# Skin Cancer - prevention and treatment

Researching Physics

Higher

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Researching Physics Skin Cancer - Prevention and Treatment

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Overview of the unit and activities.

**What is involved in the unit 'Researching Physics'?**

Studying physics involves learning physics facts and concepts. It also involves developing particular skills. These include research skills, which may involve you in doing investigative experiments or researching information, perhaps from the internet. The aim of this unit is to help you develop these physics skills. You will learn some physics facts, probably in some depth, however it is the development of skills which is the focus of the unit.

**What physics content will I be learning?**

The context for your work is the prevention and treatment of skin cancer. Sunlight has been shown to cause damage to skin. It is the ultraviolet part of sunlight that causes skin cancer. You will investigate the properties of UV and suncreams which prevent the harmful radiation reaching the skin.
Treatments of skin cancer can involve surgery (removal) or therapy, in which lasers and light sensitive chemicals are used. Physics underpins these and many other medical applications.

**What activities will I be doing?**

This material describes activities which develop skills in doing research in physics. Some of the activities are designed to develop particular skills and some use all the skills to carry out research activities.
There are three types of research activity in the unit.

**Undertaking literature based research** is a hugely important skill. In this unit, this is best carried out as web-based research. It is easy to simply look up a single fact on the internet, but undertaking a more structured project is more complex. Sifting through what is often a large amount of data is demanding. Keeping track of what you are trying to find out is one of the most difficult parts of this type of research, and summarising what you have found, without merely cutting and pasting someone else's work is also challenging. In this material, there is an activity which describes how best to carry out web-based research. There are also several research briefs which can be used in preparation for your investigation.

**Investigative practical work** can be fun and challenging. Planning and designing experiments is often the hardest part of this work. Actually carrying out the experiment may be straightforward. This material includes a number of activities which develop the skills required to do investigative practical work. There are also several investigation briefs which you can use to help you plan and carry out an investigation. The experiments you are likely to carry out in your investigation are not the kind where you can simply look up the results beforehand. There may be no right or wrong answers. What you find is what you find and your way of doing the experiment may not be similar to others in your class.

**Scientific communication** is hugely important. It does not matter how interesting or ground breaking your work is; if you cannot communicate your results then you have not completed your work. Information from your web research and data from your practical work will contribute to an assignment that you will complete under supervised conditions. This assignment is assessed externally by the SQA. You can pass this unit without completing the assignment, but you cannot get an overall course award in Higher Physics without doing so.

# Organising your work and carrying out the activities

## How will I organise my work?

Some of the work you carry out in this unit will be in preparation for your research into one or more aspects of the prevention and treatment of skin cancer. When you carry out the research activities themselves, it is likely that you will be responsible for organising your work.

You are required to produce a report on the results of a piece of web-based research, and you may produce a report of your practical investigation that you may submit as your assignment for SQA assessment. You are strongly advised not to produce these “as you go along”. Rather, it is very good practice to maintain a diary, or record of work. This should record all your experimental results, ideas, problems you met, references and all the other day to day observations and data that you want recorded. The record of work is your record and as such it should be in a format that suits you. However, experience shows that students who organise their work for ease of reference are likely to be able to extract the information more easily and the resulting reports are likely to be easier to produce.

## Will I do the same work as everyone else in my class?

This material includes a number of web-based research and practical investigation briefs. It is likely that students within the same class will be allocated different activities, depending on resources available and other classroom management issues.

## What about teamwork?

It is probable that you will undertake some of the work as part of a group. Sometimes, within your team, you will be undertaking the same task and other times you will each focus on a different part of the task. In either case, it is important that discussion takes place. Agree the part that each member of the team will play and ensure that there is time to share the results of the work.

# Assessment issues

## What do I have to do to pass this unit?

As you work on this unit, you will carry out activities which develop your skills in undertaking research in physics.
Two of the activities contribute to the unit assessment. To be awarded the unit, you need to demonstrate that your work is of at least the required standard in each of the two types of activity.
The two types of activities are:

- Undertaking web based research
- Carrying out investigative practical work - you need to take an active part in planning and carrying out an investigation.

## Do I need evidence?

For the web based research and scientific communication, you should ensure that you retain evidence that your work is of the required standard. Each year SQA will ask to see the evidence from a number of candidates. This process is easiest to manage if your evidence is stored in an e-portfolio. You can store text based work, together with pictures, web pages, and any other material which you wish to present as evidence. If you do not use an e-portfolio, you should ensure that your evidence can be easily accessed.

## What about assessment in the Higher Physics exam?

The Higher unit - Researching Physics is available as a free standing unit. It is also a required unit for a course award in Higher Physics. There will not be any questions in the Higher Physics course assessment which specifically relate to the topic of this unit. However, there will be questions in the course assessment which relate to the skills that you have developed in the unit. The following are the skills which may be assessed in the course assessment:

- Selecting information from texts, tables, charts, graphs and diagrams,
- Presenting information in a variety of forms,
- Processing information,
- Planning and designing an experiment,
- Evaluating experimental procedures,
- Drawing conclusions and making predictions based on evidence provided.

**Research Brief**

Skin cancer is one of the commonest forms of cancer and causes a significant number of deaths each year. It is a growing problem.

In carrying out your research you should answer the following questions.

- What are the main types of skin cancer?
- What are the incidence rates of skin cancer in the UK and in other countries?
- What are the trends in the incidence rates of skin cancer?

Answer the questions by carrying out research. It is probable that this is best undertaken using web-based research. You are advised to have completed an activity in which you consider the issues of undertaking web-based research. This may have been done during your work on other units in Higher Physics.

You may work individually or as part of a team.

Produce a report of your findings. This may be hand written, printed or electronic and saved in an e-portfolio.

You should spend approximately 2 hours on this activity.

If you work as part of a team which produces one report, you should include a short statement at the end of the report that indicates which part of the work you were responsible for.

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Research activity 1

Prevention of skin cancer

**Research Brief**

Skin cancer is one of the commonest forms of skin cancer and causes a significant number of deaths each year. It is a growing problem.

In carrying out your research you should answer the following questions.

- What are the characteristics of UVA and UVB? In particular, you should find out about the frequency, wavelength, atmospheric absorption and energy.
- How does ultraviolet light damage skin cells? What is it about the UV that causes the problem?
- What is the difference between a sunblock and a sun filter?
- What is UV index and how can it provide information to help avoid exposure to too much sunlight?
- Suncreams are rated with a Sun Protection Factor (SPF). What does this mean?

Answer the questions by carrying out research. It is probable that this is best undertaken using web-based research. You are advised to have completed an activity in which you consider the issues of undertaking web-based research. This may have been done during your work on other units in Higher Physics.

You may work individually or as part of a team.

Produce a report of your findings. This may be hand written, printed or electronic and saved in an e-portfolio.

You should spend approximately 2 hours on this activity.

If you work as part of a team which produces one report, you should include a short statement at the end of the report that indicates which part of the work you were responsible for.

# Treatment of skin cancer - Surgery, radiotherapy and photodynamic therapy

**Research Brief**

Photodynamic therapy is a treatment for skin cancer. It is sometimes used as an alternative to surgery or radiotherapy. Photodynamic therapy uses laser or other light sources, combined with a light sensitive cream, to destroy cancer cells. If a laser is used, the energy required to activate the light sensitive cream is applied in a short time. By using organic semiconductors, the same total energy can be delivered over a longer time.

In carrying out your research you should answer the following questions.

- What are the advantages and disadvantages of surgery?
- What is the physics underlying radiotherapy?
- What is the physics underlying photodynamic therapy (PDT)?
- Why is a laser (or other monochromatic light source) used in photodynamic therapy?
- What is an organic semiconductor, and how is it used in photodynamic therapy?

Answer the questions by carrying out research. It is probable that this is best undertaken using web-based research. You are advised to have completed an activity in which you consider the issues of undertaking web-based research. This may have been done during your work on other units in Higher Physics.

You may work individually or as part of a team.

Produce a report of your findings. This may be hand written, printed or electronic and saved in an e-portfolio.

You should spend approximately 2 hours on this activity.

If you work as part of a team which produces one report, you should include a short statement at the end of the report that indicates which part of the work you were responsible for.

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Practical activity 1A

Investigating the  absorption of UV with different thicknesses of applied suncream.

**Investigation Brief**

Suncreams stop harmful UV radiation reaching the skin.
Some are supplied in a tube for spreading on the skin and some can be applied from a spray.  In either case, it is possible to apply a thick layer or a thin layer.  Does it matter?

The aim of this investigation is to determine the absorption of UV by a layer of suncream and find how the absorption depends on the thickness of the layer applied.

Discuss how you will carry out the investigation.
Write your plan in your record of work.
You should also include an hypothesis in your record of work.  What do you think is the relationship between the thickness of the layer applied and absorption of UV?

**Investigation Notes**

UV radiation monitors normally measure irradiance in output intensity per unit area.
Thus, a typical low intensity UV lamp may emit approximately 10 $mWcm^{-2}$.
UV lamps can be harmful.  Make sure that you read the safety leaflet which is supplied with the UV lamp.
Some cheap UV monitors do not measure the irradiance of UV radiation.  Rather, they give an indication of UV index. It is possible to undertake this investigation with such a monitor, but results will be less reliable and accurate.
UV radiation passes through some transparent materials better than others.  Some plastics absorb very little UV.

Including the planning stage, it is likely that this investigation will take up to three hours.

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Practical activity 1B

Investigating the shelf-life of Suncreams

**Investigation Brief**

Suncreams stop harmful UV radiation reaching the skin.
Does their effectiveness change with time?  Can you continue to use a product for many years?

The aim of this investigation is to determine whether the effectiveness of suncream reduces after a period of time.

Discuss how you will carry out the investigation.
Write your plan in your record of work.
You should also include an hypothesis in your record of work.  Do you think that it is likely that the effectiveness of suncreams remains the same after one or more years?

**Investigation Notes**

UV radiation monitors normally measure irradiance in output intensity per unit area.
Thus, a typical low intensity UV lamp may emit approximately 10 $mWcm^{-2}$.
UV lamps can be harmful.  Make sure that you read the safety leaflet which is supplied with the UV lamp.
Some cheap UV monitors do not measure the irradiance of UV radiation.  Rather, they give an indication of UV index. It is possible to undertake this investigation with such a monitor, but results will be less reliable and accurate.
UV radiation passes through some transparent materials better than others.  Some plastics absorb very little UV.

Including the planning stage, it is likely that this investigation will take up to three hours.

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Practical activity 1C

Comparing High and Low Factor Suncreams

**Investigation Brief**

Suncreams stop harmful UV radiation reaching the skin.
Manufacturers' products are rated with a Sun Protection Factor (SPF).
Suncreams can have SPF values from 6 to over 50.

The aim of this investigation is to determine the relationship between SPF and the absorption of UV radiation

Discuss how you will carry out the investigation.
Write your plan in your record of work.
You should also include an hypothesis in your record of work. What do you think is the relationship between SPF and absorption of UV?

**Investigation Notes**

UV radiation monitors normally measure irradiance in output intensity per unit area.
Thus, a typical low intensity UV lamp may emit approximately 10 $mWcm^{-2}$.
UV lamps can be harmful. Make sure that you read the safety leaflet which is supplied with the UV lamp.
Some cheap UV monitors do not measure the irradiance of UV radiation. Rather, they give an indication of UV index. It is possible to undertake this investigation with such a monitor, but results will be less reliable and accurate.
UV radiation passes through some transparent materials better than others. Some plastics absorb very little UV.

Including the planning stage, it is likely that this investigation will take up to three hours.

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Practical activity 2A

Investigating the spectra of light sources.

**Investigation Brief**

Photodynamic therapy is a useful treatment for some types of skin cancer. The treatment involves applying a photosensitive cream to the skin. This is activated by light which is usually a laser or other light source which produces light of a certain frequency. Finding a suitable combination of cream and light source requires that the characteristics of the light source are known. A spectrophotometer can be used to measure the intensity of light at different frequencies.

The aim of this investigation is to use a spectrophotometer (or similar equipment) to investigate the spectra of a number of light sources.

Discuss how you will carry out the investigation. You will need to consult with your teacher on the following points:
What light sources do you wish to investigate, and what is available?
What kind of spectrophotometer is available?
Write your plan in your record of work.

**Investigation Notes**

Spectrophotometers can be very expensive items. However it is possible to use a spectroscope to produce a spectrum. A digital camera can be used to capture the image and software is available which allows the spectrum to be analysed (http://www.cabrillo.edu/~dbrown/tracker/).

Including the planning stage, it is likely that this investigation will take up to three hours.

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Practical activity 2B

Comparing the irradiance of light from a laser and a light emitting diode.

**Investigation Brief**

Photodynamic therapy is a useful treatment for some types of skin cancer. It involves using light to activate a photosensitive cream. The frequency of the light used has to be such that the energy of each photon is enough to excite the molecules of the cream so that a chemical reaction takes place. This is usually done with a laser. However, recent research in Ninewells Hospital in Dundee has shown that it is possible to use an organic LED and expose the cream for a longer time.

The aim of this investigation is to compare the irradiance of laser light with the light emitted from a LED.

Discuss how you will carry out the investigation.
How will you measure the irradiance of the light from a laser and an LED?
At what distance will you measure the irradiance?

Write your plan in your record of work.

**Investigation Notes**

For safety reasons, the lasers found in laboratories are restricted in their power output. They are rated according to a classification system and manufacturers provide data for their products. It is not recommended to use laser pointers as they are unclassified.
LEDs come in many colours and have various power ratings.

Including the planning stage, it is likely that this investigation will take up to three hours.