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BSHS OEC Grant: The History of the Balanced Diet

Using past experience of mixing up entertaining narratives (mainly folktales) and hands-on science activities, this initial event, **The History of the Balanced Diet**, brought together historical stories about real scientists all involved in research around aspects of our diet.

The activities involved a 'Lucky Dip': six small boxes containing clues to a dietary element. Participants had to guess what the clue meant, which was then followed by a hands-on demo/experiment for participants to carry out, alongside the story being narrated to them. These activities could easily be adapted for use in the classroom, or even for open days/transition days etc.



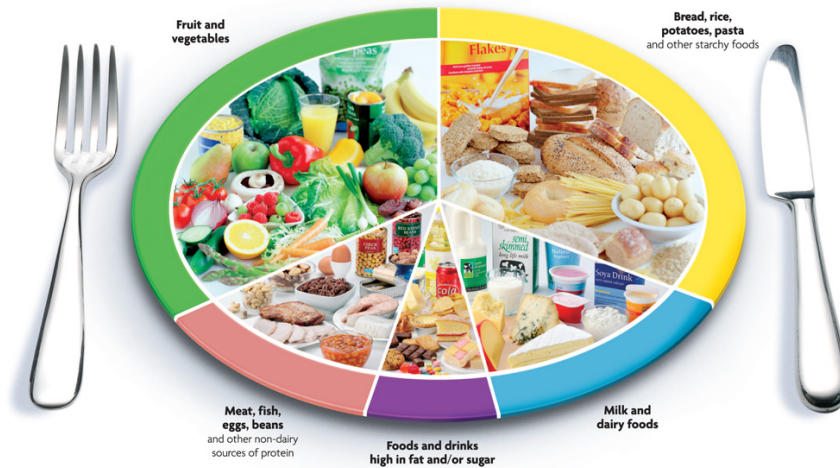
Stages of delivery:

1. What do you understand about balanced diets, have you seen the Eatwell Plate before? Why do you think we need carbohydrates, proteins etc. in our diets? Who are the people who find this all out?

The eatwell plate



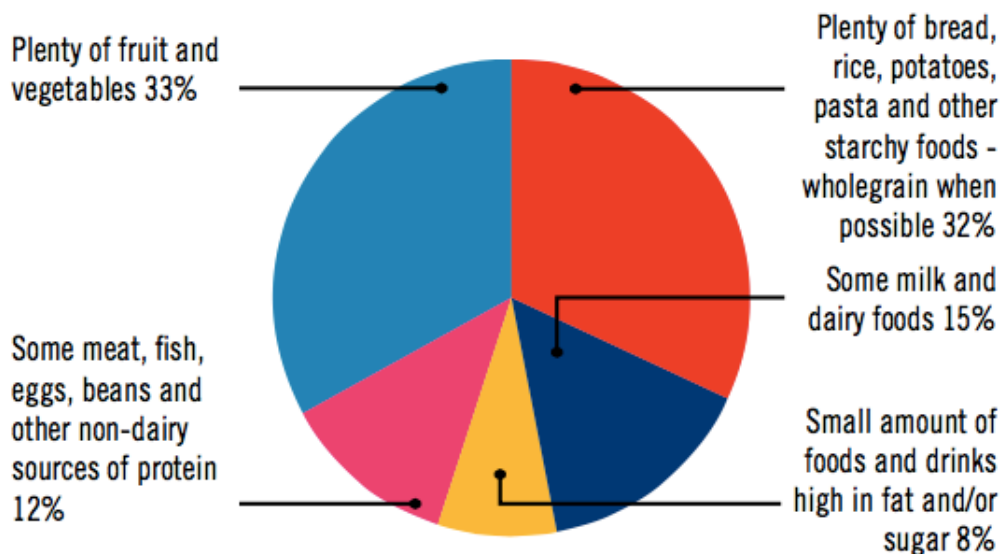
Use the eatwell plate to help you get the balance right. It shows how much of what you eat should come from each food group.



The Eatwell Plate: <https://www.gov.uk/government/publications/the-eatwell-guide>

Dietary health

The eatwell plate highlights the different types of food that make up our diet, and shows the proportions we should eat them in to have a well balanced and healthy diet. *Source: NHS/Department of Health*



2. Story about each discovery - we think about the history of medicine, but what about the history of food and how we learn about what's needed

for a balanced diet, and what we need for good health. (News stories about people being malnourished in other countries, but also here in the UK: <https://www.theguardian.com/lifeandstyle/2019/sep/03/british-teenager-loses-sight-and-hearing-due-to-processed-food-diet>; and Five-a-Day etc.).

3. Activity: Participants choose a box from the lucky dip, open up and find a clue and the image of a person. Ask them to work out/guess what the clue is, and what it might be about, and look at the person, find out their name, and what their link is to the clue and our diet.
4. Then move onto a hands-on activity linked to the clue and the discovery made by that person in history.



The six main activities:

Carbohydrates

Person: Claude Bernard

Discovery: Storage of glycogen

Clue: Flour in mini petri dish/vial

Activity: Iodine reactions, what is starch, what is glycogen?

1. Ask participants about carbohydrates. What examples can they name? How is it stored in our body?
2. It's stored as glycogen in our liver, and this is what Claude Bernard discovered.
3. In animals we store simple sugars in the form of glycogen, in plants, it's stored as starch, which we break down when we eat this.
4. On a paper plate add a little flour on one side and a little salt to the other. Ask participants to add some iodine to both the flour and the salt and see what happens. The orangey-brown iodine will turn black if starch is present.
5. They can test other foods if available, but note, iodine stains.

Amylose in starch forms a complex with iodine which is how the deep blue colour occurs.

Claude Bernard

French physiologist

12 July 1813 – 10 February 1878

Claude Bernard left school to assist in a pharmacy, but spent his spare time writing vaudeville comedies and dramas. When he turned 21, he went to Paris and a critic of his play convinced him to move away from literature and pursue medicine.

He followed this advice, became an intern at a hospital, where he met the physician, François Magendie, and became his lab assistant in 1841. Four years later he married Marie Françoise Martin, for convenience, as the dowry helped him fund his research. Claude Bernard was the first scientist to mention the use of blind experiments, and the concept of milieu intérieur (the balance of the internal bodily environment - which later became known as homeostasis). His first notable work was on the pancreas and its importance in digestion, followed by the glycogen storage in the liver, both studies of which helped us better understand diabetes. He was the first scientist to have a public funeral.

Fats

Person: Lloyd Augustus Hall (and Theodore Gobley)

Discovery: Use of Lecithin

Clue: Test tube of oil and water

Activity: Use of lecithin as surfactant and antioxidant.

1. Ask participants to shake the tube of oil and water. The oil disperses, but eventually comes back to form a layer on the water.
2. Water and oil do not mix, but how can we mix them together. We can use a surfactant, like liquid soap/detergent. Ask participants to add a drop of liquid soap to the oil and water. And shake again.
3. You can't eat this though, however lecithin can be used instead of soap. (Do the same with the lecithin).

Oil and water won't mix. The oil rises to the top of the water because oil is less dense than the water. By mixing in lecithin (or soap), which is attracted to both the oil and the water (amphiphilic), so it allows both to mix. A bit like how egg helps oil and vinegar mix in a mayonnaise.

Lloyd Augustus Hall
African American chemist
20 June 1894 – 2 January 1971

Lloyd Augustus Hall was born in Elgin, Illinois, USA, as his grandmother came to Illinois at the age of sixteen, via the 'Underground Railroad'. This was not a 'railroad' as such, but a network of secret routes and safe houses (run by those sympathetic to those needing to escape) in the mid 19th Century used by enslaved African-Americans to escape into free US states and into Canada. His grandfather came to Chicago in 1837 and was the founder and first pastor of the Quinn Chapel A.M.E. Church. Hall's family moved to Aurora, Illinois, and after graduating from high school he went onto study for a pharmaceutical chemistry degree at Northwestern University (he had the option of four universities, and chose Northwestern), and a Masters at the University of Chicago. Hall was a great track athlete too, and played football for the University.

After leaving university, Hall was hired by the Western Electric Company after a phone interview. The company didn't hire Hall after they found out he was black. Hall then went to work as a chemist for the Department of Health in Chicago, followed by a job as chief chemist at the John Morrell Company.

During World War I Hall served with the United States Ordnance Department where he became Chief Inspector of Powder and Explosives.

After the war, he married Myrrhene Newsome and they moved to Chicago so he could work as chief chemist for the Boyer Chemical Laboratory. In 1925, Hall took a position with Griffith Laboratories, a position he stayed in for 34 years. Griffiths Laboratory was run by Carroll L. Griffith and his father. Griffith was someone Hall had met at Northwestern University.

Hall was all about food science. He investigated ways of curing meat (using curing salts and flash-drying), and also looking at the role of spices in food preservation (as some spices were naturally antimicrobial). Unfortunately they found that some spices contained bacteria, yeast and mould spores, so Hall and Griffith invented a way to sterilise spices using ethylene oxide gas. They soon gave this idea up too, as ethylene oxide was found to cause cancer.

Hall also invented new uses of antioxidants to prevent food spoilage, especially when fats and oils went rancid (spoiled when exposed to air). He knew that unprocessed vegetable oils had natural antioxidants (e.g. lecithin) that meant they didn't spoil so quickly, so he combined these natural antioxidants with salts, and added them to other foods.

He retired from Griffith Laboratories in 1959 and consulted for the United Nations' Food and Agriculture Organisation, and later was on the American Food for Peace Council. In 2004 (over 30 years after his death), he was inducted into the National Inventors Hall of Fame for his work on food preservation. He had 59 United States patents, and several inventions were patented in other countries.

Theodore Nicholas Gobley
French pharmacist and biochemist
11 May 1811 – 1 September 1876

Gobley grew up in a rural area of Burgundy, and his father was a wine broker, while his mother's family was the preferred supplier of wine to the King's Court. Growing up in this alcoholic distillation environment could explain why Gobley became interested in chemistry and pharmacy.

Gobley studied egg yolks, brain tissue, fish eggs and human fluids (blood, bile) to look at what they were made up of. He found that there were similarities in chemical structure between brain tissues and egg yolk, and identified lecithin, a phospholipid: containing a part that likes water (hydrophilic) and a part that hates water (hydrophobic). Gobley named it lecithin from the Greek, lekithos meaning egg yolk, even though today lecithin can come from other sources, such as soya beans. (Hence soya lecithin, that we see on many ingredient labels).

Proteins

Person: Carl von Voit

Discovery: Protein turnover

Clue: Chickpea

Activity: Shaking chickpea water, and washing dough to get proteins from food items we don't consider as packed with protein.

1. Legumes such as chickpeas have protein in them, and by shaking up the water from a chickpea tin (or water from some boiled chickpeas) we can get the proteins to denature (like egg whites) to form a froth (used in vegan meringues - <https://www.bbcgoodfood.com/recipes/vegan-meringues>. (Known as Aquafaba named by Goose Wohlt, bringing together the Latin words for water and bean).
2. Proteins are in a lot of places we don't even think they are. Gluten is the protein in wheat. By washing off the starch from a ball of dough, we are left with the gluten protein. (Often used in creating vegan fake meats).

Carl von Voit
German physiologist and dietician
31 October 1831 – 31 January 1908

Carl von Voit studied under Justus von Liebig (see later). He was a professor of physiology and curator of the physiological collection at the University of Munich.

He is thought to be the 'father of modern dietetics/nutritional science', and found that the amount of nitrogen in excreted urea is a measure for the protein turnover. Using a 'respiration chamber' he could study animal metabolism and the significance of various nutrients, during activity, rest, and fasting, by measuring the ingestion and excretion of food, the consumption of oxygen, and the production of carbon dioxide and heat. He spent over a decade experimenting, and worked out human energy requirements in terms of calories required, and that metabolism is in the cells, not the blood. He also showed that oxygen requirement is the result of metabolism, and carbon dioxide production is proportional to the rate of muscle activity/exercise.

Vitamins

Person: Casimir Funk

Discovery: Vitamins, Niacin

Clue: Vial of red rice

Activity: Red rice (high in Vitamin B) and Vitamin C (ascorbic acid) tablet activity.

1. Add a few grains of red rice into a glass jar/cup, and add some water. The rice will remain at the bottom of the glass.
2. Add in a quarter of a Vitamin C tablet. As the tablet begins to fizz, the rice will start to move up and down.
3. Could also demonstrate ascorbic acid, mixed with bicarbonate of soda and water (could even supply separate solutions first to test with pH paper), to use instead of Vitamin C tablets.

Explain the neutralisation reaction happening, resulting in small bubbles of carbon dioxide gas which attach to the rice grains at the bottom. This allows the grains to rise to the top, and as the bubbles burst, the grains sink again.

Casimir Funk
Polish biochemist
23 February 1884 – 19 November 1967

Funk read an article by Christiaan Eijkman from the Netherlands, who wrote that those who ate brown rice were less likely to get beri beri (a disease that affects the nerves and heart). Funk wanted to find out what it was within brown rice that

was so useful. He found out what it was, thiamin (or vitamin B1), and because it contained an amine group (NH₂), he called it 'vit-amine' the vital amine/an amine for life, or anti-beri-beri-factor. In 1912 he published a book, 'The Vitamines', containing detailed information about 4 vitamins, and the diseases that could be prevented by taking these vitamins: antiberiberi, antiscorbutic (scurvy), antipellagic (pellagra), antirachitic (rickets). As vitamins did not need to have an amine group, the 'e' from 'vitamine' was later removed.

Funk later went onto research hormones, diabetes, peptic ulcers and neoplasms (cancers).

Minerals

Person: Lucy Wills (and Justus von Liebig)

Discovery: Folate/Folic acid (insufficiency in pregnant women)

Clue: Vial of Marmite

Activity: Marmite tapping activity

1. Add some Marmite into a small container.
2. Using a spoon, tap and mix the Marmite fast.
3. The Marmite should turn from a dark brown-black colour into a light brown and eventually a pale brown colour (almost white if you're lucky!).

Stirring Marmite introduces bubbles, making it a lighter colour. Marmite is a source of folate and B vitamins.

Lucy Wills

English haematologist and physician

10 May 1888 – 26 April 1964

Lucy Wills born in Sutton Coldfield to a family of those interested in science. Her father, William Leonard Wills, was a science graduate interested in botany, zoology, geology and the science of photography, and her maternal grandfather was the renowned Birmingham doctor, James Johnston. Her paternal great-grandfather, William Wills, though a lawyer, wrote papers on meteorology and was involved with the British Association for the Advancement of Science (now the British Science Association).

Until the end of the 19th century, there were very few opportunities for girls in England to be educated or pursue a career. Wills however went to Cheltenham Ladies' College, followed by Newnham College in Cambridge, and in 1915 she enrolled at the London School of Medicine for Women (now known as the Royal Free Hospital). This was the first British medical school to train female doctors, and had strong links with India. A notable alumni was Jerusha Jhirad, the first Indian woman to qualify in 1919, with a medical degree in obstetrics and gynaecology.

In 1928, Wills researched macrocytic anaemia in pregnancy (a life-threatening disease where red blood cells are abnormally enlarged), in India. Many of these women were working in the textiles industry. Wills studied different groups of

Bombay women and the likelihood of them becoming anaemic. She discovered that the poor Muslim women with the poorest diet were the most likely to develop this anaemia. Medical professionals assumed this to be 'pernicious anaemia of pregnancy' however Wills noticed that it couldn't have been true pernicious anaemia as the women did not have an inability to produce gastric acid (a key symptom). They also didn't become better after being given pure liver extract, high in vitamin B12, which is a treatment for pernicious anaemia.

Wills said that there must be another nutritional factor (named the Wills Factor), other than vitamin B12, that when deficient, could cause macrocytic anaemia. The Wills Factor was shown to be folate, the natural form of folic acid.

Following some animal experiments, Wills ran some clinical trials on patients with macrocytic anaemia and found that this kind of anaemia could be prevented and cured by yeast extracts, the cheapest source being Marmite.

Justus von Liebig
German scientist, founder of organic chemistry
12 May 1803 – 18 April 1873

Justus von Liebig has been called the 'father of the fertiliser industry' because he promoted the need for nitrogen and minerals as essential nutrients for plants to grow well. Liebig's father was a merchant who made and sold paints, varnishes, and pigments, which could be why Liebig was fascinated with chemistry.

He developed the theory of nutrition, based on plant and animal metabolism research, and said that eating meat juices as well as the meat fibre was vital. If cooking liquids were removed following cooking (e.g. during boiling), then nutrients were lost.

Because of this he also developed a process for manufacturing beef extracts, and set up a company called Liebig Extract of Meat Company, which later went on to become the Oxo brand (as the company worked with British chemist, Henry Roscoe), producing beef extract bouillon cubes. Oxo was trademarked, and sold originally as a liquid, later in 1911, in solid cube form.

Liebig wanted to reach as many people as possible, so keeping the costs down was important. Unfortunately it wasn't possible in Europe as meat was expensive, however in Uruguay the meat was an inexpensive byproduct of the leather industry, so he located the company in Uruguay.

Liebig also promoted the use of baking powder to make lighter bread, developed a breast-milk substitute for babies, and discovered that yeast could be concentrated, making the invention of Marmite possible. He also is the brain behind the Liebig condenser.

Water

Person: Margaret McWilliams and Frederick Stare

<http://www.bbc.com/future/story/20190403-how-much-water-should-you-drink-a-day>) (and John Snow)

Discovery: Discussion of how much water we need to drink/water-borne diseases

Clue: Small vial of water

Activity: Evaporation (lick the back of your hand, how we lose water as sweat, keeping us cool), and the travelling of water to show the amazing properties of water

Using two cups, place water in one (can be coloured water) and a strip of paper towel dipped in it, with the other end of the towel in an empty cup. Thanks to capillary action, the water moves up the paper towel into the empty jar. Capillary action is the movement of water within the spaces of a porous material due to the 'sticky' forces of adhesion, cohesion, and surface tension. The first recorded observation of capillary action was by Leonardo da Vinci. And Albert Einstein's first paper was on capillary action.

Why 8 cups?

We're always told to drink lots of water, for everything from feeling tired to having dry skin or to suppress your hunger, to staying generally healthy. Commuters carry water when travelling to and from work, while at work have water around them in coolers and in meetings, and children take water bottles to schools. And especially during hot summers, we told to drink more to replace what we're losing through sweat, to prevent dehydration. Obviously water is needed, it's vital for life. Making up two thirds of our body weight, it's used in metabolism, makes up our blood and other bodily fluids and lubricates our joints - so without water our bodies would simply not function. But how much are we supposed to drink?

Many think we should drink at least 8 glasses of water a day, and with each glass being around 250ml, that works out as 2 litres a day. But where does it say this? Apparently we misunderstood two pieces of advice from many years ago:

1. In 1945, the US Food and Nutrition Board of the National Research Council advised adults to drink one millilitre of liquid for every recommended calorie of food, which is 2 litres for women on a 2,000-calorie diet and 2.5 litres for men eating 2,500 calories.
2. In 1974, the book Nutrition for Good Health by nutritionists Margaret McWilliams and Frederick Stare, recommended that the average adult should drink between 6-8 glasses of water a day.

However BOTH pieces of advice mentioned that the daily intake of water could include fruits, vegetables and other drinks, which all contain water. This means we don't have to drink 8 actual glasses of water, but that our daily intake of water should be equivalent to 8 glasses, much of which will already be present in our daily diet.

Our bodies are really clever. The system of homeostasis means that our bodies are kept in a fine balance and when water levels are low, our bodies alert us to make us feel thirsty.

Extra stories around food science

Fanny Hesse

22 June 1850 – 1 December 1934

Hesse was born in New York, but met her husband, Walther Hesse in Germany. In 1881, when Walther was working for the German physician and microbiologist, Robert Koch, she volunteered for Walther. She helped with preparing the bacterial growth media, cleaning equipment and creating illustrations for his publications.

Koch was using gelatin to grow bacterial cultures. Fanny suggested that agar was a better medium as it maintained its gel-like properties at warm temperatures. A neighbour who lived in Java had mentioned this to Fanny when she was living in America, and she had been using it herself when making desserts. Koch used the agar medium to cultivate the tuberculosis bacilli, but never credited the Hesses in his publications.

John Snow

English physician, founder of modern epidemiology

15 March 1813 - 16 June 1858

John Snow, known as a leader in anaesthetics, the 'founder of modern epidemiology' and medical hygiene, was fundamental in changing the waste and water systems in cities around the world.

Snow grew up in a poor neighbourhood, the eldest of nine children and his father was a labourer who worked at a local coal yard. The area that he lived in during his childhood was always in danger of flooding (from the River Ouse) and so he and his family were often living in unsanitary conditions, due to sewage contamination in run-off water.

At the age of 14, he began a medical apprenticeship with the surgeon, William Hardcastle, in Newcastle-upon-Tyne. A few years later, in 1832, he found out about a cholera epidemic for the first time, in Killingworth (a coal-mining village). As he treated patients of the epidemic, he better understood the disease.

In 1836, he moved to London to study medicine at the University of London, graduating in 1844. He was a member of the Royal College of Surgeons in 1838 and a member of the Royal College of Physicians in 1850. At this time, everyone assumed cholera was airborne, as the theory of foul air or 'miasma' was widely accepted. Snow argued that cholera entered the body through the mouth, and published these ideas, proving his theory when another case occurred.

In August 1854, a cholera outbreak occurred in Soho. After investigating and plotting the cases of cholera on a map of the area, and by talking to local residents (with the help of Reverend Henry Whitehead), Snow found that the source of the outbreak was the public water pump on Broad Street (now Broadwick Street). He asked for the handle of the pump to be removed, and cases of cholera dropped almost immediately.

Oddly, after the cholera epidemic subsided, even though government officials replaced the Broad Street pump handle, they didn't want to accept Snow's theory. It would've meant having to accept that diseases could be spread via the faecal-oral route, which was thought to be too difficult for the public to accept.

In 1866, William Farr (who was against Snow's work), realised that Snow was indeed correct during another outbreak of cholera in Bromley-by-Bow, and immediately ordered that no one should drink unboiled water.

Snow was a vegetarian and didn't drink alcohol (from the age of 17). He also became vegan, but due to deteriorating health in later life, he resumed a meat-containing diet and drank wine to aid digestion. He only ever drank distilled water.

He also described how adulterating bread could cause rickets, which was overlooked. He was one of the first doctors to study ether and chloroform dosage to be used as anaesthesia for surgery. He designed the apparatus and mask to administer chloroform to patients, and even personally anaesthetised Queen Victoria during the birth of the last two of her nine children: Leopold (1853) and Beatrice (1857).

To set this up yourselves:

- Most of the ingredients can be obtained from local supermarkets or from Special Ingredients: <https://www.specialingredients.co.uk>
- Lucky Dip boxes from: <https://www.tinyboxcompany.co.uk>
- Display rack from: <https://www.display-stands-uk>
- PDFs for boxes, signage etc. available from:
https://www.dropbox.com/sh/2vaflwm56eaq3iz/AAA_JVT1azWfDc_Ms3yJ_ahIOq?dl=0

Thank you so much to BSHS for allowing this project to be trialled and tested.