

THE NUTRITION NEXUS: EDUCATING ON THE SCIENCE, ETHICS AND HEALTH IMPACT OF FOOD CHOICES

Argyro Kyparissi, & Lefkothea-Vasiliki Andreou

Department of Biological Applications and Technology, University of Ioannina (Greece)

Abstract

“Let food be thy medicine and medicine be thy food”, as stated by the father of modern medicine, Hippocrates. For centuries, people have experienced and questioned the impact of dietary choices on health. The present micro-scenario is designed to highlight the interconnected effects of eating habits, various cooking methods, and the role of genetically modified organisms (GMOs) on human well-being. This Biology lesson, intended for secondary and higher education, explores the biochemical transformations that food undergoes during cooking, comparing different techniques and examining their influence on nutrient preservation. Emphasis is placed on the importance of a balanced diet and the function of macro- and micronutrients in managing and preventing chronic conditions, such as diabetes and heart disease. Furthermore, students are instructed to delve into the controversial topic of GMOs, assessing potential advantages and drawbacks through the lenses of ethics, biosecurity and food safety. Through active learning and group projects, critical thinking and decision-making are promoted. Finally, students evaluate the educational experience and contribute their thoughts, in the form of a thesis on the question “Are we what we eat?”, an inquiry initially posed by the French lawyer, politician and author, Anthelme Brillat-Savarin, that still troubles individuals to this day.

Keywords: *Biology, secondary education, higher education, food literacy, critical thinking.*

1. Introduction

It has been pointed out that food is a complex and multifaceted topic (Swan & Flowers, 2015) that encompasses science, technology, disease and society. Given its complexity, it is fundamental to foster critical and creative thinking in terms of food education (Silva, 2015). It has been indicated that food education should include practical skills (Sadegholvad, Yeatman, Parrish, & Worsley, 2017), that may empower students to make healthier food choices. Importantly, a clear connection must be established between nutrition and health, so to help prevent and manage related illnesses (Silva, Araújo, Lopes, & Ray, 2023). It is equally significant to nurture awareness on food ethics, which encourages sustainable and socially conscious decisions (Costa, 2017). Finally, biosecurity and food safety are vital issues that need to be addressed in the interest of public health and sustainability (Oswald Spring, 2011; Cole, Augustin, Robertson, & Manners, 2018). However multidisciplinary food literacy is (Vidgen, 2016), this is often overlooked in educational curricula, that fail to present it as a nexus. To address this gap, we have developed an integrated lesson plan that combines nutritional science, practical skills and ethical reasoning. This teaching intervention promotes critical thinking, student participation, and self-reflection, providing an active learning approach to food education.

2. Methodology

Subject: Biology and Food Literacy - Topic: Biochemistry, nutrition, public health, bioethics, biosecurity and food safety - Age Group: Teenagers and young adults - Time: 180 minutes.

2.1. Educational goals

Through this lesson plan we aim to promote: food literacy, science literacy, visual literacy, research skills, critical thinking, student participation, teamwork and collaboration skills, communication skills, practical skills in food education.

We also aim to inform on: the biochemical processes involved in cooking, nutritional value, the link between a balanced diet, health and disease prevention, food safety, bioethics and biosecurity, food sustainability.

2.2. Materials

(1) IT classroom, (2) Video projector, (3) Speakers, (4) Printer, (5) A4 paper sheets (6) Lesson plan resources (available online in the following Google Folder; <https://drive.google.com/drive/folders/1rdeXLx9RxW2Dr-aY1BJ95xuCd3S3wbsJ>).

2.3. Procedure

The lesson plan comprises three phases, lasting a total of three hours. In the first phase, students document biochemical changes that occur during cooking and examine how various culinary techniques impact nutritional content. In the second phase, they focus on analysing the role of health-related advertising claims in shaping consumer decisions, followed by a meal redesign aimed at enhancing nutritional value and minimizing the risk of chronic disease. Lastly, students engage in a debate evaluating benefits and risks of GMOs.

2.3.1. 1st Phase (duration: 60 min). 1st micro-activity (duration: 25 min). Recording biochemical changes occurring during cooking.

1. Students are requested to watch two educational videos. The science of denaturation is showcased (<https://www.youtube.com/watch?v=CHMY4G9gTPA&list=LL&index=10>) (0:00-0:57), as well as caramelization and the Maillard reaction (<https://www.youtube.com/watch?app=desktop&v=oWCrMVMjeds>) (duration: 7:32).
2. In parallel, students record on spreadsheets (see Google folder) visible changes, the biochemical transformations involved and subsequently provide additional examples of similar processes, e.g., emulsification, gelatinisation.

2.3.2. 1st Phase (duration: 60 min). 2nd micro-activity (duration: 35 min). Reporting on how different cooking techniques affect nutrient preservation.

1. Students write on the whiteboard their favorite dishes and the cooking methods used to produce those.
2. Next, students work in groups of 3-5 people, each group assigned with a cooking method.
3. Students report on spreadsheets (see Google folder) the effect of each method on food chemistry and its impact on nutritional value. For this, they may refer to the following source: [https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Chemistry_of_Cooking_\(Rodríguez-Velázquez\)](https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Chemistry_of_Cooking_(Rodríguez-Velázquez)).
4. Outcomes are presented by means of a Canva infographic (<https://www.canva.com/>).

2.3.3. 2nd Phase (duration: 60 min). 3rd micro-activity (duration: 30 min). Reflecting on the impact of advertisement health claims on consumer choices (see more on https://food.ec.europa.eu/food-safety/labelling-and-nutrition/nutrition-and-health-claims_en).

1. Students are presented with a slideshow (see Google folder) featuring a selection of ads, product packaging and headlines that showcase health-related promotional claims.
2. Students are prompted to run fact-checking research (high school students are provided with curated literatures; see Google folder).
3. Students document findings and provide their thoughts (see Google folder) on the validity of the ad claims, as well as the possible impact on consumer behaviour.

2.3.4. 2nd Phase (duration: 60 min). 4th micro-activity (duration: 30 min). Redesigning meals to boost nutrition benefits and to reduce chronic illness risk (see also: <https://www.brighamandwomens.org/patients-and-families/meals-and-nutrition/bwh-nutrition-and-wellness-hub/recipe-makeover-tips>).

1. Students name junk food favorites.
2. Students are allotted unhealthy dishes and work in groups of 3-5 people on meal makeover assignments.
3. Assessment is based on whether criteria such as, improvement of nutritional value, compatibility to chronic illness diet and novelty, have been met (for rubric see Google folder).

2.3.5. 3rd Phase (duration: 60 min). 5th micro-activity (duration: 60 min). Debating GMOs.

1. A secret “for” and “against” student vote on GMOs takes place.
2. Then, students are presented with a case study, namely the “Hawaiian Rainbow Papaya” (<https://www.youtube.com/watch?v=CX7AqBOJS84>) (duration: 11:14).
3. They read literature (see Google folder) and watch audiovisual material (<https://www.youtube.com/watch?v=7TmcXYp8xu4&t=28s>) (duration: 9:02) on GMOs.
4. Next, they are randomly assigned (<https://www.random.org/>) to “for” and “against” teams.
5. Teams use 10 minutes to prepare arguments on the aspects of ethics, biosecurity and safety.
6. The debate (20 minutes) comprises of three rounds of arguments and counterarguments.
7. A fresh vote count takes place.
8. Students’ complete reflection worksheets (see Google folder), pointing out possible shifts in their perspectives, as a result of this activity.

2.3.6. Evaluation. Self-reflecting and assessing student understanding and learning outcomes. Students are asked to produce a short paper, the question “Are we what we eat?” serving as a prompt. In their writing, they should incorporate insights from all teaching intervention phases; on food processing, nutrition, ethics and safety. Students are instructed to add the paper to their portfolio and submit it for assessment.

3. Discussion

The present study educates on food literacy within a science, ethics and health framework. To this end, engaging, hands-on activities are employed. Notably, critical thinking and reflection are promoted, so that students grasp the complex and interconnected aspects of nutrition. By means of a student portfolio assessment, the effectiveness of the teaching intervention may be evaluated.

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