Learn Chemistry

You Are What You Ate

Resource Overview

Developed by John Bradley, University of Hull

This resource was produced as part of the National HE STEM Programme

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RSC | Advancing the Chemical Sciences

www.rsc.org/learn-chemistry

Registered Charity Number 207890

Contextual Narrative

Background.

Context- and problem-based learning, CPBL, on which this resource is based, is a widely used pedagogical technique involving placing the subject matter, in this case the metabolic causes and the incidence of obesity, in the cultural and social environment within which students, tutors and institutions operate. Context-based learning, CBL, is often understood as the use of applications to illustrate and illuminate the curriculum, and for science students this usually means providing them with opportunities to test academic knowledge with real world examples. The traditional approach of introducing real-life context after all the theory has been covered is inverted in CBL, in which the context is used as the driver for learning. Where this approach has been used, evidence has demonstrated that students engage much more enthusiastically with the learning process. In problem-based learning, PBL, as in CBL, the curriculum is organised and driven by real-life contexts. In PBL these contexts are presented in the form of problem scenarios. An important feature of CPBL is that the problems or scenarios are encountered before all the relevant learning has taken place and act as the driver for new learning. Because of this PBL is distinct from traditional problem solving, where problems are generally encountered after learning has taken place.

In the present resource, “You Are What You Ate: The Obesity Epidemic…” students are presented with a problem, the growing incidence of obesity, in a real life context in which the core subject, metabolic chemistry, plays a central role. For the purposes of this resource the local solution to this world-wide problem takes the form of public education through presentations by the students to senior school children. This requires the acquisition of new skills such as use of on-line databases, teamwork and communication skills in addition to skills in the core subject. The students work in small groups, optimally of four or five, and are presented by the tutor with some information to set the scene. The tutor plays a less didactic role after this initial phase, becoming more of a facilitator. Students are given the brief, which in the first instance is to write a persuasive application to a local authority for funding to support the creation of talks to schools in their area and for their delivery. Members of the teams collaborate to acquire additional information and develop a heuristic strategy to complete the formulation of the problem and develop options for a solution. The importance of inquiry as a means of learning is thus emphasised. This approach has been practiced to varying degrees in the physical sciences curriculum during the past decade, and has met with considerable success in terms of enhancing student motivation and consequently higher performance.

The Problem

The RSC Roadmap identifies food and ’creating and securing a safe, environmentally friendly, diverse and affordable food supply’ as a priority for the world. This is usually seen as a strategy to fight starvation in underdeveloped parts of the globe, but in the developed countries a factor of increasing importance in threatening life expectancy is not starvation but obesity – a different aspect of poor nutrition. This resource is designed to use the global relevance and urgency of this problem as a motivational framework for undergraduates in chemistry and allied disciplines.

There is a general public ignorance of the factors involved in maintaining a healthy diet. Food fads, misleading but seductive marketing, superficial press reporting of complex stories (for example on GM foods) and the celebrity chef phenomenon all distract the public from seeking and absorbing evidence-based facts about the food we buy, prepare and eat. The

commercially motivated claims of beneficial effects for food additives, which may in fact be beneficial, innocuous or deleterious, are accepted as the results of "scientific testing" when this is seldom the case. The public has no means of judging the claims made to induce them to buy and consume foodstuffs and supplements, and this has a number of consequences detrimental to public health. In particular, aggressive marketing and misleading advertising make unhealthy, fat- and sugar-laden fast foods and soft drinks attractive and readily available. The most obvious and harmful consequence of these factors is the rise in poor nutrition and obesity in all developed countries, with consequent decline in actual and predicted public health. In 2007 approximately 40% of the adult population of the UK were overweight (BMI >25kg.m^{-2}) and a further 20% were clinically obese (BMI >30kg.m^{-2}) with a cost to the NHS of over £3bn. The prospects for the immediate future are bleak. An increasing gap has been noted in general health and life expectancy between the betterinformed and -educated and the less informed, often socially deprived, sections of the public.

It falls to the trained scientist to find ways to inform and enlighten the public about food, nutrition and the risks consequent on a poor diet rich in fats and sugar, especially when that diet is coupled with a sedentary lifestyle. It is a useful goal for chemists to attempt to put this information in an assimilable form for a lay-audience. Unfortunately, the publication in the press of conflicting and poorly reported stories on the risks/benefits of dietary habits has contributed to a general distrust of science and scientists. The problem remains of how to express useful, science-based information on diet and nutrition to counteract the exaggerated claims for "superfoods", "nutritional" additives made by the food industry and the sensationalist reports of miracle obesity cures in the press.

In "You Are What You Ate …" we will use the context of this societal problem to engage and motivate science undergraduates in chemistry and related disciplines to focus on the acquisition, development and dissemination of chemical and biochemical knowledge relevant to public health and to the food industry. Students in the course will take the role of teachers for senior schoolchildren, an important target audience for receipt of nutritional and health information. They will write proposal letters to a local Education Authority requesting support for the delivery of talks in schools on the obesity crisis. A crucial component of the course will be the acquisition of analytical and presentational skills by student chemists aimed at fostering the growth of a population of informed young consumers with the ability to make evidence-based choices in food and nutrition. The closeness in age and consonance in life-views between the students and their target audiences adds to the potency of the approach and to the prospect of engagement.

The Structure of the Resource

Students will form teams to construct an appraisal of the problem of overweight, obesity and public health with particular emphasis on the problems these issues pose for children and young adults. They will do this based on information gleaned from public sources such as press coverage, government reports, websites and recommended texts. The knowledge thus obtained will form the basis of a detailed letter to a local education authority with the aim of giving their presentations to senior pupils in local schools. The groups will then construct 20-minute presentations for delivery to schools. The students will also compose a two-page leaflet or flier to introduce the issues to a sixth-form group, and finally write a report containing policy recommendations to address the problem.

This resource may be used with undergraduates of differing academic backgrounds and at different levels. The appropriate material content and the expectations for the students'

performance will be chosen by tutors in alignment with the identity of their department or school and the academic year of the class. Thus senior undergraduates in chemistry would be expected to be more familiar with details of the appropriate metabolic chemistry, as would students at a similar level in biochemistry; students in medical schools perhaps less so, and students in schools of public health etc. would have the least need for that level of detailed chemistry, but would be expected to have a general knowledge of dietary and nutritional content. It is not expected that details of metabolic chemistry be reproduced in the student output from the course but only that an adequate level of knowledge should inform the presentations and reports produced. It is one of the learning objectives of the resource that students acquire the ability to assemble technical information from a variety of sources and then select the crucial components for synthesis into a form more accessible to a general audience.

Students are first given background information on the obesity crisis via a PowerPoint presentation from the tutor, to provide a common starting point. This will also describe an outline of the structure of the course and the tasks that are to be assigned. Groups of four or five students are to be identified by the tutor on the basis of an approximate assessment of ability (mixed ability teams are needed) and the “rules of engagement” outlined. It is important that the students are made aware that self-assessments of the contributions of each team member to the team output will be part of the final assessment of their performance.

In the first phase of the resource students working in the assigned teams are tasked with preparing a letter to a local authority proposing presentations to sixth-formers on the obesity crisis. The teams will also prepare a letter to a school head teacher requesting permission to visit the school (in essence a shorter, informal version of the letter to the Education Authority). One or more of these letters, (after some expert editing as necessary) will be used after the completion of the resource to provide a reality component to the process by sending the top achieving team to a local school to give the presentation. The announcement of this will act as a spur to the student teams and will add a real-life competitive edge to the application process.

A short list of possible resources will be introduced by the tutor, exemplifying information contained in texts, press websites, government reports online and other sources. These sources are such that each is linked, through the original documents, to others that the students will be encouraged to inspect, thus developing their knowledge base. This kind of fractal development of information can be daunting to the uninitiated, and selection of useful information will require a degree of critical appraisal of the content of the sources. Teams should assign the exploration of different aspects of the problem to individual team members and write the proposal letter on the basis of pooled results. The focus and scope of the proposal letters are left to the students and it should be made clear that the presentations they will deliver when their proposals are accepted must reflect the content of the proposal letters. For example they might stress the imbalance of energy input and expenditure in the average adolescent lifestyle, the saturation advertising of nutritionally inadequate fast foods and soft drinks in the media, the interlocking of metabolic pathways that leads to fat deposition, the lack of adequate nutritional information on food packaging, the inadequacy of public policy on nutrition. Successful proposal letters will show a balance between several possible themes.

Education authority letters will be appraised by the tutor, with some possibility of requiring a rewrite to ensure that all teams are at a similar point before beginning the next phase. On the successful appraisal of the proposal letters the students enter the second phase of the

resource as the teams are tasked with the preparation of the talks to be given at school for senior pupils. These will be short, 20 minutes in length, and are to be designed for a technically literate school audience, perhaps with a higher level of science background than the average school population, to enable the student presenters to delve into some metabolic chemistry as the technical underpinning to their talks. They will also be asked to prepare a poster or leaflet to be delivered to schools in advance of their visits to attract an audience and to serve as a reminder of their visits. The talks and posters/leaflets should reflect the theme of the successful proposal letters. The delivery of effective talks, especially short talks, is not a skill that comes naturally to all speakers, especially in presentations that are based on technical information. This is especially the case for inexperienced speakers, and sadly it remains true at quite advanced stages of scientists' careers, as a visit to any large professional meeting will confirm. The acquisition of this skill is another of the goals of the resource. Tutors should introduce some rhetorical and iconographic skills that aid in the construction and delivery of a persuasive and informative presentation. These skills will then be used in student-led short practice presentations in front of the other teams, who will offer their critiques with those of the tutor.

A summary of issues central to the problem of obesity will be given based on which the teams will develop a strategy for developing their schools' presentations. As with the preparation for the proposal letter, some seminal sources of technical, epidemiological, demographic, historical and political information will be provided, and search strategies suggested for this phase. The students should focus on those aspects of the problem that they described in their proposal letters, presumably those that stimulated them the most, thus generating a variety among the presentations. They are to be encouraged to appraise the value of the type of information that they inspect to prevent overload resulting from following every available link. The only prescription is that the presentations they prepare should contain at least some aspects of metabolic chemistry to be made understandable to their prospective audience (more is better). A PowerPoint presentation "Molecules in Metabolism" is provided for delivery in a tutor-led session. Some aspects of public health considerations should of course be included. It will be especially useful in developing the critical faculties of the students for them to compare some items of press coverage of the topic – there is no shortage of sensational examples in the tabloid press, and more balanced and informative coverage will be found by following some selected links provided.

Students will meet with tutors periodically to monitor progress and to be offered guidance where needed to maintain momentum and student engagement.

One team member, selected by each team, will present the team's talk. Practice sessions by the students are encouraged in which short talks (five to ten minutes) are given to develop skills in constructing presentations, increasing confidence and fluency of presentation and optimizing timing. The delivery of the final presentations should be in as realistic a setting as possible. The whole class and tutor(s) will be present for each talk, and other staff might be encouraged to attend to provide an audience that should be able to ask useful questions. Local schoolchildren might also be invited to attend, giving an authenticity to the event.

Feedback from Piloting of the Resource.

From the School of Food Science and Nutrition, University of Leeds.

Tutor comments:

The goals of the work were successfully achieved. The students applied their knowledge of chemistry and biochemistry to understand and explain a complex biological process such as obesity. They used their creativity to develop a presentation aimed at high school students relating to the science of obesity, and proposed solutions to tackling and preventing obesity in adolescents.

The students were given the freedom to choose a topic of interest, and to apply their science knowledge and personal interests to developing some science educational material aimed at secondary school children. The fact that the assignment was a real-life situation allowed them not only to gain knowledge in this area of chemistry but also allowed them to put their knowledge into practice. It is known from employers that graduates are often lacking in 'soft' skills and this resource allowed the students to develop these. Also, if students are applying for jobs within this area in the future, this assignment is something that they can also use to discuss in application forms and interviews to show that they are capable of applying such skills to a relevant situation.

The aims of the resource were met as the interaction of the students with the assignment allowed for both independent thinking as well as effective team work, use of both oral and written communication to a lay audience which is a difficult skill to master and finally problem solving. Overall, the students commented that the assignment allowed them to enhance their knowledge on the subject area and this is through their critical analysis of the information that they found on dietary and metabolic chemistry related to obesity.

Student comments:

- I enjoyed working within a group and presenting to the class, as it improved my confidence around the subject.
- Enhanced my knowledge on how to tackle obesity.
- Like the idea of presenting to adolescents instead of normal students.
- Freedom of topic choice involving obesity.
- Was a very broad subject therefore challenging to pick one certain aspect to tackle. Made us get involved and explore the subject more than just listening in lectures.
- The whole assignment played on my interests in the role of reducing obesity in children.
- The whole assignment and module where very interesting and very relevant to current events.
- The assignment was interesting and was different in the way that normal assignments are structured, therefore it was quite refreshing and stimulating.
- I liked the most, the fact that the assignment could actually be represented in real life.