Learn Chemistry

Small Materials to Solve Big Problems: Nanochemistry in Innovative Technology

Student Guide

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Resource Overview

This resource is designed for year one or two of an undergraduate BSc honours chemistry or physical sciences course. The context of the resource is to examine nanomaterials for the purpose of preparing a commercial product, while giving the students an introduction to the synthesis and characterisation of nanomaterials. Context/Problem Based Learning (C/PBL) is a teaching methodology that aims to increase students' engagement with a subject by delivering courses based upon real-life applications of the principles, techniques and experiments students encounter in their undergraduate courses. These real world contexts are presented in the form of problem scenarios which are ill-defined, and have a number of satisfactory solutions. Learners work collaboratively to solve problems and acquire new knowledge and present the outcomes or product. This approach provides the opportunity to develop valuable transferable skills such as communication, team working and problem solving. Students are encouraged to take control of their learning and real world examples are used as an effective means to promote real learning. Academic staff adopt the role of facilitator or guide during this process. It is recommended that the following review on context and problem based learning be consulted for further information; T.L. Overton, Context and Problem-Based Learning, New Directions, Issue 3, Oct. 2007, pages 7-12.

The resource is a paper based exercise, but will be supported with data previously collected from experiments, which is available electronically. You will be presented with an introduction to nanochemistry and with self directed exercises to introduce concepts. Characterisation techniques for nanomaterials showing the instrumentation used and the applications of these materials in a real life context will be considered. Figure 1 provides an outline of how this will be achieved. The module has been designed to allow students to build an introductory level knowledge about nanomaterials and their applications during the workshops, which include student presentations and debates as depicted in Figure 1. The case study will allow you as groups to build on your learning to compile your case study material into a wiki format and present it to the class. Introductory support on the synthesis of nanomaterials and the characterisation techniques involved have been supported with electronic resources provided.

The workshops have been designed to promote student driven learning. Each workshop should take up to three hours per session. The assessment has been aligned with the learning outcomes (both for the module and the individual workshops) to address transferable skills in parallel with the scientific context. The workshops will encompass: student presentations, debates, group wikis, and individual reflective statements.

Guidelines are provided in the appendix to this guide on:

- Using a wiki
- Preparing presentations
- Writing a reflective piece
- Plagiarism

These should be read and followed when preparing work.

This resource aligns with the RSC Chemistry for Tomorrow's World priority areas “Future cities” and “Human health.”

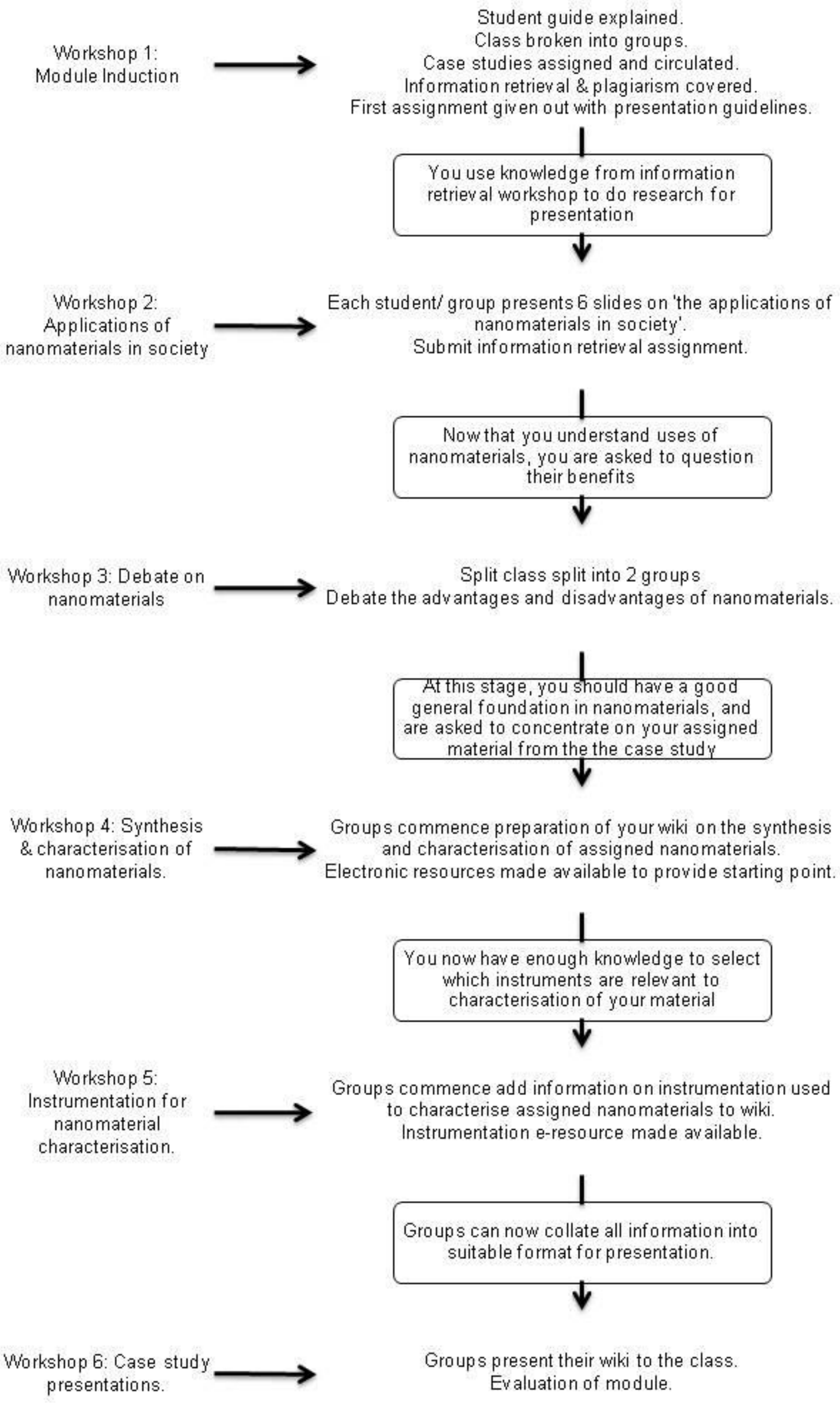


Figure 1: Overview of workshop sessions.

Module Learning Outcomes

On completion of the resource, the learner will be able to do the following within the context provided:

- Describe nanomaterials and the difference between their properties and those of the bulk material.
- Explain the applications of nanomaterials and discuss the advantages and disadvantages of using them.
- Identify instruments suitable for the characterisation of nanomaterials.
- Suggest which instruments and techniques will be suitable for the identification of particular nanomaterials.
- Prepare group reports on your research of the subject area and support this work with individual reflective statements.

Transferable skills

This resource allows the learner to further develop the following transferable skills:

- Problem solving: learners work in groups to address the brief presented in the contextualised scenario.
- Analytical and critical thinking: learners use their background knowledge to inform opinion in the debate, and decide on synthetic protocols and characterisation methods.
- Team work: learners work in groups to complete the task assigned, use a wiki to facilitate collaboration and meet between sessions to review progress.
- Communication skills: learners present (oral presentation) and report (wiki) on the scientific work performed in keeping with the context.
- Independent learning: learners can justify decisions, assumptions and conclusions made with reference to supporting documents and literature in order to produce a logical and clearly reasoned scientific proposal.
- Information technology skills: learners use a wiki to collaborate and develop their ability to use word-processing, spreadsheet, presentation, chemical drawing and library database software.
- Metacognition: learners reflect on the process involved in working on the brief given, the extent to which the stated learning outcomes were met and to which their transferable skills were developed.

Assessment

Table 1 provides an outline for the assessment of this module. For certain workshops, additional detail is given on assessment of specific tasks driving the session, but in general, this can be used as a guideline for the module.

Table 1: Overall assessment of module

Assessment Component	**Mark Allocation**	**Assessment mark**
Information retrieval (Workshop 1)	Individual	10%
PowerPoint presentation (Workshop 2)	Individual	20%
Debate (Workshop 3)	Individual	20%
Case Study Breakdown: Attendance and contribution at workshop 4 Attendance and contribution at workshop 5 Attendance and contribution at workshop 6 Group wiki Peer assessment mark for wiki presentation Final individual reflective piece	 Individual Individual Individual Group Group Individual	**50%** (5%) (5%) (5%) (20%) (5%) (10%)

Since this module is continuously assessed, you must submit an assignment or present/prepare work each week by the deadlines shown in Table 2. It is very important that you submit assignments on or before the deadline and that you check the timetable below carefully. All assignments should be prepared/submitted on a weekly basis as shown below during the workshop session unless otherwise indicated by your module tutor.

Table 2: Outline of module assessment submission/presentation dates

Module Week	**Outline of Assessment Description**
Week 2 Date:	Submit a library information assignment from week 1. Present a 6 slide presentation per individual on 'the applications of nanomaterials in society'.
Week 3 Date:	Submit debate points to module tutor in advance of the debate. Attend and participate in the debate.
Week 4 Date:	Prepare material for wiki on the preparation of nanomaterials and characterisation for case study.
Week 5 Date:	Prepare material for wiki on instrumentation for case study. Finalise material for the project description template.
Week 6 Date:	Present as a group the case study wiki and submit a compilation of individual work.

Bibliography

This bibliography is provided to give a starting point for your research.

Nanochemistry: A Chemical Approach to Nanomaterials, Ozin, G.A., Arsenault, A.C., Cademartiri, L.; 2009, Published by Royal Society of Chemistry

Concepts of Nanochemistry, Cademartiri, L., Ozin, G.A., Lehn, J.M,; 2009. Wiley-VCH.

Nanomaterials chemistry: recent developments and new directions, Müller, A. K. Cheetham, Wiley-VCH, 2007.

Royal Society event: The Lilliput Laboratory: Chemistry & biology on the small scale http://tinyurl.com/nanochem1, accessed August 2011.

First Experiences Teaching Experimental Nanoscale Science and Technology to Undergraduate Students, Shanov, V., Yun Yeo-Heung; Smith, L., Iyer, S.S., Jadhav, S., Hoang, T.B., Gorton, A., Schulz, M., Mantei, T., Abel, J., Barbour, C., D'Souza, N., Direnzi, C., Dlesk, D., Kier, Z., Negassi, N., Schaub, R., Seger, K., Wagner, R., Witt, E., Bickle, J., Paputsky, I., Gerner, F., IEEE-NANO 2006, 1, 410- 413.

Feyman's Fancy; P. Ball, in *Chemistry World*, Royal Society of Chemistry, 2009, vol. January, ch. 58, pp. 58-62. http://tinyurl.com/nanochem2

Semiconductor Clusters, Nanocrystals, and Quantum Dots. Alivisatos, A. P.; Science, February 1996, 271, 933 – 937

Quantum dot technologies explained in three levels of difficulty http://tinyurl.com/nanochem3

Resource for anyone interested in learning about Nanoscience and Nanotechnology http://tinyurl.com/nanochem4

Putting the nano into nanochemistry, Chemistry World, December 2005 http://tinyurl.com/nanochem5

Nano-regulation creeps closer, Chemistry World, February 2009 http://tinyurl.com/nanochem6

Why do we worry about Nanomaterials?, Report by Royal Society of Chemistry Environmental Health and Safety Committee, August 2010 http://tinyurl.com/nanochem7

10 things you should know about nano http://tinyurl.com/nanochem8

A full suite of learning materials, including teacher and student materials, for introducing the topic of nanotechnology http://tinyurl.com/nanochem9

Video Lab Manual for Nanotechnology experiments http://tinyurl.com/nanochem10

Introduction to topics on Nanotech Project: http://tinyurl.com/nanochem11

Contextualising nanotechnology in chemistry education, O'Connor, C., Hayden, H.; *Chemistry Education Research and Practice,* 2008, 9, 35-42 (Accessible from the RSC website)

ACS Nanotation – collection of papers and discussions on nanotechnology http://tinyurl.com/nanochem12

Other useful links http://tinyurl.com/nanochem13

Nottingham Science – What is nanotechnology http://tinyurl.com/nanochem14

Online educational resources on nanotechnology http://tinyurl.com/nanochem15

TED^x Talk: Peter Janse van Rensburg - 10 Nifty Things You Can Do With Nanotechnology http://tinyurl.com/nanochem16

TED[x] Talk: Dr. Wade Adams – Nanotechnology: Making Small Stuff do Big Things
http://tinyurl.com/nanochem17

Wikipedia article on nanochemistry(last accessed April 2012) http://tinyurl.com/nanochem41 and nanoparticles http://tinyurl.com/nanochem42

Research into nanotechnology to prevent AIDS by Jacob Silverman (last accessed April 2012) http://tinyurl.com/nanochem43

How could gold save my life? (last accessed April 2012) http://tinyurl.com/nanochem44

How Nanotechnology Works by Kevin Bonsor and Jonathan Strickland (last accessed April 2012) http://tinyurl.com/nanochem45

British scientists 'seek and destroy' cancer cells using iron nanoparticles By David Derbyshire, Daily Mail, 5 October 2009 (last accessed April 2012) http://tinyurl.com/nanochem46

"Atomic, Monatomic, Subatomic Particles" http://tinyurl.com/nanochem47

Class organisation

Insert table of case study groups.

Workshop 1: Module Induction and Information Retrieval Session

Introduction to Case Study - Preparation and characterisation of nanomaterials

Workshop 1 will be broken into two sessions. The first part will be a module induction from your tutor in which you will receive the student guide for the module. The second part of the workshop is an information retrieval session from your institute's librarian. If you have done such a library session before, inform your tutor and a shorter recap session may be put in place. The class will be split into groups given a contextualised case study under the three themes highlighted in Figure 2. One of five case studies (potentially 8 case studies) will be assigned to your group, giving you a nanomaterial to research within a particular context. The contexts should be addressed at each workshop over the course of the module. There is a possibility of five to eight case studies as shown, however given the variety of content covered under carbon allotropes, this may be further sub-divided.

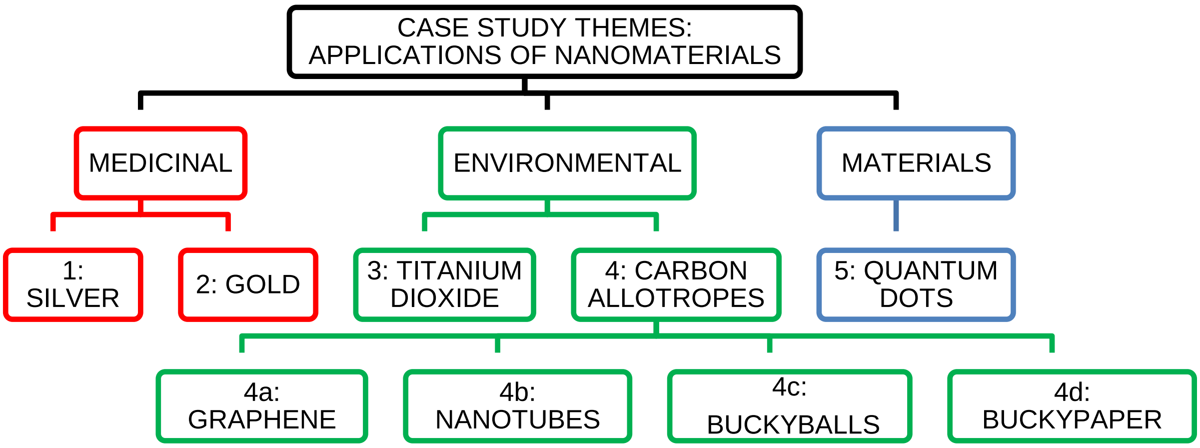


Figure 2: Themes for case study and examples of relevant nanomaterials.

Each case study has an associated scenario on which the group has to carry out research to address a real life application, and prepare a group presentation/report in the form of a wiki (the content of which should cover a project description template as supplied). Each individual will also have to provide a reflective piece on their contribution to the case study and the final report.

As outlined in Table 1, assignments will be due each week, details of which will be provided in each workshop description that follows. A major output from your work will take place in workshop 4 and 5, when you will be expected to create a group wiki on your case study on:

1. The synthesis and characterisation of your assigned nanomaterial and
2. Three types of analytical instruments you have selected to characterise your nanomaterial.

You are provided with a template for the content of the wiki and a word count with each case study. Guidelines for the preparation of the wiki are given in the appendix. If you require further guidance on getting your research started, you should consult your module tutor as soon as possible. You will also be required to submit an individual folder of work at the end of the module, this should be compiled as the module progresses as hardcopy evidence of the work you are doing. Your tutor will use this when assessing individual contributions to group activities.

Workshop 6 will be the culmination of your work as a group. The case study wiki will be presented by the group to the class. The presentation will be assessed by the tutor and your student peers. An individual reflective piece is also required to feedback on how you as individual students contributed to the case study, and what you learned during the process of the group exercise and the module as a whole.

Completion of the case study will enable you to:

- Provide an overview of the synthesis of the nanomaterial in your case study.
- Create an information portal *via* a wiki/PowerPoint presentation with other members of their peer-group.
- Construct a well designed description from the information retrieved.
- Provide an overview of an instrument capable of characterising nanomaterials.
- Evaluate the importance of the data provided from the instrument.
- Construct a well designed instrument description from the information retrieved.
- Evaluate the importance of the data provided from the literature.

Getting started as a group

Your group will be assigned a particular case study. Working in your assigned groups, compile an initial list of actions for your group work, and assign responsibilities and due dates. Ensure to check through the list of tasks to be completed. Consider what you need to do and what information you need to get. Arrange a time when the group will have a short meeting to review progress before the next workshop. It is important that you contribute to your group taking account of your relevant skills and experience, but it is also expected that you will contribute to areas you are less experienced in. A wiki will be used to support your group work, by sharing a collaborative online work space. The wiki for each group is intended to provide a means to produce a presentation in a format that each group member can access, modify and review by means of the wiki pages. In addition, it should be used as a forum for posting relevant files, and linking them to wiki pages, organising pages that summarise the project management process, organising meetings and work to be done, preparing draft work, asking questions of other group members and providing feedback by leaving comments on pages. It will develop into a very useful archive of information for your group if used effectively. Care should be taken to name each page, file and link clearly, and to identify each comment as to its content so that information can be found easily. Your final task on completion of the module work will be the production of a reflective piece. It is recommended that you become familiar with the topics that need to be addressed by reading the guidelines provided in the appendix towards the beginning of the project so that relevant notes can be made over the course of the project. You are also required to submit an individual folder of work at the end of the module, this should be compiled as the module progresses as hardcopy evidence of the work you are doing. This will be used for assessing individual contributions to group activities. Your tutor will be able to monitor each individual's contribution on the wiki, so it is important you input into the wiki throughout the process.

Information Retrieval

During this session, you will be introduced to a number of web-based and library-based sources of information available to you in your institution such as Web of Knowledge and Google Scholar. These resources will prove very useful when researching the background information for your assignments. Upon completion of this session you are asked to reflect and build on your learning by completing a short reflective exercise and preparing a short PowerPoint presentation using the resources available from the Library Services.

Learning Objectives

- Demonstrate an awareness of the types of information resources available.
- Summarise where to find them within a library context.
- Begin to evaluate the relevance and reliability of academic resources.
- Apply them to a chemistry assignment.

Assignment to be completed before Workshop 2:

After completing the information retrieval workshop, please complete the following two exercises:

1. You should use the library resources available to prepare a PowerPoint presentation for the next workshop on 'Applications of Nanomaterials in Society' under the theme of your case study. The slides should tell a story with a start, middle and end, and cover current applications of the relevant nanomaterials in society or research into potential uses, with relevant diagrams, images and references. The slides must be e-mailed to the tutor by 5 pm the day before the presentations, and a copy should be brought on memory key the day of the presentation. In this workshop you will experience how to use PowerPoint to prepare a professional looking presentation. Useful tips are provided in the appendix to assist you in doing this.

2. Complete a reflective exercise on what you learned in this workshop, choosing **one** of the following assignment formats:

    1. Outline the different types of academic information resources available for chemistry and where to find them **as a visual representation** e.g. a mindmap or flowchart.

       You can use freeware such as:
       - EDraw (http://tinyurl.com/nanochem21)
       - Bubbl (http://bubbl.us/)
       - VisualMind v11 (http://tinyurl.com/nanochem22)
       - MS PowerPoint or other software

       Please print out your mindmap for submission.

    OR

    Prepare a written reflective piece (approx 500 words typed) indicating:

    - which information resource types you were shown in the class which were new to you
    - what you need to access them
    - where you can locate the different types of resources
    - which parts of the session on information retrieval you found most useful

Workshop 2: Applications of Nanomaterials in Society

In this workshop you will present six PowerPoint slides on the topic 'Applications of Nanomaterials in Society' under the theme of your case study. The slides must be e-mailed to your module tutor by 5 pm the day before the presentations and a copy should be brought on memory key on the day of the presentation. You should use this opportunity to learn about other applications of nanomaterials from the other presenters and you may also pick up some presentation skills from the other students.

Learning Objectives

- To retrieve relevant information about nanomaterials and their applications.
- To understand how to use PowerPoint to prepare a professional presentation.
- To evaluate and provide a well supported opinion on the application of nanomaterials in society.
- To participate in a discussion of academic interest with other members of your peer-group.
- To discuss the role of nanomaterials in society and particularly its applications in society.
- To evaluate the importance of a number of applications of nanomaterials in society.

Assessment

Table 3: Assessment components for the group presentation

Assessment component	**Mark**
Submission of powerpoint presentation	30%
Presentation marks:	
Attendance at presentation	10%
Content	15%
Clarity and structure	10%
Visual impact	15%
References	10%
Questions answered at end of talk.	10%

Assignment to be completed before Workshop 3:

Following on from your research on the applications of nanomaterials in society, you will be required to submit 10 debate points (5 advantages and 5 disadvantages in relation to the applications of nanomaterials in society). The points should be validated with a reference from a textbook, journal publication, newspaper or some other source. E-mail your debate points to your tutor prior to the debate taking place, and bring a copy of your points with you on the day of the debate.

On the day of the debate the class will be split into two groups, arguing the advantages and disadvantages of nanomaterials. Your tutor will place you in one of the groups at random, so you should be prepared to take either side in the debate.

The assignment will be assessed on the submission of the debate points, and the attendance and participation at the debate. You will not be marked directly on winning or losing the debate.

Workshop 3: Debate: 'Advantages and disadvantages of nanomaterials in society'.

In this workshop you will be split into two groups to debate (for and against) the applications of nanomaterials. Having submitted 5 points to support each side, you will be placed in a group for the debate. Your points will support the groups' arguments, and be used when putting together the final argument.

When your tutor has split the class, your group should first elect a spokesperson and a recorder. The recorder will be required to take note of points from members using a white board/flip chart in order to decide as a group their top 10 points to give to the spokesperson for the debate. Your tutor will assign a time frame for this to be done in, so make sure to work efficiently in order to be fully prepared.

The debate will be structured so that each spokesperson can state their points without interruption and once the points have been delivered from each side the group can be asked to contribute to the debate (usually better facilitated if students raise their hand to make a point). The tutor can summarise some of the main points on the board/flip chart to wrap up the debate session. All statements should be supported from reliable sources.

This assignment is assessed as an individual one. The assignment will be marked on the submission of the debate points and the attendance and participation at the debate and the marking scheme is given in Table 4. You will not be marked directly on winning or losing the debate.

Learning objectives

- To evaluate and provide a well supported opinion on the application of nanomaterials in society.
- To participate in a discussion of academic interest with other members of your peer-group.
- To discuss the role of nanomaterials in society and particularly its applications in society.
- To construct a well-reasoned argument based on the information retrieved.

Assessment

Table 4: Assessment components for the debate

Assessment criteria	Assessment mark
1. Submission of debate points	30%
2. Attendance and participation at debate:	
a. Attended the debate	10%
b. Attended the debate and gave points to the group	20%
c. Attended the debate and had input into the groups selection of points to make	30%
d. Attended the debate and had some input into the group discussion	40%
e. Attended the debate and had a lot of constructive involvement in the group discussion	50%
f. Attended the debate and had input from (b - e)	60%
g. Attended the debate and made a major contribution to the debate which was supported by research findings	70%

Assignment to be completed before Workshop 4

In preparation for the next workshop, you should research synthetic methods for preparation of your assigned nanomaterial from your case study. This information should be brought to the next workshop for discussion.

By the end of this workshop you should have provided your tutor with **<u>your email address</u>** to allow wikis to be setup for each group. A guide to using a wiki is included in the appendix to this guide, depending on which wiki your tutor chooses to use, instructions will be available on them on how to set up the group workspaces. Your tutor will discuss the wiki in more detail in the next workshop.

Workshop 4: Synthesis and cost of nanomaterials

Part 1: Introduction to using a wiki as a tool to support and assess the workshops

This workshop will explore the uses and versatility of wikis, and sets out protocols for the wiki based project. Guidelines are provided in the appendix on how to use a wiki. All members of your group will have received invitations to your wiki by e-mail. Uploading files and editing page details can be practiced at this stage.

Examples of Nanotechnology wiki's

- http://tinyurl.com/nanochem24
- http://tinyurl.com/nanochem25
- http://tinyurl.com/nanochem26

Advice for successful collaboration:

From now until the end of this activity, a list of actions should be compiled before you leave each workshop (i.e. things that must be done before the next workshop). Name the people responsible for completing each action, and arrange a time when the group will have short meetings to review the group's progress before the next workshop.

Part 2: Synthesis of nanomaterials

This part of the workshop will give you an overview of the synthesis of nanomaterials and identify the instruments used to characterise the nanomaterials in your case study. You will be required to create a wiki or give a PowerPoint presentation as a group on your assigned case study. If the wiki is used this should be prepared by the group as a whole, and you may be graded on your input to the wiki (guidelines on preparation of a wiki are given in the appendix).

Your case study identifies a specific nanomaterial, you are requested to research a suitable nanomaterial application, describe how it is prepared, cost the preparation of the nanomaterial, and identify three instrumental techniques to characterise the nanomaterial. You should also record any unusual properties the nanomaterial may have.

In this workshop you should focus on the synthesis and costing of preparing your nanomaterial. Synthesis and/or characterisation of each nanomaterial is provided as an electronic resource. This should be used alongside your own research to identify a suitable method for the production of the nanomaterials.

Once a method has been agreed upon in the group, costing should be estimated based on preparation of 100 mL or 100 g of the selected nanomaterial. The costing can assume a yield of 90% for each synthetic step. They must remember to include VAT (20 %) on all raw materials to be purchased. ChemSpider provides a chemical vendors category for all compounds listed. Remember to consider whether a vendor will have to ship materials a long distance, the grade / specification for the chemical and the unit sizes that can be supplied.

An excel spreadsheet similar to that shown below may be useful for this process.

Template for Costing for Synthesis of 100 g of Target Compound								
Name of Chemical	Name of Vendor	Purity Grade and Product Number	Quantity Required (g or ml)	Unit Size	Cost per Unit (€ or £)	No. of Units Required	Total Cost Including VAT*	Actual Cost to Produce 100 g of Target Compound (€ or £)
Example only- Acetone	Jupiter Chemicals	Reagent grade, >99.5%, Prod. no. 179124	450 ml	500 ml	23.80	1	28.56	25.70
							Subtotal:	
							Overheads:**	
* Value Added Tax = 20%							Total Cost per 100 g:	

Learning objectives

- To provide an overview of the synthesis of nanomaterials.
- To create an information portal *via* a wiki/PowerPoint presentation with other members of your peer-group.
- To evaluate the importance of the data provided from the literature.
- To construct a well designed description from the information retrieved.

Assignment to be completed before Workshop 5

You should work as a group in advance of workshop 5 to upload information on the method and cost of synthesis for the assigned nanomaterial. In this process, you should also suggest some analytical methods/instruments which could be used to characterise the nanomaterial, although in depth research into this need not be carried out until the next workshop.

Where a wiki is being used, your tutor may check on each groups progress in advance of the next session, so be sure to keep up to date with tasks.

Workshop 5: Introduction to Instrumentation

This workshop will give you an overview of the type of instruments used to characterise a variety of nanomaterials. You are required to update your wiki or PowerPoint presentation as a group to include three instruments suitable for characterisation of your assigned nanomaterial. If the wiki is used this should be prepared by the case study group as a whole and you will be graded on your individual input to the wiki.

Suggested instruments:

1. Atomic Force Microscope (AFM)
2. Scanning Electron Microscope (SEM)
3. Transmission Electron Micrscope (TEM)
4. X-Ray Diffraction (XRD)
5. UV/Vis Spectrometer
6. Fluorimeter
7. Laser flash photolysis
8. Raman Spectrometer
9. Dynamic Light Scattering (DLS)

Images of each instrument and sample data have been supplied in the supporting electronic resource. You are requested to describe the instrument, comment on how it operates, what data it will provide, and the instrument limitations/sample considerations if any.

Learning objectives

- To provide an overview of instruments capable of characterising nanomaterials.
- To create an information portal *via* a wiki/PowerPoint presentation with other members of your peer-group.
- To evaluate the importance of the data provided from the instrument.
- To construct a well designed instrument description from the information retrieved.

Assignment to be completed before Workshop 6

Each case study group must write on three types of instruments from the list supplied that are suitable for analysis of the nanomaterial and mention the following:

1. A description of the instrument along with an image.
2. Comments on how it operates.
3. What data it will provide.
4. The limitations of the instrument and sample requirements if any.
5. Time requirements for synthesis and analysis as a Gantt chart.

This information should be included in the wiki/PowerPoint presentation.

When producing your Gantt chart consider matters such as whether analysis is necessary during synthesis or whether it should be carried out after, if data is needed from one process before the next analytical step etc. An example of a Gantt chart is provided in the Appendix. It is desirable to carry out the work in the shortest possible timescale so you should consider which tasks (if any) can be performed simultaneously. Multiple analysis runs may be needed for accurate results (refer to Table 5 as a guideline for timings for analysis). Timings for synthesis steps should be deduced from experimental procedures.

Table 5: Timings for analytical procedures

Instrument	Time for analysis of 1 sample (min)
Atomic Force Microscope (AFM)	15
Scanning Electron Microscope (SEM)	15
Transmission Electron Microscope (TEM)	15
X-Ray Diffraction (XRD)	10
UV/Vis Spectrometer	5
Fluorimeter	5
Laser flash photolysis	5
Raman Spectrometer	5
Dynamic Light Scattering (DLS)	5

Workshop 6: Close of Module

In this workshop your group will present your work and you will listen to and assess the presentations of the other groups in your class. Your tutor may opt to invite some guest tutors to provide additional feedback.

You should be prepared to provide others with constructive feedback as well as receive constructive feedback from your peers and tutor. It is important to realise your role as an audience member for your peers. You should contribute to a supportive environment by listening attentively, making some eye contact with the presenter, asking any questions you have in a respectful and non-confrontational way and (if requested to) making some constructive comments on the peer feedback forms for the group assigned. Listening to the other presentations also provides a very useful opportunity to see how others approached the same project, and to assess what you might incorporate from their methods in the future.

You should submit your individual folder of work in this workshop as evidence of the individual work you did. Your tutor will use this when assessing individual contributions to group activities.

After the presentation, your final task is the production of a reflective piece, and this should be done once all other tasks are complete. The deadline for submission of your reflective piece will usually be several days after the presentation to give you some time to complete it. Along with any notes you made during the process, you should also find that reviewing some of the group wiki will be helpful. Guidelines are given in the appendix.

You should receive an individual form in which you are given feedback on each workshop assignment based on your folder of work which is given an overall mark as shown in Table 6. A sample peer assessment form is provided in Table 7.

Table 6: Overall module assessment form and feedback.

Assignment	Assignment weighting	Mark	Strengths	Room for improvement
Information retrieval (individual)	10%			
Powerpoint presentation (group)	20%			
Debate (individual)	20%			
Case Study (group)	50%			

Table 7: Peer assessment form for wiki presentations

Case Study Group:				
Criteria (Tick box)	**Very Good**	**Good**	**Average**	**Fair**
Wiki layout				
Content & relevance				
Clarity & accuracy of content				
Visual impact				
References				
Comment on what they did well:				
Comment on where they could improve:				
Mark out of 10				

Appendices

Appendix 1: Plagiarism

Plagiarism is not acknowledging the work of others. Therefore, all work which is not of your own creation must be accompanied by a reference which gives a detailed description of the item from which you have obtained information (e.g. article, website, book).

Important things to remember:

- Make sure that you acknowledge any information that you obtain from a particular source by including a reference.
- You should not reproduce information word for word from a reference even when you have acknowledged the source. The only exception is for a direct quotation; however these should be used sparingly. You are expected to communicate the information in your own words.
- Failure to meet these requirements means you have plagiarised work. This is the same as stealing someone else's work. If you are found to have plagiarised material, marks will be deducted.

References should be formatted according to the Royal Society of Chemistry Publishing author guidelines format. (See page eleven of the document at this link: http://tinyurl.com/nanochem40)

Useful resources:

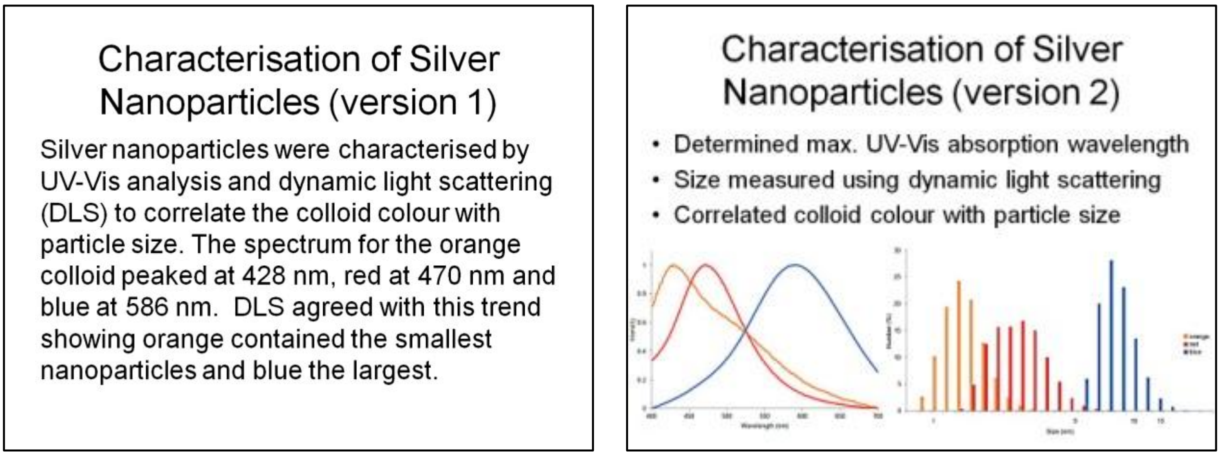
- Study and Communication Skills for the Chemical Sciences, Tina Overton, Stuart Johnson, and Jon Scott, Oxford University Press, 2011 (Chapter 10)

Appendix 2: Oral Presentation Guidelines

When preparing a presentation, take care to:

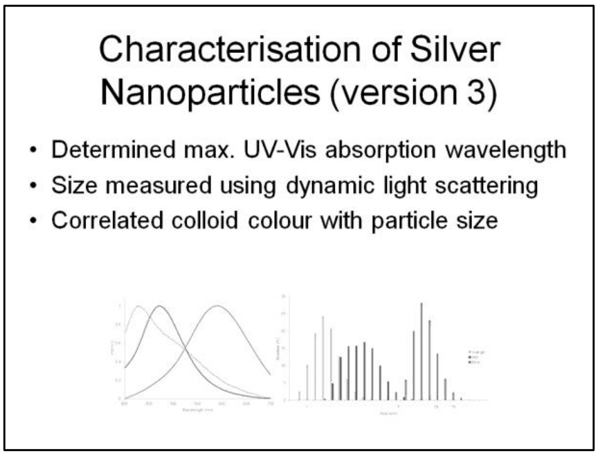
- Tailor the tone and content to the audience
- Be informative and interesting
- Keep to appropriate timing
- Make slides simple and visually engaging

Slides 1 to 3 show sample presentation slides. Slide 1 shows the common mistake of overloading slides with information. Remember you will be talking about the slides when they are shown, so can provide the additional detail then. Slide 2 expresses the same information, but the use of pictures and bullets makes it easier for the audience to take the information on board.



Slides 1 and 2: Dos and don'ts in slide preparation

As Slide 3 shows, when you have chosen the best content for the slide it is important to present it well. Ensure pictures are big enough and clear so that the audience can read the detail. Make use of the space available to you, and use a reasonable font size (preferably minimum size 20 in Arial).



Slide 3: Poor use of slide space.

Remember:

- Keep slides simple – large font, simple colours
- Bulletise text - aim for maximum 6 bullet points containing 6 words
- Pictures speak a thousand words, but make sure they are clear and big enough
- Don't over use animations
- Credit sources and provide references

It is important to carefully structure your presentation to ensure it flows well. Content can be split into three categories:

- Beginning - introduce topic on level suitable to audience
- Core - longest section covering key messages
- End - summarise results and emphasise main point

Plan your content carefully. It may not be necessary or possible to include all of the data you collected so be critical when choosing what to include. Too much information may cause you to overrun the time slot, and result in loss of marks or having to stop before you reach the final slide.

When delivering the presentation be sure to:

- Practice several times, preferably with an audience
- Check you can use the technology
- Be confident – make eye contact and try to smile
- Speak slowly and clearly
- Face your audience when you speak
- Avoid blocking the screen
- Stay calm - if you make a mistake or something goes wrong; you may be the only one who notices so take your time, correct the mistake, and move on.
- Take your time answering questions, and if you don't know an answer, just say so.

Useful resources:

- Key Skills for Scientists – Getting the Message Across, ed. Natalie Mansfield, Royal Society of Chemistry, 2007
- Study and Communication Skills for the Chemical Sciences, Tina Overton, Stuart Johnson, and Jon Scott, Oxford University Press, 2011 (Chapter 11 & 12)
- Effective Communication for Science and Technology, Joan van Emden, 2001, Palgrave, Hampshire (Chapters 6 & 7)

Appendix 3: Guidelines for using a wiki

“Wiki: A collaborative website consisting of one or more pages that allow authorized users to contribute to or edit page content.” (source: http://usermanual.pbworks.com/Glossary)

Why use a wiki?

Wiki software is very easy to use and allows people to work and to write collaboratively to produce a report/presentation/webpage. The wiki is a means of generating a very useful archive of all of the information that is relevant to a project as it proceeds. It provides the added flexibility of being able to work anywhere where a PC or laptop and internet connection are available at any time. Wikis are regularly used in organisations to allow groups to collaborate on projects and documents and to share knowledge and the ability to use one is a valuable transferable skill (see examples at the end of this section).

All previous versions of each page can be accessed using the Page History function which means that no work can be permanently overwritten or deleted. Contributions made by each member can be easily tracked to assess their quality, quantity and whether they were made across the entire timeframe of the assignment. Peer feedback and review is facilitated by the comments and page editing option. The assignments and the feedback provided can be accessed easily and stored indefinitely for future reference and are available in a flexible format (pages can usually be saved as pdfs).

What do you need to be able to do?

Instructions on the technical details of using the selected wiki are given on its website, but it is important to remember basic etiquette when preparing and updating your wiki.

The common tasks you will perform using the wiki are:

- adding and editing wiki pages
- adding comments and links to pages and
- inserting tables and chemical schemes/structures.

Most chemical drawing software allows for structures to be saved as images (required format is usually specified in the help menu).

If you have a specific technical problem, it is recommended that you check any guidelines that have been provided to you by your tutor and also ask the other members of your group for help. If you are still having a problem, you should then contact your tutor.

Always remember:

- Use folders, link related pages and name files and pages in a logical and structured way so that you can find information on the wiki easily. To help with this, your group are provided with names that should be used for the pages that will make up the main body of your report/presentation (see end of this section).
- References should be cited when necessary and all information should be put into your own words
- This information is intended for publication online so **ensure that the information is accurate, will not offend anyone and is not plagiarised.**
- The page should be informative and engaging and make a visual impact.

- Try to keep the page to a reasonable length. Long pages can cause the reader to lose interest. Try to arrange data in sensible subcategories with pages for each to make it more engaging for the reader. If your page is quite long, you may reach a stage where you can't save any additional information. If this happens, you can return to the previous version of that page in page history to retrieve it and you should begin a new second page to continue.
- The minimum knowledge level of your target audience is non-technical management at HugePharma Ltd.; the target audience is their chemical development team.
- Note that there is a space limit on each wiki page. If you find that a page is no longer accepting edits, you have probably reached the limit. You will need to add a new page, and link to this page from the end of the existing one to continue that section.

Examples of Nanotechnology wiki's

- http://tinyurl.com/nanochem24
- http://tinyurl.com/nanochem25
- http://tinyurl.com/nanochem26

Netiquette and online communication

The concept of "netiquette" is very important because when you are communicating online, there are no visual cues (you can't see the face of the person or people you are in contact with). This means that it is more difficult to communicate clearly and it is more likely that a comment may be misunderstood or misinterpreted. Also, you should remember that all comments made on a wiki remain in the page history even after they are deleted.

It is recommended that you read over a comment carefully before you add it to the wiki to make sure that it is clear and there aren't any spelling mistakes that will make it confusing. You should be respectful and polite to each other, and be conscious of not offending or insulting anyone. Use of capital letters only is the online equivalent of shouting at someone and should be avoided. The same approach applies in any professional environment.

Ground rules for your group

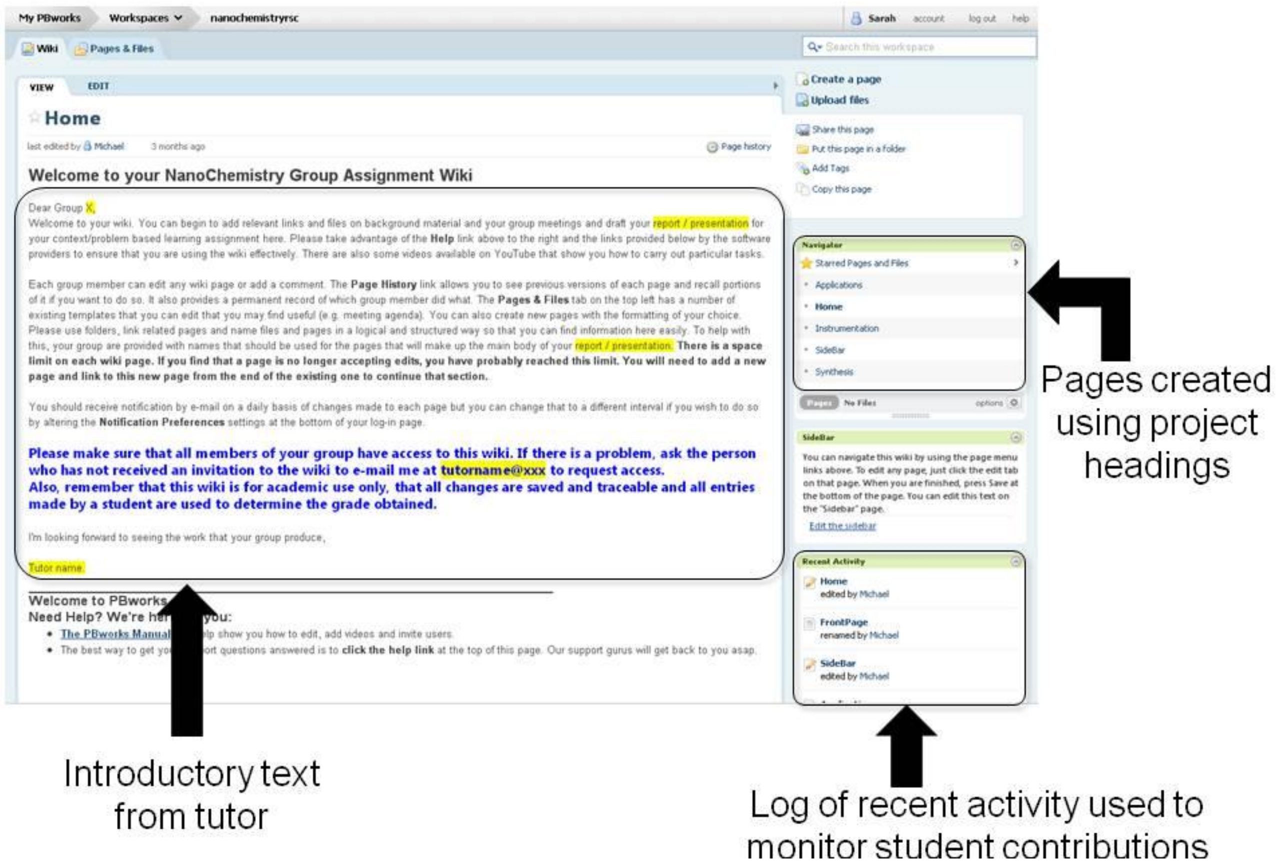
You may want to consider establishing some ground rules about working in your groups such as remaining respectful towards a group member who you feel is not contributing, providing constructive feedback to peers (e.g. posting a comment first before making changes to someone else's work), responding to a query or message within a reasonable timeframe, communicating with the group to let them know if you will be late or absent and consulting with the group in relation to important decisions.

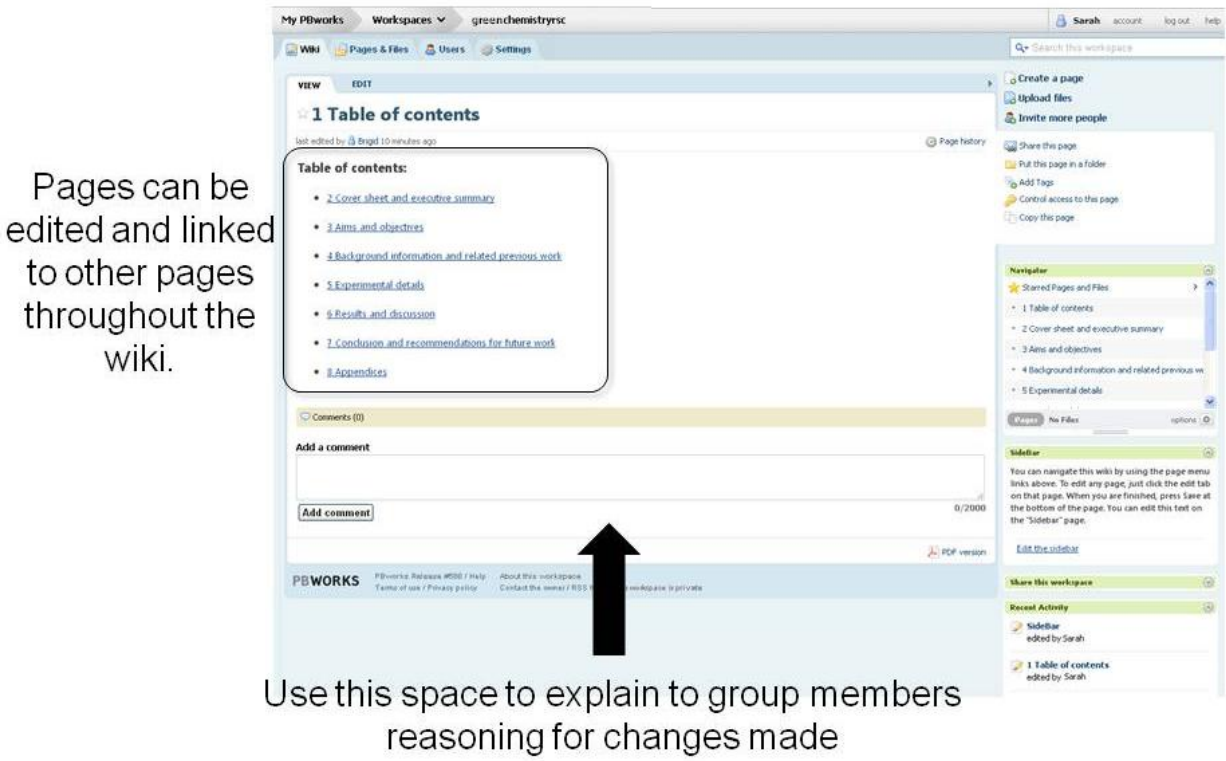
Remember that working in a group can be very productive, but it requires communication, planning and compromise.

Peer feedback and review

In the initial weeks, your group could consider waiting until a group member asks for feedback or editing of their contribution before making changes to their work. It is helpful if contributors are specific about feedback required (e.g. proof-reading for grammar, spelling and formatting or aspects such as relevance, structure, clarity and validity of the conclusions drawn). It is recommended that feedback and changes are constructive. A comment should address what was done well, and also the areas where it was felt changes were required and why.

Suggested layout of Wiki





Appendix 4: Sample Gantt chart

TASK	Day 1 -4	Day 5 - 8	Day 9 – 13	Day 13 – 17	Day 18 - 22	Day 22 - 25
Synthesis of nanomaterial						
Characterisation step 1						
Characterisation step 2						
Characterisation step 3						

Appendix 5: Wiki/presentation checklist

The following are the names of the pages that should be used to make up the main body of your wiki/presentation:

- Project overview (300 words)
    - Table of contents (with links to the other pages) or talk overview
    - Aims and objectives of project
    - Brief background on case study
    - Application of selected nanomaterial
- Method and cost of nanomaterial preparation (1500 words)
- Characterisation of the nanomaterial (1000 words)
    - What analysis will be done
    - Information it will provide
    - Constraints of method
- Gantt chart
- Conclusion (200 words)

There are also a number of pages that your group should consider adding to the wiki that will help with planning and communication. These are:

- Project planning and meetings - Use this page for summaries of your group's weekly meetings and any other project planning. Some wikis include templates for reporting on meetings that could be incorporated here.
- Ideas and suggestions - Use this page as a sounding board and suggestion box for general issues.
- Annotated bibliography - Use this page to post links or citations to useful websites, videos, articles or textbooks. Each one must include a short summary of why this information source is useful and refer to a specific page/section in it if necessary.

Appendix 6: Guidelines for your reflective piece

In this short report (500 to 800 words approx), you should:

1. Briefly describe your role in the project and the contribution you made.
2. Discuss how you experienced working in a team (consider both the positive and negative aspects).
3. Discuss any changes that you would make to how you and your group went about the project if you were repeating it.
4. Summarise what you found to be the most interesting aspect of the project as well as the most challenging aspect (presentation, debates, group work etc.).
5. Consider whether you think the project was useful to your learning and whether all of the learning outcomes were met.
6. Assess whether you have developed the transferable skills listed at the beginning of this guide further as a result of this project. Highlight any that you think are particularly important or that you have now gained confidence in.
7. Consider whether you have found that writing a reflective piece like this helps you to review what you learned over the course of the project.

This reflective piece is assessed based on;

- **content** (60% **-** there are no right or wrong opinions, but you must make sure that you discuss **all** of the topics listed above)
- **presentation** (10%) and
- **coherence, accuracy and structure** (30%).

Appendix 7: Case Studies

1. Mediwraps - Silver nanoparticles in wound dressing
2. Goldglow - Gold nanoparticles as probes to detect cancer biomarkers
3. Kleeenview - Titanium dioxide in self cleaning windows
4. Nanoklenz - Carbon Nanomaterials in water filters
5. Solarsunrayz - Quantum Dots for solar energy capture in solar panels

Case study 1: Mediwraps

Metalopharm is a pharmaceutical company which is currently investigating two applications of metal nanoparticles. Project Mediwraps uses silver nanoparticles to form antimicrobial coatings on their plasters/bandages. Metalopharm wish to investigate the viability of silver nanoparticles in wound dressing, and to learn more about the preparation, characterisation and costing of this material.

You are required to prepare a group wiki that deals with the content specified in a project description template as shown below.

Project Description Template

Project overview [Abstract/Summary] (max 300 words) Aim of the project. Overview of nanomaterial, including relevant background information.
Product Preparation (max 1500 words, may include reaction schemes and diagrams) Protocol for the preparation of the product (this should include any interesting observations/properties of the product).
Product Analysis (max 1000 words) What analysis will be done? What information this will provide?
Timelines Timelines of analysis to be carried out to include report writing (present in a Gantt chart format).
Costing How much will the raw materials cost.
Conclusion (max 200 words) Summarise results and recommendations

Your tutor may be able to supply some references to start your research if needed.

Case study 2: Goldglow

Metalopharm

Goldglow: Pioneers in cancer diagnosis

Metalopharm is a pharmaceutical company which is currently investigating two applications of metal nanoparticles. Project Goldglow involves using gold nanoparticles as ultrasensitive fluorescent probes to detect cancer biomarkers in human blood. The project brief is to investigate the viability of gold nanoparticles in biomedical applications, and learn more about the preparation, characterisation and costing of this material.

You are required to prepare a group wiki that deals with content specified in project description template as shown below.

Project Description Template

Project overview [Abstract/Summary] (max 300 words) Aim of the project. Overview of nanomaterial, including relevant background information.
Product Preparation (max 1500 words, may include reaction schemes and diagrams) Protocol for the preparation of the product (this should include any interesting observations/properties of the product).
Product Analysis (max 1000 words) What analysis will be done? What information this will provide?
Timelines Timelines of analysis to be carried out to include report writing (present in a Gantt chart format).
Costing How much will the raw materials cost.
Conclusion (max 200 words) Summarise results and recommendations

Your tutor may be able to supply some references to start your research if needed.

Case study 3: Kleeenview

Kleeenview are a company that manufactures self cleaning windows. They are looking into the area of TiO_2 and photocatalysis, and wish to investigate the viability of TiO_2 as a photocatalyst and learn more about the preparation, characterisation and costing of this material.

You are required to prepare a group wiki that deals with the content specifies in a project description template as shown below.

Project Description Template

Project overview [Abstract/Summary] (max 300 words) Aim of the project. Overview of nanomaterial, including relevant background information.
Product Preparation (max 1500 words, may include reaction schemes and diagrams) Protocol for the preparation of the product (this should include any interesting observations/properties of the product).
Product Analysis (max 1000 words) What analysis will be done? What information this will provide?
Timelines Timelines of analysis to be carried out to include report writing (present in a Gantt chart format).
Costing How much will the raw materials cost.
Conclusion (max 200 words) Summarise results and recommendations

Your tutor may be able to supply some references to start your research if needed.

Case study 4: Nanoklenz

Nanoklenz

Cleaner water quicker

Nanoklenz are a company that manufactures water filters. They are looking into the area of the use of carbon nanomaterials in water filters for water remediation. Nanoklenz wish to investigate the viability of carbon nanomaterials in this application, and learn more about the preparation, characterisation and costing of this material.

You are required to prepare a group wiki covering the content of a project description template as shown below.

Project Description Template

Project overview [Abstract/Summary] (max 300 words) Aim of the project. Overview of nanomaterial, including relevant background information.
Product Preparation (max 1500 words, may include reaction schemes and diagrams) Protocol for the preparation of the product (this should include any interesting observations/properties of the product).
Product Analysis (max 1000 words) What analysis will be done? What information this will provide?
Timelines Timelines of analysis to be carried out to include report writing (present in a Gantt chart format).
Costing How much will the raw materials cost.
Conclusion (max 200 words) Summarise results and recommendations

Your tutor may be able to supply some references to start your research if needed.

Case study 5: Solarsunrayz

Solarsunrayz

Capturing the power of the sun

Solarsunrayz is a research based company that is currently examining the use of Quantum Dots for solar energy capture in solar panels. They wish to explore the types of quantum dots, how they are made and how they may be characterized before use with the relevant costing.

You are required to prepare a group wiki covering the content of a project description template as shown below.

Project Description Template

Project overview [Abstract/Summary] (max 300 words) Aim of the project. Overview of nanomaterial, including relevant background information.
Product Preparation (max 1500 words, may include reaction schemes and diagrams) Protocol for the preparation of the product (this should include any interesting observations/properties of the product).
Product Analysis (max 1000 words) What analysis will be done? What information this will provide?
Timelines Timelines of analysis to be carried out to include report writing (present in a Gantt chart format).
Costing How much will the raw materials cost.
Conclusion (max 200 words) Summarise results and recommendations

Your tutor may be able to supply some references to start your research if needed.

Appendix 8: Full length urls

The urls used in this guide have been shortened for ease of use. In the case where the shortened urls no longer work the list below provides the original.

http://tinyurl.com/nanochem	1	http://royalsociety.org/Event.aspx?id=8417&gclid=CPCg9-bQ5aoCFQkf4QodlFbU6A
	2	http://www.rsc.org/chemistryworld/Issues/2009/January/FeynmansFancy.asp
	3	http://www.evidenttech.com/technology/basic
	4	http://www.trynano.org
	5	http://www.rsc.org/chemistryworld/Issues/2005/December/nano.asp
	6	http://www.rsc.org/chemistryworld/News/2009/February/25020901.asp
	7	http://www.rsc.org/images/Nanomaterials_tcm18-187860.pdf
	8	http://www.nanowerk.com/nanotechnology/ten_things_you_should_know_about_nanotechnology.php
	9	http://nanosense.org
	10	http://mrsec.wisc.edu/Edetc/nanolab/
	11	http://www.nanotechproject.org/topics/nano101/
	12	http://community.acs.org/nanotation/
	13	http://research.uiowa.edu/nniui/links.html
	14	http://youtu.be/e80bflcoNUA
	15	http://education.technyou.edu.au/field
	16	http://youtu.be/XurpzMGRRnU
	17	http://youtu.be/1GFst2IQBEM
	21	www.edrawsoft.com/freemind.php
	22	www.visual-mind.com/download.php
	24	http://iwawaterwiki.org/xwiki/bin/view/Articles/tonni6
	25	http://future.wikia.com/wiki/Nanotechnology
	26	http://nanowiki.info/
	29	http://usermanual.pbworks.com/w/page/11632091/Glossary
	30	https://plans.pbworks.com/academic
	31	http://usermanual.pbworks.com/w/page/11632089/Home
	32	http://www.youtube.com/watch?v=gRj5ABJ-IPY&feature=related
	33	http://online.cofa.unsw.edu.au/sites/default/files/episode-pdf/CS_Wikis_LTTO.pdf
	34	http://www.youtube.com/watch?v=SZ5OV14v4xU
	35	https://blog.itu.dk/MVOL-F2010/files/2010/02/corporate-wiki-users-results-of-a-survey.pdf
	36	http://cagreenchem.wikidot.com/start
	37	http://cagreenchem.wikidot.com/welcome
	38	http://eponline.com/articles/2009/02/09/calif-launches-wiki-to-develop-green-chemistry-regulations.aspx
	39	http://www.ganfyd.org/index.php?title=Main_Page
	40	http://www.rsc.org/images/Guidelines_tcm18-186308.pdf

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