



The Scottish Baccalaureate in Science

Interdisciplinary Project- Exemplar 1

“Barefoot Running Versus Training Shoes”

Grade: A

Science: Interdisciplinary Project

Proposal

Candidate name								
SCN								
Centre name								
Assessor name								
Project title	Barefoot running Vs Training Shoes							
Project outline (<i>what it is you want to do and how will you go about it</i>)								
<p>My aim is to show to athletes how the physics and biomechanics behind barefoot running justifies claims that running barefoot is more beneficial and less injury prone than running in training shoes. I will explain how the invention of training shoes has altered the way we run and in doing so has increased our chances of injury. I shall also describe the benefits of barefoot running and the advantages it has on our performance.</p> <p>I will gather information from a variety of sources including scientists from Glasgow University who collaborated with scientists at Harvard University, America into researching the concept that barefoot running is more beneficial than running with training shoes, a sports physiotherapist, an athletic team and Footworks Edinburgh (a running shop that provides running gait analyses). Information from these sources provides an audience with a more professional point of view. I also intend to show how the new idea of barefoot running provides various development and economic opportunities for businesses such as Nike and Adidas.</p> <p>After I establish my findings I will create a questionnaire. I will direct this questionnaire at athletes to ask their opinions on barefoot running and running in training shoes initially and what injuries they frequently get. This will give me an insight into what common injuries athletes get and if they are aware of barefoot running.</p> <p>I intend to present my findings as a report to an audience of athletes. The report will include all the analysed information I have gathered, the results of the questionnaire a variety of images of products that have been designed to imitate the feeling of barefoot running. Attached to my report I will have a follow up questionnaire to see if after reading my report my audience are fully aware of the benefits of barefoot running and if they now consider running without training shoes or with specially designed barefoot running shoes.</p> <p>I will add the results of the final questionnaire to final report.</p>								

Reasons for choosing this project (*egg personal interest, future plans, links to other subjects you are studying/ have studied*)

Throughout my life I have been fascinated with the mechanisms of the human body and its ability to adapt to circumstances it is faced with. Along with this interest I am extremely passionate about sports and enhancing performance. Competing in various sporting activities, some at international level, I have become fixated on developing ways to improve athlete's performances whilst still staying injury free. The idea of barefoot running fits perfectly into my area of interests. By using my knowledge gained throughout studying Higher Human Biology and Physics I hope to show to athletes that barefoot running is a highly efficient way to train.

I have chosen to create a questionnaire directed at an athletic audience as I know that customer feedback is highly regarded when developing new ideas and products.

I feel that choosing this topic acts as a stepping stone on my journey to pursue a career in sports related medicine.

The broad contexts this project will cover are

Economic development - Barefoot running provides new opportunities for businesses to develop products to simulate the ever increasingly popular barefoot running e.g. minimalist running shoes

Learning environments I will access are

I intend to contact scientists at Glasgow University who have conducted research into barefoot running.
The internet.
"Runners World" magazine.
Athletes in my school and at local athletics club.

How I will use my knowledge of science/technology

I will apply my knowledge gained throughout studying Higher Human Biology and Higher Physics to justify that barefoot running is more beneficial than running in training shoes. I will use my knowledge of Physics and Mathematics to analyse collision forces. I will apply my Biology knowledge to look at the muscles used in running.

The skills I will develop and/or improve in the course of this project are:

(carry out a short analysis of your current strengths and weaknesses in the skills areas below and how you think your project will allow you to develop and/or improve these skills)

application of subject knowledge and understanding

- I will apply my knowledge gained throughout studying higher Human Biology and higher Physics to justify that barefoot running is more beneficial than running in training shoes.
- I will need to understand collisions as they are.

research skills – analysis and evaluation

- I will have to gather the results of the questionnaire evaluate them and then come up with a conclusion.
- I will be using various sources to gather my research. I will use my analysis skills to pick out relevant information.

interpersonal skills – negotiation and collaboration

- I have had little experience collaborating with professionals and therefore I am anxious about getting in contact with them.
- I will have to ask for my fellow pupils and athletes co-operation as to completing the questionnaire.

planning: time, resource and information management

- I will have to use my organisation skills to make sure that I meet my deadlines.
- I will also have to file all the information gathered to make sure that I do not misplace anything.

independent learning – autonomy and challenge in own learning

- I look forward to working on my own as I feel that this suits well for university education. It will also develop my confidence in my own abilities.

problem solving – critical thinking: logical and creative approaches

- I will have to be creative in my report make it original

presentation skills

- My report will have to be exciting and innovative to capture the attentions of my audience. However it will have to be easy to understand so that the main concept is fully appreciated.

self evaluation – recognition of own skills development and future areas for development

- I will keep a diary of the skills I have used and skills that I have to improve. I will regularly update this diary to evaluate my development.

Assessor feedback to candidate

This is an excellent proposal it is a very creative idea.

You have a good clear outline of what you would like to achieve and how you plan to achieve this.

There is a lot of scope in your project to allow for collaborative work and to further develop your communication and interpersonal skills.

This topic is clearly of interest to you and your enthusiasm comes across in your plan. I am pleased that you have decided to combine your science and sporting knowledge, this gives your project a very interesting edge as your enthusiasm for both is clear.

You will have to apply your knowledge of different sciences in completing this and you have clearly identified how your subject knowledge links with the broad themes of this project.

It is good that you are planning to contact outside agencies (Glasgow University, Athletics team) as this collaboration will enhance your project.

Well done, I am looking forward to following your progress with this project.

Proposal approved	YES	Further work required	N/A
Candidate signature			Date
Assessor signature			Date

Science: Interdisciplinary Project

Plan

Candidate name									
SCN									
Centre name									
Assessor name									
Project title	Barefoot Running Vs Training Shoes								
Is this a group project? no									
<p>Timescales (<i>this should be a detailed timeline and any separate spreadsheets or charts should be included as evidence</i>)</p> <p>See Gantt chart.</p>									
<p>Planning (<i>how you are going to meet the agreed objectives of your project</i>)</p> <ul style="list-style-type: none"> • I will gather information from various sources which I will later analyse and file. • I will create a questionnaire which I will hand out to my local athletics club. • I will analyse the data from the questionnaire. • I will write a report with a follow up questionnaire that will hand out to my audience. • I will write my final report that will include all data gathered from sources and questionnaires. • I will follow my Gantt chart carefully to ensure that I complete all tasks on time. 									
<p>Resources (<i>e.g. people, materials, places</i>)</p> <ul style="list-style-type: none"> • Runner's World magazine • Sports physiotherapist • Specialists at Footworks • Various websites • Athletics team/ athletes in my school • Specialists in the topic of barefoot running 									

Research methods (e.g. contacting companies, surveys, focus groups, experimentation)

- I will have to contact Footworks to either arrange a date to meet or to ask for information via e-mail
- I will create a questionnaire aimed at a group of athletes, asking them their opinions on barefoot running and what injuries they feel are associated with running or that they frequently get. I will then analyse these results to establish what the most common injuries associated with running are.
- I will have to contact a physiotherapist to arrange a date to meet so that I can interview them about the injuries that they commonly see with runners and what may be the cause of these injuries.

Presentation

Who do I think will benefit from listening/reading/looking at my presentation of my project findings/product?

- Runners/ athletes who are looking to stay injury free and improve their performance.
- Running coaches will hopefully see the benefits of barefoot running and will hopefully adapt training sessions to suit barefoot running.
- PE department.

What methods are appropriate to my audience(s) (e.g. demonstration, presentation software, websites, oral, report, piece of theatre, DVD, wiki/blog or any combination)

- A report will be appropriate because it will allow my audience to read it in their own time as I know that athletes are extremely busy training. Also after my audience have read it I will encourage them to take the report away and show others who are also interested in the idea of preventing injury and improving their performance. This should hopefully spread the awareness and benefits of barefoot running. My report, however, will have to be both exciting and aesthetically pleasing to capture the interest of the reader. It will also have to be of an intellectual standard that is not too complex and easy to understand.

Dependencies (what is required for your project to go ahead i.e. reliance on other people or resources, steps in plan that must be completed before starting the next step)

- A physiotherapist willing to provide me with information on running injuries.
- Footwork providing me with information on running gait analyses.
- Athletes willing to complete my questionnaire.
- Scientists who specialise in barefoot running providing me with information on the physics behind barefoot running.

Contingencies	
<p>Any anticipated problems</p> <ul style="list-style-type: none"> • Scientists are not willing to provide me with information. • Physiotherapist and Footworks do not have any free time to meet. • Athletics group are not willing to complete my questionnaire. • I am struggling to make time to complete a certain area of my project on time due to my school exams or training for a karate competition. 	<p>My plans for overcoming the anticipated problems.</p> <ul style="list-style-type: none"> • Do more research using internet. • Get all information by e-mail. • Find another sporting group whose activity involves a lot of running e.g. basketball or football. • I will have to be organised and allow myself plenty of time to complete each area. Also I will have to be able to be flexible with my time.
<p>Method for recording my skills development and future areas for improvement</p> <p>Throughout my investigation I will be keeping a very detailed log book. I will record my skill level at the beginning of my project then continuously throughout to see if there are any improvements in my skills. This will also allow me to see what areas I need to develop further.</p>	

Assessor feedback to candidate

This is a well conceived plan. You have outlined clear objectives and how you plan to meet these.

You have carefully considered your timescales and wisely plan to complete this project early before other subjects and exams demand more of your time.

You have identified resources that you plan to access and opportunities for collaborative work with a variety of people. You have carefully considered what techniques are suitable for gathering information and for presenting your findings.

Careful consideration has been given to the dependencies in this project and how you will tackle some issues if they arise.

I am pleased with your plan to analyse your current skill level and then assess your personal development at different stages throughout your project. This will help you to review and evaluate your progress and skills development. I like that your timescales show a continuous evaluation of your project and skills over the 10 weeks you have decided to complete your Interdisciplinary Project.

Plan approved	YES	Further work required	
Candidate signature			Date
Assessor signature			Date

Tasks	Sub Tasks	Duration	31.10	07.11	14.11	21.11	28.11	5.12	12.12	19.12	26.12	01.01
Gather data		3 weeks										
	Decide which speacialists and sources I will contact	1 week										
	Contact Specialists to organise meetings	2 weeks										
	Prepare questions for specialists	1 week										
Analyse and file data		2 weeks										
Questionnaire		1 week										
	Create the questionnaire	3 days										
	Hand out questionnaire	2 days										
	Collect and analyse data	3 days										
Report		4 weeks										
	Combine all data into a report which will be handed out to audience	2 weeks										
	Create follow up questionnaire	2 days										
	Hand out report	2 days										
	Collect follow up questionnaire	2 days										
	Write final report	2 weeks										
Evaluation												
	Evaluation of project	10 weeks										
	Evaluation of personal skills	10 weeks										

Science: Interdisciplinary Project

Presentation of Project Findings/Product

Candidate name	
SCN	
Centre name	
Assessor name	
Project title	Barefoot Running Vs Training Shoes
How I presented my project findings <i>(describe in detail how you presented your project findings and explain the choices you have made with regard to your presentation method(s) and audience(s))</i>	
<p>I presented my findings in a report. In my report I compared the kinematics and biomechanics of barefoot running and running in training shoes to explain how barefoot running is more advantageous and less injury prone than running in training shoes. It also included information on: the benefits of barefoot running, the modern running shoe and how it encourages heel striking, a variety of barefoot running products, problems associated with barefoot running and examples of famous runners who ran barefoot. The results of my survey were incorporated within the report to explain why we should run barefoot.</p> <p>I presented my report to members of a running group. This was because I wanted to show to athletes the benefits of barefoot running and perhaps provide them with an alternative training method. I understand that runners are constantly trying to improve the performance whilst remaining injury free. Runners are also willing to try new methods of training but they are very sceptical because of the risk of injury. By presenting them with a report that included results from recent studies on barefoot running, information on how barefoot running works and some benefits and negatives of barefoot running it provided them with enough information to fully consider the option of barefoot running as part of their training regime.</p> <p>I presented my finding in a report format because I know that athletes are extremely busy training. The report therefore allowed the runners to read the report in their own time and as a result I did not interrupt their training time. By having it as a hand out also allowed the runners to pass on the report to other athletes so that they could also learn about barefoot running. By including information on famous acknowledged barefoot runners I hoped to also motivate the group of runners to try barefoot running as it provided them with proof that barefoot running can be done at the highest level.</p> <p>My report included some complex physics and biology but with the aid of diagrams and graphs the information could be fully understood and interpreted. I also included several images throughout to make the report both aesthetically pleasing and exciting e.g. pictures of famous barefoot runners.</p>	

Assessor feedback to candidate

An excellent written report. Well done.

I found the report extremely interesting. I liked the fact that you had incorporated information from your survey in you report.

It is clear from your report that you have done a lot of research on this topic. The detailed mathematical analysis provided from the University of Glasgow added to the scientific approach to your report. I felt that the information gathered from your collaboration with physiotherapists and Footworks enhanced your project greatly.

The economic development of sports shoes and how companies were developing and marketing of sports shoes was very interesting and established very good connections with your chosen context.

You have produced a very detailed report outlining your findings on barefoot running and its development.

Candidate signature	Date	
Assessor signature	Date	

Science: Interdisciplinary Project

Evaluation of project

Candidate name									
SCN									
Centre name									
Assessor name									
Project title	Barefoot Running Vs Training Shoes								
<p>How successful has my project been overall? <i>(consider the strengths, weaknesses and learning points of your planning, implementation and findings/outcomes giving examples to support your comments)</i></p> <p>My project aim was to investigate the differences between barefoot running and running in training shoes and hence show that barefoot running is more beneficial and less injury prone. I intended to show these differences by comparing the biomechanics and kinematics of both running methods. I feel that I have successfully achieved my aim and have proved the theory that barefoot running is more advantageous. I have managed to explain how the differences in collision forces between the two running styles benefits the barefoot runner and I have successfully explained in terms of biology, using anatomical images, how barefoot running is less injury prone. I have also managed to include information on a variety of new barefoot running products that have been designed to mimic barefoot running.</p> <p>I altered my initial plans only slightly. Unfortunately the specialists who I first contacted did not reply. After a few weeks with no reply I was beginning to panic. However, I used my problem solving skills and worked out who else, on a broader scale, would be able to provide me with information. As a result I decided to do some more research on the internet and I found more specialists such as a physiotherapist, podiatrist and a running shop owner, who were willing to provide me with information and to arrange meetings. The initial setback was frustrating but I feel that I was successful in working around the problem by thinking outside the box. On the plus side, the information I received from the second group of contacts was extremely detailed and helped considerably. It also inspired me to include more biology as well as the physics in my report. At first I had planned to send out a second questionnaire to my local running group. However, I did not wish to take up any more of their training time. Instead I decided on asking them to read the report in their own time and if possible they could pass on their thoughts to their coach who would then e-mail me. I found this to be a far more effective way as it did not take up any of their running time and it saved creating a second questionnaire.</p> <p>There are many aspects of my project that have been a challenge. The task itself of creating a project, collaborating with professionals and creating a report that</p>									

would inspire athletes to try barefoot running all on my own accord was daunting at first. However, once I got started and got past the initial obstacle (not getting any response from my contacts) I began to enjoy gathering and analysing data and meeting with specialists. I feel that when I was faced with a challenge, my determination to help other athletes and my problem solving skills were the main factors that helped me surpass the problem. I also found the tasks of simplifying the complex physics into a form that was understandable to those with very little understanding or knowledge of physics extremely difficult. Although it took me a long time the feedback from the running coach suggested that the physics was well understood.

In terms of planning and time management I feel that I have been successful. Using the Gantt chart helped me considerably. I was able to split each task into smaller subparts and devise timescales to each in terms of weeks. By doing this I was able to see exactly what I needed to do each week which allowed me to organise myself so that I did not fall behind or forget to do something important. I also included extra time for each of the tasks in case they did not go according to plan. This extra time helped considerably especially during my prelims. As a result of my careful planning I have managed to meet all milestones before or on the deadline and as a result my project has progressed, despite the initial setbacks, smoothly.

How effective were my communication methods throughout the project?

Collaborating with professionals was probably the most enjoyable part of my project. However, plucking up the courage to contact them initially was the hardest part. I felt slightly intimidated talking to people who were more knowledgeable in the field than I was. I was worried that they would look down on me as I was only a school pupil. However, I found that all of them were more than willing to help me. They were all extremely enthusiastic and surprised that I had chosen to do my project on barefoot running. All my contacts provided me with a lot of information some of which was irrelevant. However, the University of Glasgow scientists and the manager from Footworks provided me with the most helpful information and also gave me useful links to websites from scientists who have done research into barefoot running. By overcoming my nervousness I was able to gather vital information which has no doubt benefited my project. This has therefore definitely provided me with the confidence to do similar tasks in the future.

I was pretty nervous meeting with my local running group to hand out and explain the questionnaire as I was worried that they would just shrug of the idea of barefoot running. However, I found that they were all excited as their coach had told them that I was investigating barefoot running and how it may improve their performance. As a result they were all extremely enthusiastic and willing to complete the questionnaire.

I had to make sure that the questions that I asked my various contacts were going to provide me with as much information as possible. I also had to ensure that the questions and instructions in the questionnaire were easily understood. I had to do this so that no one misunderstood the questions which in turn would have made my results unreliable. This took a lot of time and required a great deal of attention as I

did not want to jeopardise my project. However, I feel that I have asked appropriate questions and everyone understood them fully.

Various meetings were carried out between my teacher and me so that we could assess my progress. During these meetings I was able to discuss any problems and ask for advice. Feedback was also given during these meeting which allowed me to make alterations to my plans which in turn made my project more successful.

Is there any aspect of my project that could be taken further? What might my next steps be?

Perhaps my next steps could be to carry out an experiment of my own. I could investigate over a period of time the effects of barefoot running on an individual including physical and performance differences. Doing this would further support the theory that barefoot running is more beneficial.

Candidate signature	Date	
Assessor signature	Date	

Science: Interdisciplinary Project

Self evaluation of generic and cognitive skills development

Candidate name									
SCN									
Centre name									
Assessor name									
Project title	Barefoot Running Vs Training Shoes								

In evaluating your skills consider the skills analysis which you carried out at the Proposal stage and how you said you would develop and improve these skills.

Now refer to your reflective diary/log/blog and feedback you have received and evaluate how you have developed and/or improved these skills through the work on your Interdisciplinary Project.

Application of subject knowledge and understanding

(Think about practical uses for the science you have learned. How did you use your knowledge of science/technology effectively to help you carry out various aspects of your project and how it related to your chosen broad context(s)?)

I used my knowledge gained from Higher Physics, Human Biology and Maths to explain the basics of collision forces. If I didn't have the knowledge of collision forces I would not have been able to show the differences between barefoot running and running in training shoes and therefore I would have not been able to prove that barefoot running produces a smaller impact and transient force. Although I was able to use my higher physics knowledge to some effect, I did require some additional information so that I could fully compare the two methods. My human biology knowledge allowed me to describe, in terms of anatomy, how the two running methods use different muscle groups and as a result have different levels of control and cushioning on impact.

By understanding that barefoot running produces a smaller impact and transient force due to the positioning of the foot and the muscles on impact has enabled manufacturing companies, such as Nike, Saucony and Virbam to produce products that mimic barefoot running. Their aim is to produce a product that provides all the benefits of barefoot running but provides the foot with support and protection from the elements. With proof that training shoes produce a higher impact and transient force because they force you run on your heel unlike in barefoot running where you run on your forefoot, these companies are trying to produce a shoe that has a small a heel as possible. They are also trying to incorporate mechanisms that allow independent movement of the big toe which in turn allows for the engagement of

the arch just like in barefoot running. Manufacturing companies have still not perfected the minimalist shoe. The company who comes up with the perfect barefoot shoe will in no doubt be famous and loved by thousands of barefoot runners. It is for this reason that the large manufacturing companies continue to strive for perfection.

Research skills – analysis and evaluation

(Think about the research process. How did you plan, carry out, analyse and evaluate your research? You should evaluate your research methodologies, tools, resources and contacts, data recording and referencing, reliability and usefulness of data.)

Plan

To plan out my project I initially wrote down what I actually needed to do in my project e.g. conduct a survey and gather and analyse information and I gave each of these tasks a rough timeline. I then split each of these main milestones into smaller more detailed subparts e.g. devise questions for my survey and decide on what specialists I would contact. I gave each of these subparts a rough timescale also. From this rough plan I made a Gantt chart which helped me to organise my time so that I allocate different weeks to different tasks which in turn helped me each deadline. I was able to refer to my Gantt chart throughout my project to see if I was keeping to the deadlines and on target to complete my project in the time I had decided on.

My initial plan was to contact scientists from Harvard University. However, after waiting several weeks I had still unfortunately not received a reply. I therefore had to change my plan slightly and do some more research on the internet to find other scientists who could help and also to get some more information on the biomechanics. Luckily I received numerous replies from the scientists that I had contacted the second time and they provided me with great detailed information which helped me with my research.

My plan was successful because I had used my time management skill to divide my time up to incorporate each task which made sure that I was organised. I made sure that I had allocated some extra time in case of any setbacks, such as the lack of replies. By having this flexibility in my plan I did not stress when something did not go according to plan as I knew that with the extra time allocated I was still going to make my deadlines.

Research

I used a variety of sources to gather information about barefoot running: internet, books, websites, running groups, physiotherapists and podiatrist. I found most of my contacts from research on the internet. For example I researched several experts in the barefoot running, biology and physics fields and from there I contacted them and arranged meetings via e-mail. I also gathered information from various running magazines such as Runners World and Woman's Running. Most of the biological information in my report was given to me from a group of podiatrists from a running shop in Edinburgh –Footworks. The physics related information was given to me from scientists at Glasgow university. They also provided me with links to work produced by a biologist at Harvard university. I had a folder dedicated to my

science baccalaureate which included sections for each topic. I also had a wallet in which I kept clipping of articles from magazines. This meant that when it came to writing my report all the information I needed was in one place. I also had a jotter in which I kept a note of all the websites I had used to gather my information. This was so that I could use them as references later on.

I chose to conduct my survey on a running group because I knew that are constantly striving to improve their performance and looking for new ways to reduce injury. They also all ran several times a week and covered large distances in training e.g. 20+ miles per week. The running group was therefore appropriate because the differences between barefoot running and running in training shoes only really occur over large distances and frequent running.

Analysis

I had to analyse the results of the survey and create pie charts. This could have taken a long time but I used a spreadsheet which sped up the process considerably. I was also given a lot of information from my contacts, some relevant to my project and some not. I therefore had to read through all the articles I was given highlighting the relevant information. Some of the information I was given from websites was a bit dubious e.g. some of the figures quoted. I therefore decided to exclude them from my project as I was not fully convinced that they were reliable. As a result most of the information included in my report was provided to me from scientists via e-mail or directly. This was to ensure that the details in my project were as accurate as possible.

Interpersonal skills – negotiate and collaborate

(Think about how you considered other peoples' views/feedback, discussed issues of concern, reached a solution where needed, adjusted your approach in response to a situation/environment, showed positive self belief and had the confidence to offer and ask for support.)

Whilst deciding to do the Baccalaureate I knew that I would have to collaborate with professionals from various fields. This, at first, was pretty nerve wracking as I did not know how willing they would be to provide me with information, However, when it came to it, all the professionals I met with were very enthusiastic and passionate about their subjects and were very excited that I had chosen to do my report on barefoot running. As results they were more than willing to give me as much help as possible.

When I handed out the survey to a group of athletes some of them did not fully understand the questions. I therefore had to use my communication skills to explain what each question meant so that the questions were fully understood and answered correctly to ensure that my result were as reliable as possible.

Some of the information on the physics behind barefoot running some of the physics was too advanced and far above higher level. I therefore had to ask for help and for him to simplify the physics so that I understood fully and so that I could put it into my own words in the report.

When after a few weeks I had received very little feedback from any of the sources

I began to panic. However, I did a little more research and found some more scientists which I contacted. Thankfully I received plenty of information from them. A few weeks later I received an apology letter along with a lot of information from one of my contacts apologising that he had not replied but he had been on a field trip in Kenya!

Initially I had planned to send out a second questionnaire along with the report to the group of athletes. However, I did not want to interrupt or take up any more of their time. As a result we agreed that after they had read the report they would tell their coach if after reading the report they were considering trying barefoot running, and their coach would get back to me via e-mail.

Planning – time, resource and information management

(Think about your time management. How did you set targets, monitor/record progress, consider any probable barriers to achievement and take steps to minimise them?)

By using the Gantt chart I was able to keep track of my time throughout the whole project. When I had reached a particular deadline I put a tick on the Gantt chart I had printed out. This allowed me to keep track of my progress. By including extra time for possible contingencies I was able to keep to my final deadline as when something went wrong I had given myself time to adjust my plan and rethink my strategy.

Independent learning – autonomy and challenge in own learning

(Think about how you used your skills to make things happen, took the initiative to establish links with other learning environments/opportunities and looked for challenges rather than taking the easy option.)

I initiated contact with the majority of the professionals independently via e-mail. I then had to organise meetings where possible and create questions that were specific to the topic and would help me gather as much information on the topics as possible. As the meeting with the podiatrist and with Footworks was time restricted I decided to keep in contact via e-mail so that could ask more questions if I had not understood fully the information they had given me.

I had initially only considered including physics in my project but as time went by I wanted to challenge myself by including biology as well. This required more effort and research but I thought it helped to explain barefoot running more thoroughly. I also made an effort to hand out questionnaires to as many people as possible so that my results would be more reliable. I spent time trying to make the questionnaire as easy to understand as possible so that the runners did not have to spend a long time completing it.

Whilst researching the internet I found several websites that referred to the article [Lieberman DE, Venkadesan M, Werbel WA, Daoud AI, D'Andrea S, Davis IS, Mang'eni RO, Pitsiladis Y. \(2010\) Foot strike patterns and collision forces in habitually barefoot versus shod runners. Nature 463: 531-5.](#) I used my initiative and researched this article and found very helpful information on the biomechanics and kinematics as well as various results of experiments. I could have quite easily just used the information

given to me by one of my contacts but I wanted to expand my knowledge and gain a better more detailed insight into barefoot running.

I have enjoyed gathering information from various sources and meeting experts in different fields. It was a challenge at times but I feel that I have learnt a lot about the subject that I didn't know beforehand and as result I feel that I have gained valuable information on barefoot running that I can pass on to other athletes. Meeting people who are highly thought of in their fields was slightly intimidating at first but doing so has developed my confidence.

Problem solving – creative approaches; critical thinking; logical approaches

(Think about your problem solving skills. How did you generate and explore ideas, use logical and creative approaches, analyse source materials in order to support findings, reflect on problems and possible contributory factors and think critically about possible actions/changes?)

I came up with the idea of Barefoot running vs Training shoes completely on my own. I was introduced to barefoot running 5 years ago when I developed an injury whilst running. Ever since then I have always wanted to investigate whether it is more advantageous than running in training shoes. My intentions of choosing this topic was to provide athletes with an in depth report on biomechanics and kinematics of barefoot running and hence provide them with another training method.

Whilst creating my report I had to adopt a mindset of someone who had never studied human biology, physics or maths. This was to ensure that my audience did not get put off reading my report or trying barefoot running because it all seemed too complicated or they just did not understand the concept.

There were many things that could have gone wrong with my project however I had prepared solutions which would have ensured that I could still carry out my project. For example the running group may have not returned my surveys. To prevent this I asked them all to fill it out on the spot and return it to me straight after. Also my contacts may be delayed in responding to me. As a result I included additional time slots in my plan so that if this occurred I could still meet my deadlines.

Presentation skills

(Think about how you presented your findings. Evaluate your presentation method(s), choice of audience(s), layout, structure, degree of formality and choice of content. Did your presentation include information/ideas/reflections with supporting detail in a logical order and reach a reasoned conclusion?)

I feel that my choice of audience was completely appropriate. My project aim was to compare barefoot running to running in training shoes and show that barefoot enhances performance and is less injury prone. I feel that a running group was therefore, in no doubt, the best audience for my report as they are always looking to find new method of training that will increase their performance whilst reducing injury. I also included in my report the results of the survey which I carried out on the same group of athletes that I handed the report out to. By doing this I proved to them using themselves as subjects that barefoot running is more beneficial.

I feel that a report in a form of a handout was the best option as it can be easily passed on between athletes and thus passing on the knowledge. It can also be read in the athletes' own time so that their training is not interrupted. My report included several diagrams and graphs to help my audience understand the complex physics involved in barefoot running. I also included images of the lower leg muscles to help my audience understand the different muscles used in barefoot running compared to training shoes. I included various pictures of famous barefoot runners who have been extremely successful athletes to hopefully motivate them to try barefoot running as it is evident that success can be achieved by doing so. I made sure that the content in my report was not too complex so that even people who had very little understanding of physics or biology could understand (with help of the diagrams) the concepts behind barefoot running.

My report followed a logical order: I chose to start off by explaining the biomechanics and kinematics of barefoot running compared to training shoes so that my audience had a good understanding of how they both work. I then went on to describe the positives and negatives of barefoot running. I followed this with information on new products that have been designed to mimic barefoot running in shoes and I then finished with details on famous barefoot runners.

Self evaluation – recognition of own skills development and future areas for development

(Think about how you have developed throughout your project. How did you deal with feedback, praise, setbacks and criticism and their impact on your own development of knowledge, skills and understanding? To what extent did you ask for feedback, learn from experiences and how will you use these to inform future progress?)

Over the duration of my baccalaureate I have developed several skills. Using the Gantt chart has improved my time management skills and I will certainly use this method in the future. By collaborating with professionals and other athletes I have become more independent and confident in my interpersonal skills. I now have the confidence to talk to people who are highly rated in their chosen fields because I know that most of the time they are willing to help as they are passionate about their subject and wish to share their knowledge with others who share their enthusiasm. This confidence will undoubtedly help me in later life. I have learned to deal with setbacks more positively. Instead of becoming stressed when a contingency occurs I now understand that it is not the end of the world and instead I can use my problem solving skills to overcome the problem.

Feedback from the running coach said that the runners were very impressed and they are now considering introducing a barefoot training day to their programme. This feedback made me feel as if all the hard work and dealing with setbacks had been worthwhile. It has also motivated me to do some further research into barefoot running.

I had initially intended to record the meeting with the manager of Footworks using a Dictaphone. However, the interview was held in the shop where there was a lot of background noise. My Dictaphone was extremely sensitive and as a result I could not hear what he was saying. I had to make notes instead which was quite stressful

as it was hard to include everything he was saying. In future I will make sure that the interview can be held in a quiet room so that I can use the Dictaphone.

By doing the Science Baccalaureate I have gained a wealth of knowledge on barefoot running. I have also increased my knowledge in Physics and Biology which will help me in my future career.

This section is not mandatory. It has been included to allow you the opportunity to undertake an overall reflection of your project.

Reflection on my experiences throughout this project *(eg things you feel you have achieved, things you have done that you feel particularly proud of, anything you would do differently were you to do something similar in future)*

Completing this project and knowing that it has successfully achieved its aim is extremely rewarding. I feel that all the hard work has paid off! The various setbacks have, at times, been extremely frustrating especially when I felt that everyone was just ignoring me. However, I am proud that I persevered and as a result I have gained various skills and knowledge which will help me in later life. I was extremely relieved when my report came together because at points I thought that it would be impossible. In the future perhaps I would try an experiment to back up my report with my own results.

Skills that I have used in this project that I would like to develop further *(eg using skills in even more challenging situations, more working on your own, more team working)*

I would like to do some more collaborating with professionals. I thoroughly enjoyed listening to what they had to say and I felt that I have learned a lot from them. I enjoyed the whole concept of conducting a survey and analysing the data as a result I would therefore like to do some more practical work. Doing this would definitely improve my analytical skills which would help me in my future career.

Candidate signature	Date	
Assessor signature	Date	

Science: Interdisciplinary Project

Assessor Report

Candidate name:

Candidate number:

Centre:

Project proposal	Tick as appropriate
Grade C criteria	
The title and aims of the project.	✓
Clear aims and reasoned arguments to support the relevance and practicability of the project.	✓
Identification of opportunities for:	
• own skills development	✓
• collaborative working	✓
• accessing less familiar learning environments	✓
• application of science subject knowledge in a broad context	✓
• use of knowledge and skills across different disciplines	✓
• making connections between subject knowledge and the wider world	✓
Evidence of the ability to communicate clearly and concisely in advocating the proposal.	✓
Grade A criteria, includes all of above plus	
Well conceived proposal which sets creative and challenging goals which are at the same time realistic, achievable and practicable.	✓
Robust and carefully argued justification of the proposal.	✓
Substantial links and understanding of possible connections across disciplines contributing to the project.	✓
Comments	
<p>This comprehensive proposal involved several areas of interest for the candidate. It was very creative and included links with science and sport, an area of personal interest.</p> <p>She identified significant academic and economic links which would contribute to the project and provide varied opportunities for collaborative working with external agencies.</p> <p>The candidate's proposal shows opportunity for significant skills development and connections across disciplines.</p>	

Project plan	Tick as appropriate
Grade C criteria	
Development of clear project objectives in line with the project proposal.	✓
Relevant and detailed planning strands to enable the project to be implemented, monitored, presented and evaluated.	✓
Realistic timescales and achievable milestones for each stage of the project.	✓
Clear identification of resources needed, research methodologies to be used, opportunities for support and feedback.	✓
Grade A criteria, includes all of above plus	
Careful selection and effective use of research/investigation techniques.	✓
Anticipation of probable and possible factors which may impact on the project.	✓
Clear identification of dependencies or reliance on the success of other strands of work and of necessary adjustments to the plan.	✓
Outline the process for achieving own identified development needs.	✓
Comments	
<p>The candidate produced a highly competent plan with extensive opportunities for research and investigation. A range of research techniques were employed throughout this project including collaboration with external agencies. Despite lacking in confidence in her skills in this area she showed confidence when working with external agencies and embraced collaborative working. Her contacts increased as the project developed.</p> <p>The candidate was realistic about anticipated problems and took this into account in her thorough planning. She also looked in advance at the times when Advanced higher projects and prelims would require more of her time and accounted for this.</p> <p>She identified the importance of keeping a log book and reviewing her skills and the project throughout.</p>	
Presentation of project findings/product	Tick as appropriate
Grade C criteria	
Evidence of effective and critical use of — resources, research methodologies, information and time management, prioritisation, problem solving approach to reach objectives, feedback, collaborative approaches, self monitoring.	✓
Application of specialist and interdisciplinary subject knowledge to establish meaningful connections within the broad context.	✓
Clear presentation of main findings/outcomes.	✓

Grade A criteria, includes all of above plus	
Critical thinking, analysis and reflection used at key stages in the project to construct rigorous arguments, draw convincing, well supported conclusions, identify and resolve issues.	✓
Skilful and creative use of resources, including people, information and learning context to progress the project.	✓
Accurate and deepening of understanding through application of subject knowledge in the chosen context, with meaningful connections well established.	✓
Comments	
<p>The candidate made excellent use of resources and committed to extensive collaboration, contacting experts at Harvard university by email, handing out surveys to athletics groups and visiting specialist companies and physiotherapists.</p> <p>Her initial contacts did not respond as quickly as she would have liked. She approached this by confidently expanding her research and collaboration. This worked effectively and when her initial contacts also responded gave her a wide range of research from a variety of sources.</p> <p>She effectively analysed her information and further developed her IT skills when creating graphs of the surveys she had conducted.</p> <p>She effectively used her knowledge from Biology, Physics, Maths and PE and made meaningful cross curricular connections. Her knowledge was advanced and some advanced Physics and Maths calculations were included in her report. She showed skill in presenting these and making them easily accessible to those with limited knowledge in this field.</p> <p>She developed her context by analysing products produced by sports companies and how this continued development of sports shoes for barefoot runners will provide new business for many manufacturers.</p> <p>Her product was a clear written report including rigorous arguments backed by the information gathered to support the fact that bare foot running (when done correctly) reduces the risk of injuries in certain areas. There was creative use of diagrams included in the report to enhance the readers understanding.</p>	

Evaluation of project	Tick as appropriate
Grade C criteria	
A critical and justified evaluation of all stages of the project process — planning, implementation and findings/outcomes in terms of strengths, weaknesses and learning points.	✓
Effective use of chosen communication method(s).	✓
Grade A criteria, includes all of above plus	
Incisive, well balanced evaluation of the project outcome against project aims, supported convincingly by well selected evidence.	✓
Careful choice and skilful use of communication and presentation methods(s).	✓
Comments	
<p>Clear evidence of critical thinking and analysis, both in the candidate's report and throughout her Interdisciplinary Project.</p> <p>A very effective written report produced for the athletic community, creative use of graphs and diagrams to enhance her report.</p> <p>Her IT skills in producing the report and graphs provided further opportunity for skills development which she did not shy away from.</p> <p>The connections from different areas were well established and integrated from the beginning.</p> <p>A very balanced product resulting from rigorous research and self reflection. She produced a very honest evaluation of her product.</p>	

Self evaluation of generic/cognitive skills development	Tick as appropriate
Grade C criteria	
A critical evaluation of own skills development against the list of specified generic/cognitive skills.	✓
A reasoned evaluation of own strengths and key goals for development in the specified list of generic/cognitive skills, which takes account of feedback sought and evidenced from others throughout the project.	✓
Grade A criteria, includes all of above plus	
Insightful, balanced and well structured self evaluation of own development.	✓
Assertive and justified use of feedback from others in evaluation and identification of development areas.	✓
Comments	
<p>Outstanding self reflection and self evaluation evident throughout.</p> <p>The candidate tackled this project in an excellent manner.</p> <p>She repeatedly pushed herself beyond her comfort zone and has developed skills as a result.</p> <p>Her confidence in collaborating with others and working in unfamiliar environments grew as the project progressed.</p> <p>She has provided a very detailed and honest evaluation of her skills development through this project.</p>	

The overall grade will be:

- A indicative of a highly competent performance which meets the additional Grade A criteria and consistently demonstrated a high degree of autonomy, initiative and effective information management across the five pieces
- B indicative of a competent Grade C performance across the five pieces, but with some aspects of work meeting the criteria for highly competent performance (as outlined by the Grade A criteria)
- C indicative of a competent performance across the five pieces, with all aspects of the work meeting the criteria identified for Grade C performance

Overall Grade Awarded	A
Additional Comments/Overview The project produced was more than highly competent. The candidate showed initiative, interest and significant development in interpersonal skills through her extensive collaboration. The candidate worked independently throughout the project and showed exceptional skill in time management. She coped very well with the demands of this project and a full timetable. I was impressed by the candidate's manner in overcoming difficulties with IT, and the initial lack of response from her contacts. Her self reflection throughout the project allowed her to produce a very thorough evaluation of her project and her own development.	

Assessor signature _____

Date

Internal verifier signature _____

Date