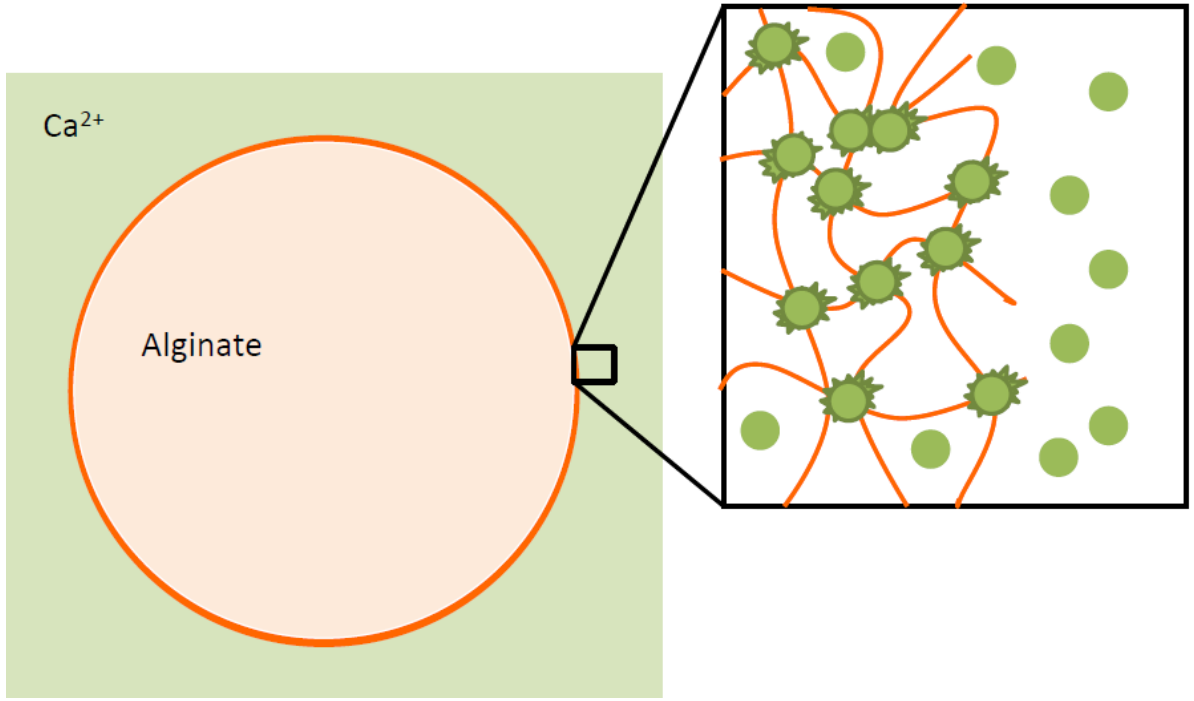
- Covering topics like
  - Elasticity and viscosity
  - Polymers and gelation
  - Diffusion
  - Phase transitions
- Problem sets and quizzes to make sure students understand scientific concepts
- Final exam: students conceptualize and make a dish, using the scientific and cooking concepts they learned about in the class

# Lab: Diffusion

$$T_{food}(t) = T_{ext} - \left(T_{ext} - T_0\right)e^{-t/\tau} \qquad \tau = \frac{1}{\pi}\frac{L^2}{D_{heat}}$$

Heat diffusion

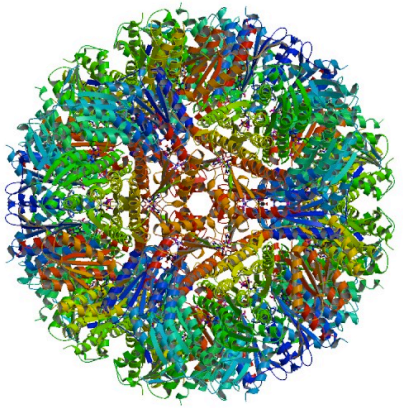
Matter diffusion




**Lab:**

Chocolate lava cake
Basic spherification
Reverse spherification

# Lab: proteins and enzymes



## Key concepts:

introduction to amino acids

properties of amino acids

protein folding and unfolding

catalysis and enzymes

## Lab:

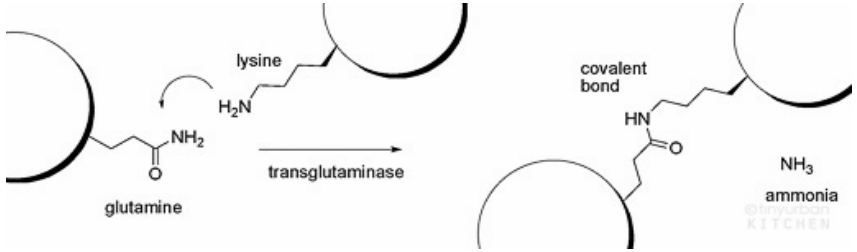
Egg flan

Crème anglaise

Pastry cream

Soufflé

Meat glue




# Lab: Phase transitions

Key concepts:

- phases: solid, liquid, gas
- Temperature, pressure
- Phase diagrams: water, oils, nitrogen
- **Supersaturation, crystallization, and glasses**
- **The effect and importance of mouthfeel**

Soft caramel

VS

Sucre à la crème


# Sucre à la crème history

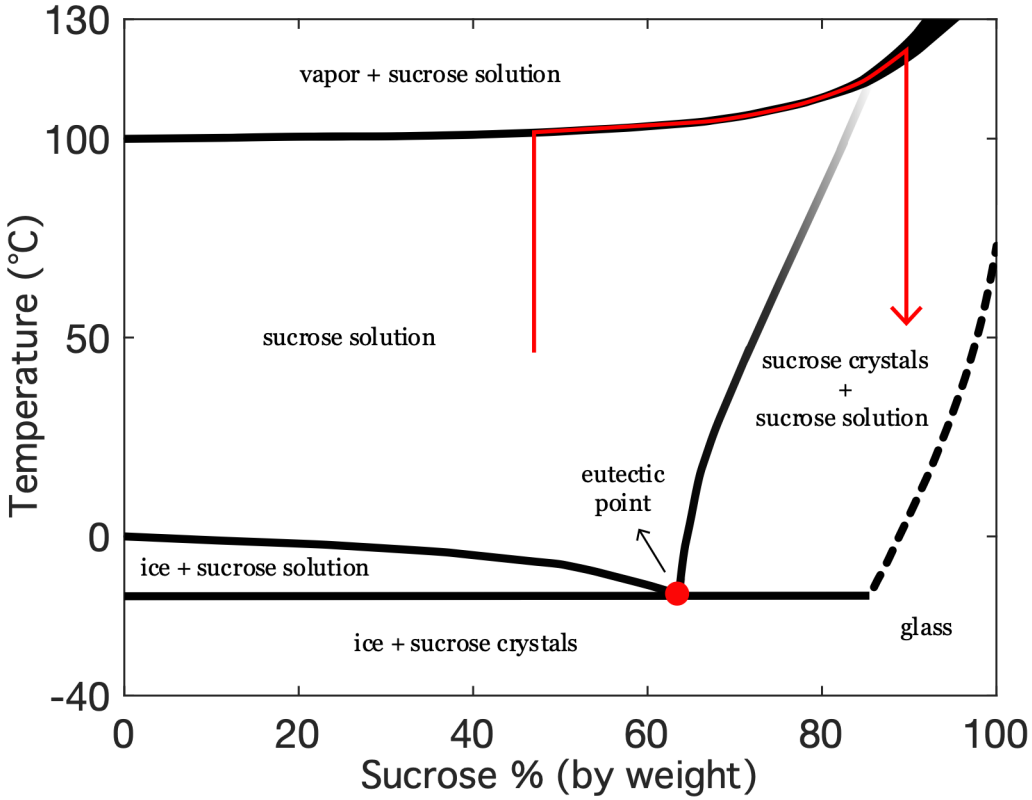
https://en.wikipedia.org/wiki/File:Sugar_Making_in_Canada,_1852._By_Cornelius_Krieghoff_(1815-1872).jpg


Credit: Keely Glass, 2014


Credit: Keely Glass, 2014

Credit: Keely Glass, 2014

Credit: Ashley Yaeger, Duke News, 2013



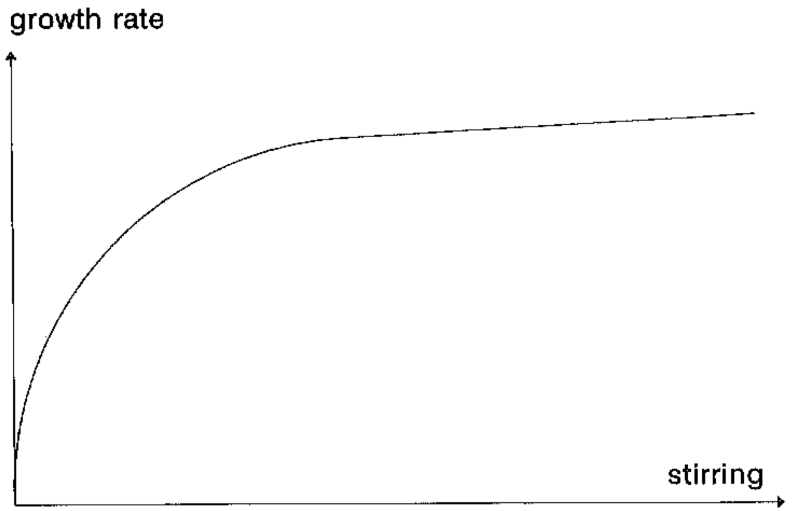




**Figure 3.22** Effect of stirring on crystal growth rate.

Sucrose Properties and Applications (1995)

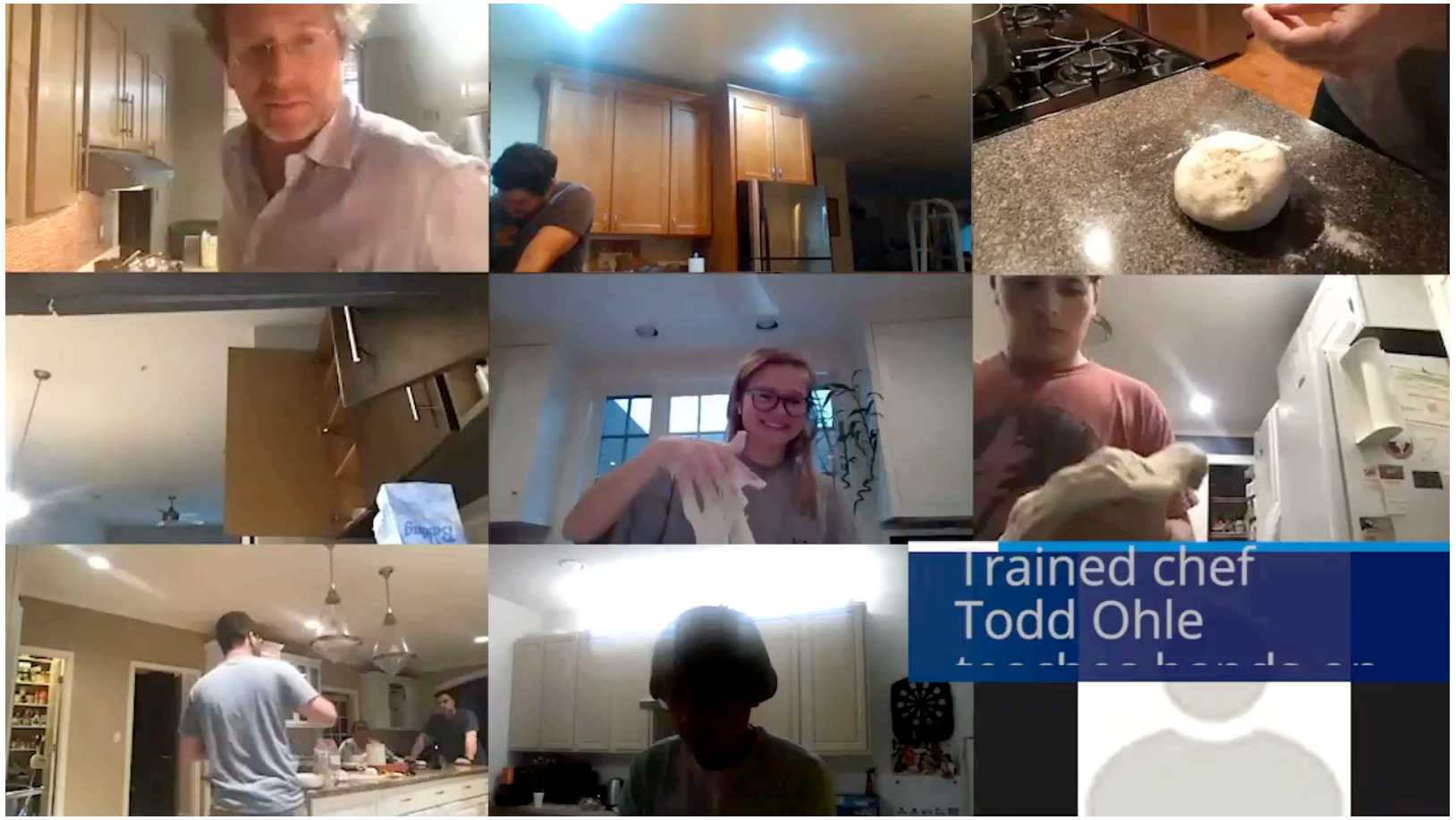







# Outlook and Challenges

- Class is a popular success and has received a fair amount of local press coverage.
- Bridges sciences (physics, chemistry, biology, biochemistry etc.) in a uniquely coherent way.
- There are logistical challenges to overcome.
- Also taught during the pandemic, remotely.




https://today.duke.edu/2021/03/check-out-molecular-chemistry-through-cooking


Thank you for your attention