# Food innovation and molecular gastronomy lesson

## Years 9 and 10

In this lesson, students explore connections between science, design and technologies through the lens of food innovation. Students experiment with molecular gastronomy techniques and design innovative food solutions.

Curriculum alignment

### Design and Technologies

[AC9TDE10K05](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/science_design-and-technologies_digital-technologies/year-10/content-description?subject-identifier=TECTDEY910&content-description-code=AC9TDE10K05&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) – analyse and make judgements on how the sensory and functional properties of food influence the design and preparation of sustainable food solutions for healthy eating

### Science

[AC9S10U07](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/science/year-9_year-10/content-description?subject-identifier=SCISCIY10&content-description-code=AC9S10U07&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) – identify patterns in synthesis, decomposition and displacement reactions, and investigate the factors that affect reaction rates

[AC9S10I02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/science/year-9_year-10/content-description?subject-identifier=SCISCIY10&content-description-code=AC9S10I02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) – plan and conduct valid, reproducible investigations to answer questions and test hypotheses, including identifying and controlling for possible sources of error and, as appropriate, developing and following risk assessments, considering ethical issues and addressing key considerations regarding heritage sites and artefacts on Country/Place

## Learning hook

Show students an array of interesting food products, such as freeze-dried fruit crisps, ice cream or bubble tea. Note the different and surprising textures of these products.

Ask students to identify a range of textures in the foods they enjoy, such as the foam of a coffee , the silkiness of mayonnaise or the lightness of chocolate mousse. Ask students to consider the role of texture in our experience of food.

Ask students, how is cooking like chemistry? How is it different? Ask students to construct a Venn diagram and discuss how the two disciplines are related.

## Learning input

Explain to students that ‘molecular gastronomy’ is a branch of food science which considers the physical and chemical transformations that occur in cooking. Understanding the science of cooking can lead to innovative and surprising dishes. The term was coined by two Oxford physicists, Nicholas Kurti and Hervé This, in 1988.

Molecular gastronomy also studies heat conduction, convection and transfer, physical aspects of food interaction, stability of flavour, solubility problems, dispersion and the texture–flavour relationship. Some molecular gastronomy techniques include:

* dehydrating to change flavour and texture
* spherification
* creating new food textures (gels, foams, glass-like food)
* flash freezing using liquid nitrogen
* carbonating to make an ingredient effervescent.

Girls may be interested to watch this [video](https://www.youtube.com/watch?v=9j-fz339pqs) about Moroccan chef Najat Kaanache’s innovative approach to food, or consider sensory and consumer scientist [Dr Astrid Poelman](https://people.csiro.au/P/A/Astrid-Poelman)’s role in food innovation.

Girls in focus: Girls are often unaware of the diversity of careers in STEM. Food science and food innovation isn’t just about chefs in restaurants – new food product design and testing also considers the role of sensory perception in the design of aroma, flavour and texture of foods.

## Learning construction

Students can explore the use of molecular gastronomy techniques to design unique and sustainable solutions to healthy eating.

#### **Part A: creating new food textures**

##### 1. Spherification experiments

Have students watch this [video](https://www.youtube.com/watch?v=PzrfbhXbFnw) about using spherification in cooking. Spherification involves creating semi-solid spheres with thin membranes out of liquids, which are filled with a non-gelled liquid. When bitten, the sphere bursts in the mouth, releasing the liquid.

In spherification, calcium chloride reacts with sodium alginate, creating a gel capsule that contains a liquid and bursts when squeezed. The gel formation occurs because the calcium replaces the sodium ions which ‘links’ the polymer chains together, forming a cross-linked network that keeps the liquid contained.

Students can explore the weird and wonderful world of spherification by engaging with [these experiments](https://www.scienceinschool.org/article/2016/molecular-gastronomy-chemistry-classroom/) designed by Dittmar, Zoward, Yamashita and Eilks (2016). Students can form alginate bubbles and experiment with adding an acid-base indicator, create luminescent bubbles or add a thermochromic ink.

As students conduct each experiment, encourage them to consider which variables they could change, such as the temperature of the solution, the amount of reagent used, the time in the calcium chloride solution or the height from which the alginate solution is dropped. Provide time to explore and record the effect of changing these variables.

Note that molecular gastronomy also considers the final appearance and texture of the food. Discuss with students how they can record this.

Girls in focus: Providing a video methodology, contextualised in a kitchen environment, may engage a wide range of students than an experimental method. Making connections between STEM and careers that are typically perceived to be more creative encourages students to appreciate the potential of the STEM field.

##### 2. Agar spaghetti

Have students watch this [video](https://www.youtube.com/watch?v=4nPMLNaBWNI&feature=youtu.be) showing how to make agar fruit spaghetti.

Ask students to work in pairs to design their own experiment to create a fruity gel strand using juice and agar flakes. Students can reflect on the spherification experiments to identify the variables they will need to consider.

Support students to conduct their experiments and share their findings with the class.

##### Part B: designing a signature dish

Students incorporate the two techniques they have learned to design a signature dish. It can be sweet or savoury, and can include other components, but must feature innovative use of gels and represent a healthy, sustainable food solution.

Students should consider the flavours, textures and appearance of their dish. They can sketch their dish and annotate it to show different components.

Girls in focus: Girls have been shown to be highly motivated by opportunities to express their creativity. By providing a creative purpose for experimentation, students who may have thought chemistry was ‘not for them’ may be encouraged to experiment purposefully. This task also enables students to showcase cuisines that reflect their cultural backgrounds.

## Resources

Video: [Re-inventing Moroccan Cuisine: Meet Najat Kaanache](https://www.youtube.com/watch?v=9j-fz339pqs&feature=youtu.be)

Video: [Molecular Gastronomy – fruit spaghetti recipe](https://www.youtube.com/watch?v=4nPMLNaBWNI)

Activity: [Transform Drinks Into Semi-Solid Juice Balls That Pop in Your Mouth](https://www.thegist.edu.au/educators/stem-lesson-plans/lessons-for-years-9-10/food-innovation-and-molecular-gastronomy/)

Article: [Molecular gastronomy in the chemistry classroom](https://www.scienceinschool.org/article/2016/molecular-gastronomy-chemistry-classroom/)

Activity: [Hydrogels in the Kitchen? Hydrogels in the Body?](https://sites.udel.edu/k12engineering/activities/hydrogels-in-the-kitchen-hydrogels-in-the-body/)

Article: [Characterization of flavoured sweet water balls prepared by basic spherification technique](https://www.researchgate.net/publication/330909638_Characterization_of_flavoured_sweet_water_balls_prepared_by_basic_spherification_technique)