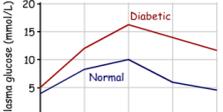


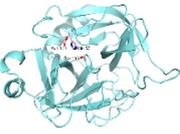
### 1) Use non-stereotypical images of scientists.

Research shows that the majority of people hold a stereotype of scientists as white and male. Broadening these stereotypical views with non-stereotypical images of scientists has a positive effect on student performance.

AN OLD SLIDE	A NEW SLIDE
<p style="text-align: center;"><b>Glucose Tolerance Test</b></p> <p>Tests the response to a glucose load, typically 75g for an adult, over a period of time.</p>  <p>10 hr fast</p> <p>The test is performed at 10 in the morning, after a 10 hr fast. Test can be affected by recent illness. Also by exercise, so patient must remain seated.</p>  <p>At 120 mins, if sample is above 11.1 mM, patient is considered to have diabetes. Normal fasting glucose and 120 min levels between 6.1 and 7.8 mM may indicate impaired glucose tolerance.</p>	<p style="text-align: center;"><b>Genetics and Bodysize Regulation: Example</b></p> <p>The melanocortin 4 receptor is expressed in the hypothalamus - when bound to the ligand alpha-MSH, appetite is inhibited.</p> <p>Loss-of-function mutations in MC4R are the most common monogenic cause of obesity.</p> <p>Recent research has shown that the heritability of 'persistent thinness' is similar to that of severe-early onset obesity: ~30%</p>  <p>Researcher: Prof. I. Sadaf Farooqi</p> <p>Gain-of function mutations in MC4R have been identified that decrease negative feedback on the signal transduction pathway.</p> <p>Prof. Farooqi et al identified genes associated with thinness and obesity (e.g. MC4R), only thinness (e.g. CADM2), and only obesity (e.g. FTO).</p>
<p>This was the <b>only</b> example of black people pictured in the whole of my teaching.</p> <p>The image depicts a black person as an unhealthy patient, linked to an obesity-related condition that comes with social stigma.</p> <p>I am altering slides like this to avoid reinforcing negative stereotypes.</p>	<p>This slide would be one example that illustrates a non-stereotypical image of a research scientist.</p> <p>I would also discuss the importance of researchers generating unique approaches to problems. This would discuss the researcher in a respectful context, and wouldn't make any students feel targeted or excluded.</p>

### 2) Make scientists relatable.

Research shows that the way we talk about scientists can be off-putting and discouraging to students who don't see themselves as potential geniuses who will make scientific breakthroughs all on their own. Describing scientists as people who have overcome difficulties, and research as a collaborative effort, is much more accessible to students who have also experienced difficulties, and models a more realistic way of working.

OLD SLIDE	OLD SLIDE plus anecdote
<p style="text-align: center;"><b>Enzymes</b></p>  <p>Enzymes are biological catalysts, most are proteins.</p> <p>Enzymes exhibit several features that make them excellent catalysts.</p> <ol style="list-style-type: none"> <li>1) Activity at low temperatures - Enzymes can speed up reaction rates at very low temperatures.</li> <li>2) Specificity towards substrates - Enzymes can distinguish between almost identical compounds.</li> <li>3) Specificity of reaction - Enzymes carry out very specific reactions with the substrates they bind.</li> </ol>	<p>I could talk about how the idea of enzymes being proteins was at one time controversial. The first person to crystallize an enzyme was James Sumner. Nobody believed that enzymes were proteins because another more established researcher had 'proven' that enzymes were not proteins. Furthermore, his idea of crystallising an enzyme was considered 'ridiculous'. A further barrier - due to having earlier lost an arm, he was initially denied the opportunity to do a PhD. When he managed to crystallize urease and confirm it was protein, his findings were disbelieved and ridiculed. Only after others also purified proteins with catalytic activity were his findings accepted.</p>

Examples like this could be very encouraging for students who are frequently told (subtly or explicitly) that they can't excel in science, or who find it hard to believe that they could one day know more than the scientists they look up to.

### 3) Include real-world relevance

Understanding how lecture content applies to the real-world has been shown to increase student engagement and persistence with difficult topics. Relevance can be latest examples of research, medical applications, or use in non-science based careers. According to a recent survey of Division of Biosciences undergraduates, less than half are interested in pursuing a research career, so mixing up the types of 'real-world' relevance used will appeal to a broader range of students.

OLD SLIDE	ADD CONTEXT
<p>Preparation of glucose requires an energy investment</p>	<h3>Glycolysis and Cancer</h3> <p>Warburg effect - Almost all tumours show an increased rate of glucose uptake and glycolysis.</p> <p>Advantageous in hypoxia caused by rapid growth. Poor prognosis and aggressiveness correlates well with increased glucose uptake.</p> <p>Glycolysis can link with other enzymes to provide NADPH and substrates for growth.</p> <p>18Fdg PET can be used to identify metastasized tumours.</p> <p>Inhibitors of glycolysis (such as the GAPDH inhibitor, 3-bromopyruvate) are being investigated as anti-cancer drugs.</p>
<p>A basic description of the facts (this isn't my only slide on glycolysis).</p>	<p>This slide shows how knowledge of glycolysis is important in contemporary research, and has medical implications.</p>

A similar approach holds for assessment types; first-generation students in particular may benefit from clear explanations of what useful skills are developed by different types of assessment.

### 4) Challenge simplistic links between genetics and race

OLD SLIDE	ADDITIONAL SLIDE
<h3>MCAD Deficiency</h3> <p>The most frequently diagnosed defect in beta-oxidation.</p> <p>In fasting - hypoketotic hypoglycaemia, lethargy, coma, seizures, death.</p> <p>Responsible for ~2% of sudden infant death cases in white infants, and ~20% people die in first crisis.</p> <p>Once diagnosed, advice is to avoid fasting, have a low-fat diet, and take carnitine supplements. If followed, there are normally no further incidents.</p> <p>Leads to an accumulation of fatty acid oxidation intermediates in plasma and urine, such as medium-chain acyl-carnitines. Tandem mass-spectrometry of blood spots allows early diagnosis.</p>	<h3>MCAD Deficiency Frequency</h3> <p>In the UK, ~1 in 65 people are carriers for this mutation.</p> <p>More common in people of recent 'northern european descent', 80% of these are K329E.</p> <p>Who is of 'northern european descent'?</p> <p>Still occurs in other groups/locations, including K329E</p> <p>Understudied populations (regions) more difficult to diagnose due to unknown mutations...</p> <p>(Tayo et al, 2011)</p>
<p>The reference to the proportion of cases in white infants: implies that racial categorizations are useful proxies for genetic similarity, phrasing could suggest that white people are more important to study/teach about.</p>	<p>Points to emphasize: 'ancestry' is a more useful concept, often correlates poorly with self-reported 'race', which is a social construct, not a biological reality. Recent mutations cluster by geographic origin rather than 'race'. Racial categorization more likely to lead to misdiagnosis and understudying of some groups than to any useful information.</p>

	Regarding the previous slide, I would say that the '2%' study reflects an outdated understanding of the relationship between 'race' and genetics that has been disproven in the genomics era. It is also a useless category, as the definition of 'white' is fluid over time, and between places.
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Teaching students that 'race' is a biological reality rather than a social construct has the side-effect of confirming student beliefs that races differ in complex characteristics such as intelligence, and that such differences have biological causes. These beliefs have a particularly negative effect on black and minority ethnic students, making them more likely to attribute difficulties to a lack of potential (as well as affecting how they are treated by their peers).

Important points to convey to students, as appropriate:

- Racial definitions change over time, are socially constructed, not biologically determined
- The *vast majority* of gene variants / alleles are found in all racialized groups
- There are no gene variants / alleles that are diagnostic of any particular 'race'
- Genetic polymorphisms that are more common in a particular racialized group are the exception not the rule, arising from two main mechanisms:
  - They are more common in people whose ancestry traces back to specific locations (they relate to a place, not a race)
  - They are relatively recent mutations that have not yet spread out into the wider population
- There are no known race-based genetic explanations for complex characteristics such as intelligence
- We all share common ancestors remarkably recently (in the last few thousand years)
- The concept of 'race' as a biological reality has hampered scientific progress in understanding human evolution and patterns of genetic variation

## 5) Use Active Teaching Strategies

BEFORE	After
Lecturer stands at the front of the lecture theatre (or sits in front of the camera), imparting facts that students must come to understand and learn in their own time.	A variety of options, e.g: Provide pre-lecture activities/reading material, and encourage students to read around the topic. Include mid-lecture questions to assess understanding. Replace some lectures with independent/group study of certain topics, followed by a test that allows self-assessment of understanding. Note: Skills developed by different activities should be clearly outlined.
Lectures focus on the acquisition of facts, rather than the development of any skills. This method of teaching is hierarchical, it emphasizes the knowledge and superiority of the lecturer, and the ignorance and inferiority of the students. This is particularly alienating for students from disadvantaged backgrounds, who may find it easy to see themselves as inferior, but may not	The examples above encourage students to develop confidence that they can independently research topics and come to correct conclusions. They allow students to develop their own interests to some extent, making the educational experience more inclusive.

Examples of how to change lectures and lecture slides – Charmian Dawson

picture themselves as ever attaining that position of authority.

Group interactions provide opportunities to reinforce core content as well as introduce different aspects to each other.