

Subject Spotlight Lesson Plan

Title of Session	Subject Spotlight: Physics – Treating Cancer with Protons
Description:	NHS England have recently opened their first high-energy proton therapy centre at the Christie hospital in Manchester. In this workshop students will find out how we can use radiation to treat cancer, and how the physics behind protons could have the potential to improve outcomes for patients.

Duration of session:	~45 mins	Target Audience:	Y12/13
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Regional Progression Framework - Learning Outcomes:
LO1 - Awareness of HE and the different opportunities available. Be able to challenge any myths relating to HE.
LO2 - Identify the link between GCSE attainment and progression opportunities and how these can support life or career goals
LO5 - Learner knows how to research different routes into HE and how to make an application
Gatsby Benchmarks:
7. Encounters with Further and Higher Education - All students should understand the full range of learning opportunities that are available to them. This includes both academic and vocational routes and learning in schools, colleges, universities and in the workplace.

Please note: This workshop centres on a sensitive topic and may be upsetting for any students whose lives have been affected by cancer. If any students do get upset, please direct them to the [Macmillan Cancer Support website](#) where support is available.

Timings:	Activity/Task/Information:	Instructions for teacher:	Resources needed:
00:00:00	Introduction <ul style="list-style-type: none"> - Introduction of myself as a physicist working in Cancer Science. - Mention of cancer sciences as a career path available for physicists. 		
00:00:40	Ice breaker <ul style="list-style-type: none"> - Students can discuss in groups/as a class what their initial thoughts are when they hear the word 'radiation'. 	Pause video for discussion.	
00:00:57	Summary of discussions and examples of radiation <ul style="list-style-type: none"> - E.g. GCSE topics of atomic radiation and the electromagnetic spectrum, nuclear energy, nuclear weapons, background sources of radiation, X-rays. - Anecdote of radiation dangers not being understood in the past and used in cosmetic products and energy drinks. - Introduction of radiation being used to treat cancer. 		
00:02:29	Overview of radiation and types of radiation		
00:03:20	Overview of X-rays being used to treat cancer <ul style="list-style-type: none"> - Overview of main types of cancer treatment - Photo of first X-ray image 		
00:05:06	Animation of radiation ionising DNA		
00:05:32	Aim of radiotherapy to kill tumours while sparing healthy tissue		
00:06:14	Example radiotherapy treatment plans <ul style="list-style-type: none"> - Example technique used to improve dose conformality to the tumour. 		
00:09:25	(Optional) discussion about what students already know about protons	Pause video for discussion.	
00:09:35	Overview of protons <ul style="list-style-type: none"> - Mention of their discovery and first use in radiotherapy and their behaviour as a radiotherapy modality compared to X-rays. - Summary of proton therapy centres. 		
00:10:44	Protons vs X-rays <ul style="list-style-type: none"> - Energy deposition behaviour of X-rays compared to protons shown by going through dose vs depth graph. - Short video showing each radiotherapy modality in a patient - Animation to show ability of protons to avoid organs at risk - Comparison of treatment plans 		
00:14:48	Summary of proton centres		

00:15:37	Treatment planning activity* <ul style="list-style-type: none"> - Slide showing what students will need (see resources needed below) - Instructions of activity and example gameplay - Summary of activity and what students will have learned 	Pause video to set up, resume to go through instructions, then pause to play. (See detailed instructions on instruction sheet) Give students 5-10 minutes to play. At the end, option to discuss the scores as a class.	Instruction sheet and worksheets
00:20:49	(Optional) discussion of situations when X-rays might be the better treatment option	Pause video for discussion.	
00:21:21	Challenges of protons compared to X-rays <ul style="list-style-type: none"> - Proton range uncertainties, and problems from patients moving - Technology for proton therapy – additional space and costs required - Photos of proton therapy equipment at The Christie 	/	
00:26:30	Summary of benefits and challenges of protons	/	
00:27:35	Where to find more information <ul style="list-style-type: none"> - The Christie hospital website - Cancer Research UK website - Proton Therapy Research (PRECISE) group at the University of Manchester (See links below)		

Overview of all resources:	
Pre-recorded video	
X-ray and proton activity sheets	
Score card	
Instruction sheet	
Online resources to share with students	<p>Proton Therapy at The Christie: https://www.christie.nhs.uk/patients-and-visitors/services/protons/proton-beam-therapy-at-the-christie</p> <ul style="list-style-type: none"> - Information aimed at patients - Video showing how proton therapy treatment procedure works - Video to see inside the proton centre at The Christie - 'Meet the team' information showing different jobs involved in proton therapy <p>Cancer Research UK Website: https://www.cancerresearchuk.org/about-cancer/cancer-in-general/treatment/radiotherapy/external/types/proton-beam-therapy</p> <ul style="list-style-type: none"> - Information mostly aimed at patients. - Links to general cancer and treatment information <p>Proton therapy research at University of Manchester (Precise Group): https://www.bmh.manchester.ac.uk/research/domains/cancer/proton/</p> <ul style="list-style-type: none"> - Overview of proton therapy research at the University of Manchester - Information on research areas and people involved