

2018/19 CANDIDATE RECORD FORM, PRODUCTION LOG AND ASSESSMENT RECORD

INTERNATIONAL INDEPENDENT PROJECT QUALIFICATION (9690)

Please attach the form to your candidate's work and keep it at the centre or send it to the moderator as required. The declarations should be completed as indicated.

Centre number 65432	Centre name Southview School
Candidate number 45678	Candidate's full name Toby Davies

Work submitted for assessment **must** be the candidate's own. If candidates copy work, allow candidates to copy from them, or cheat in any other way, they may be disqualified.

Candidate declaration

Have you received help/information from anyone **other than** your supervisor (include specialist consultant if relevant) to produce this work?

☒ No ☐ Yes (give details below or on a separate sheet if necessary).

Please list below any books, leaflets or other materials (eg DVDs, software packages, internet information) used to complete this work **not** acknowledged in the work itself. Presenting materials copied from other sources **without acknowledgement** is regarded as deliberate deception.

n/a

From time to time we use anonymous examples of candidates' work (in paper form and electronically) within our guidance materials to illustrate particular points. If your work appears in Oxford AQA Exams materials in this context and you object to this, please contact us and we will remove it on reasonable notice.

I have read and understood the above. I confirm I produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate signature	Date 21 st January 2017
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Supervisor declaration

I confirm the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied (to the best of my knowledge) that the work produced is solely that of the candidate.

Supervisor signature	Date 21 st January 2017
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Candidate number	Candidate's full name
45678	Toby Davies

Submission checklist

To be completed by the supervisor

International Independent Project working title	Why do Giant Pandas eat bamboo?
International Independent Project final title	Why do Giant Pandas eat bamboo?

Please note that failure to complete or submit a compulsory element may result in a mark of zero being awarded.

Select/tick	Items that must be included	Notes
☒	1. A signed and completed <i>Candidate record form, production log and assessment record</i>	This document. All pages must be completed.
☒	2. Research based written report	Must be 5,000 words in length (+/- 10%).
☒	3. Evidence of a presentation within the <i>production log</i>	Presentation on the project process and findings/conclusions.

Candidate number

45678

Candidate's full name

Toby Davies

The taught skills element

To be completed by the supervisor

Outline details of taught skills

Record here details of relevant skills taught in a class/group and details of relevant skills taught individually to this candidate as described in the specification eg your scheme of work. Continue on a separate sheet if necessary.

All students received a 30 hour taught skills course, delivered by the supervisor in a class-room setting. This course was divided into five sections, based on the guidance in the IPQ specification:

1. Project Planning/Management
2. Research Skills
3. Report Writing
4. Presentation and Oral Communication
5. Evaluation skills

For the part of the course on Research Skills, the school librarians ran several workshops on skills including: selecting relevant resources, evaluating sources, research ethics and the importance of referencing and bibliographies (in the context of avoiding plagiarism). The librarians also introduced students to the range of paper-based and online/electronic resources available in the school.

Regarding the part of the course on Presentation/Communication skills, students delivered practice presentations (on a separate subject of personal interest), to implement the skills learned.

The taught skills course was based on a number of resources, including the OxfordAQA Scheme of Work (<https://oxfordaqaexams.org.uk/subjects/projects/ipq>) and some online resources from:

- Southampton University: <https://www.southampton.ac.uk/learnwithustransition/epq-support/index.page>.
- Manchester University (Resources for Extended Project tutors and assessors): <http://www.manchester.ac.uk/connect/teachers/students/post-16/extended-project/resources/>
- Birmingham University (Research and Study Skills: Academic Writing): <https://www.birmingham.ac.uk/Documents/students/guide-to-academic-writing.pdf>

No additional/specific skills were taught to the particular student in question.

Candidate number

45678

Candidate's full name

Toby Davies

Record of grade

To be completed by the supervisor

Grades must be awarded in accordance with the instructions and criteria in the specification.

Has the student done the following:

Identified and selects an area of interest.	☒ Yes	☐ No
Set a working title.	☒ Yes	☐ No
Undertaken a risk assessment.	☒ Yes	☐ No
Produced a project plan.	☒ Yes	☐ No
Implemented the project plan and documents any changes to it.	☒ Yes	☐ No
Produced a report addressing the selected final title.	☒ Yes	☐ No
Used a referencing method.	☒ Yes	☐ No
Communicated findings in the report and the presentation.	☒ Yes	☐ No
Created a bibliography/reference list.	☒ Yes	☐ No
Evaluated the strengths and weaknesses of the project.	☒ Yes	☐ No

If you answered "No" to any of the above, the student must be awarded a Grade U. If all answers are "Yes" proceed to the Grading section below.

Grading

Which grade descriptor is the project most like? (circle one)

A

If you selected **A**, is the project an **A**,
or is it better (**A***)
or worse (**B**)?
(circle one)

A*	A	B
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D

If you selected **D**, is the project a **D**,
or is it better (**C**)
or worse (**E**)?
(circle one)

C	D	E
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If you selected **E** above, as a final check,
is the project worthy of a pass (**E**) as
opposed to a fail (**U**)?
(circle one)

E	U
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Candidate number

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Toby Davies

Record of grade (continued)

To be completed by the supervisor

Summary information to show how the grades have been awarded should be given in the spaces below in addition to comments in other pages of this document and any supporting information in the form of annotations on the candidate's work.

Assessment objectives	Supervisor's supporting statement
AO1: Selection of topic	An appropriate area of interest is identified and selected in the Record of Initial Ideas. Aim clearly identified in Part A Candidate Proposal. Very clearly presented rationale for the work in Initial Planning; constructive supervisor advice used to focus the work. Whilst preliminary research is not explicitly mentioned, it is clear from the Record of Initial Planning and the Part A Candidate Proposal that a working title has been well developed.
AO2: Planning, monitoring and developing	Proposed action laid out in Project Proposal Part A shows a clear strategic approach. Very ambitious working plan in Planning Review reduced in scope to aid achievability after consideration of supervisor advice. Monitoring of progress and subsequent modification of plan in Mid Project Review. Project Product Review identified successes and failures and identified the latter as due to failure to identify all relevant features during the research. Evaluation of progress and subsequent modification of plan in Mid Project Review. Changes made were documented and justified in the log. Largely well planned but evidence of a slight lack of foresight.
AO3: Demonstration of research skills	Very detailed bibliography of textual and web-based sources – clearly sources selected for a clear and justified purpose. However, no referencing in the report. This makes it impossible to judge which sources were actually used, or for what purpose. No evaluation/source scrutiny in the report. This AO is borderline A/B grade.
AO4: Analysis and application of research	The final plan was implemented and the aim (just about) achieved. Unfortunately, the absence of documentation of source use prevents identifying what is scientifically proven from conjecture. However, the planned investigations were carried out logically, information and data analysed and reasoned conclusions drawn from it to address the aim. The report was in an appropriate format and did present clearly both the investigation carried out and the conclusions drawn. The style was rather more conversational than scientific, but did communicate the conduct and conclusions of the investigation. Material was relevant and structured to reflect the planned study. The supervisor appears to have given very poor advice in Project Product Review to remove numbers that correspond to sources, resulting in no referencing. There is much evidence of analysis of information and data in the report but only implicit evidence of synthesis between sources. Reasoned conclusions drawn that were based on both existing evidence and the candidate's own reasoned extensions. Good oral communication and answers to questions revealed a clear understanding of the current theories of why Giant Pandas eat bamboo and identified clearly where current wisdom had been extended during this work. Existing evidence and extensions were discussed in answers to questions. The work is clearly in the A grade band for AO4: the criteria are met with some consistency across the piece.
AO5: Evaluation of product, process and self	Detailed reflection on both own learning and the process/organisation of the project. Identified clearly the value of the project to future studies. The candidate identified the many mistakes made. As the candidate did learn from each mistake, this was an important part of the learning process. The candidate also clearly identified the skills developed.

Candidate number

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Toby Davies

Record of grade (continued)

Supervisor's concluding comments

A reasonable attempt at a very diverse investigation.

Internal moderation comments if appropriate

n/a

Supervisor declaration

I confirm that no work assessed for the award of the grade above is also to be submitted, or has been submitted, for any other accredited qualification(s).

Supervisor signature

Date

12th December 2016

Candidate number

45678

Candidate's full name

Toby Davies

Record of initial ideas

To be completed by the candidate

This page records initial meeting(s) with your supervisor to agree your project ideas. Additional pages can be submitted if more than one idea has been explored.

My idea(s) for topic/title:

Asia is an exotic land with rich culture backed up by history that belongs in movies. As I want Asia to be my focus I am choosing pandas as a research topic. More specifically I want to investigate into why pandas eat bamboo and what the future holds for the animal both physically and politically.

Comment [A1]: An appropriate area of interest is identified and selected after careful consideration. (AO1)

My preliminary research and development of my project ideas:

Research into the biology of pandas is a must. Once acquired through the use of research papers and books, I need to search for an answer to what sort of pressure would lead an animal to adopt a bamboo diet. Bamboo would be the next focus. What about bamboo makes it such a viable source of food for pandas? What are the limitations of a bamboo plant? How does this contribute to it being consumed by pandas?

Looking at the genome of Panda's and compare to others such as grizzly bear can provide an interesting look at the evolutionary history. Comparing diet, looking at their physiology will allow an insight into their evolutionary history and how they adapted through the ages to eat bamboo. A look at Pandas teeth as well as a look at their behaviour can also hint into the reason for their diet.

Experimentally calculate the energy value of bamboo to see more limitations on bamboo, look at the landscape at the time of the ancestor of the pandas when they first emerged to where today is China. A look into the environment of other bears can also be used to contrast the environment of Pandas.

I'll start with a basic outline of an essay and once I outlined what I'm going to cover, a detailed explanation will be written to express each topic. As there are many different possibilities to the cause of why pandas eat bamboo I will commit to paper as many reasons for why and narrow it down as I collect more data so I can focus on the likely and fruitful investigation.

Comment [A2]: Whilst still provisional at this stage, this section shows the development of initial ideas. (AO2)

My summary of the comments and advice from my supervisor (and specialist consultant if applicable):

My supervisor agreed that the scope of my topic would be open to investigation and that if I look at the right sort of information I will do well. Some advice she mentioned was to focus on the research aspect of the topic, there is a wealth of information and I need to organise which is relevant to my EPQ. Getting the accurate nutritional value for bamboo may be hard as I do not have the right equipment to determine the information, although I may find out how much energy is contained in a piece of bamboo the value is so little it may not be worth the investment as they can be expensive to obtain.

Modifications I have made as a result of my discussion with my supervisor (and specialist consultant if applicable):

While the idea of calculating the energy value is useful, I have decided to drop the idea of pursuing bamboo as money may be an issue. I will compile an investigation focusing on the question using evidence I have found from other reliable resources like scientific papers. It was mentioned that finding data, such as the genome, will be difficult as information will be more likely to be found in scientific papers that are occasionally restricted. While this may be true there will also be some that are not restricted so I can use those papers for facts. Some focus on bamboo itself may provide an avenue for research so I shall look into that.

Comment [A3]: This change/development is clear and justified (AO2)

Comment [A4]: It would be good if one or two pieces of preliminary research were mentioned here. (AO1)

My proposed title, aims and objectives:

Why do Giant Panda's eat bamboo?

I want to investigate into why pandas eat bamboo and what the future holds for the animal both physically and politcally.

Research into the biology of pandas.

Research into comparisons with other bears.

Research into bamboo.

Comment [A5]: Aims and objectives are reasonably clear and precise at this early stage. (AO1)

Date 7th January 2016

Candidate number

45678

Candidate's full name

Toby Davies

Part A: Candidate proposal

To be completed by the candidate

Working title of my International Independent Project.

Present the topic to be researched in the form of a short statement/question/hypothesis with clear focus.
Why do Giant Pandas eat bamboo?

My initial resources will be

I plan to investigate the reason why for Pandas it is advantageous for them to survive on bamboo, using books, internet and personal research carried out through experimentation (primary data). Though most research will come from secondary data, I hope to find out why these reasons for these advantageous exist in the first place.

The courses of study or area(s) of personal interest to which the topic relates

I took biology, chemistry which will greatly enhance my ability to research. My personal interest lies mainly in evolution and pandas in general so I will be looking forward to be gathering information about both.

My project aims and objectives

I will look into what sort of pressures will push pandas into eating bamboo. Then I would look into the limits of what those pressures are and see which is the most important. To do this I need to acquire bamboo and test how much energy it releases. Look at enzymes found in Pandas that's responsible for digesting food other than bamboo, and see how common they are in proportion to the enzymes that digest bamboo. Comparing the teeth of pandas to the other bear's teeth will allow me to. Find the fossils of Pandas and see how they relate to the landscape. Look more into the structure of bamboo to explain why Pandas decided to have a feed on it.

Comment [A6]: Planning here shows a clear strategic approach. (AO2)

Provide details of the courses that you are currently studying

Qualification type	Awarding body and subject
eg A-level, IB, Modern Apprenticeship, BTEC	eg AQA Mathematics, OCR Computing, WJEC English
A-level	Mathematics
A-level	Biology
A-level	Chemistry

Qualification type	Awarding body and subject
A-level	Physics

Notice to candidate You must not take part in any unfair practice in the preparation of project work required for assessment and you must understand that to present material copied directly from any book or any other sources without acknowledgement will be regarded as deliberate deception. If you use or attempt to use any unfair practice you will be reported to Oxford AQA Exams and you may be disqualified from **all** subjects.

Candidate declaration

I certify that I have read and understood Oxford AQA Exams Regulations relating to unfair practice as set out in the notice to candidates above.

Candidate signature

Date 22nd January 2016

Candidate number

45678

Candidate's full name

Toby Davies

Part B: Supervisor's comments on candidate proposal

To be completed by the supervisor

Please comment below on the validity and feasibility of the candidate proposal (Part A) as an International Independent Project.

	Supervisor's comments
Indicate the relation to, and development/extension outside of, the main course(s) of study or interest.	As the student is studying A-level Biology there is a strong link with this subject and the topic will extend significantly beyond the specification he is studying. It will rely on strong independent research and evaluation of the resources found. He will study evolution and genetics and physiology.
Comment on the suitability of the proposed initial sources and research base.	Research using the internet. I am concerned at how accurate any test that he does on the bamboo. I think he should investigate current research.
Confirm that the project is feasible in the proposed timescale and/or indicate any potential difficulties that may prevent the candidate from meeting the Assessment objectives.	I think this project is manageable in the time frame given. I would like to see evidence that this test on bamboo is something that is possible to replicate in the classroom.
Comment on the suitability of the proposed title, aims and objectives.	Interesting title which is challenging. Student is looking at comparing the diet of the panda to other bears. It's primarily focused on diet and adaption to their environment with a link to evolution.

Comment [A7]: The supervisor should be careful not to direct the student too much.

Comment [A8]: This is a good way to express the concern.

Supervisor signature

Date

28th January 2016

Candidate number

45678

Candidate's full name

Toby Davies

Part C: Centre coordinator's approval of candidate proposal

Supervisor's name

Jude Andrews

To be completed by the centre coordinator

If you are acting as both the centre coordinator and the supervisor, please seek counter signature from a senior colleague.

Centre coordinator's comments on the feasibility and acceptability of the proposal (parts A and B) as an International Independent Project Qualification.

The candidates's planning is rigorous and aims are sufficiently ambitious. I am confident that there is plenty of scope for a feasible project with this title.

☒ Approved

☐ Approved subject to the implementation of the centre coordinator's recommendations

☐ Resubmission required

Centre coordinator's name

George Morley

Centre coordinator signature

Date

2nd February 2016

Candidate number

45678

Candidate's full name

Toby Davies

Planning review

To be completed by the candidate

This page records your outline plan once your proposal has been approved.

My next steps in planning, researching and deadlines that I will set myself. What I intend to do, by when, what resources I will use and how I will implement the recommendations of the centre coordinator (where appropriate).

The investigation ideas are:

- Investigation one - Food sources surrounding the area where panda lives became scarce due to a period of unsuitable climate forcing the ancestors of Panda to adopt a bamboo diet
- Investigation one (a) - Food sources were low due to competition from other type of predators.
- Investigation one (b) - Food sources became infected out due to disease/illness; the resulting accumulation of pathogens caused most of the meat eating pandas to die out.
- Investigation one (c) - Pandas became isolated through changes in landscape and due to the lack of suitable food or difficulty in hunting animals resulted in a bamboo diet.
- Investigation one (d) - A change in the panda's genomes caused pandas to feed on bamboo. To investigate these I must acquire information on all bear's family on biology, diet and genome.

Research into bamboo, specifically how well it grows in certain conditions and its advantages over other plants. Research into what sort of pressures would cause an animal to focus on one particular organism to consume. What was the environment like before and after bamboo became the main food source for pandas

Mutations and what causes them Panda's evolutionary history

The climate Pathogens Geography of china

Adaptations of pandas

Comment [A9]: Again, clear evidence of a strategic approach taken to project planning. (AO2)

The reasons for my decisions.

I plan to achieve this by looking at specific books detailing their species and contacting an expert on the subject. Talking to an employee who works with pandas at a zoo and interviewing them may help me confirm facts is the first idea as they deal with their diet and they must have to be a member of staff or someone they can contact on the biology of Pandas as pandas are an endangered species, hence they have people there to make sure they live correctly. See how to obtain a bamboo plant.

I have a planned trip to Hong Kong and I aim on visiting Ocean Park where they house four pandas. I plan on asking the staff questions and recording it for use later.

My summary of the comments and advice from my supervisor (and specialist consultant if applicable).

My supervisor commented that the idea with the investigations is good but most likely it is a combination of each that resulted in pandas eating bamboo. My supervisor also mentioned that as I have a lot of research, organising all the data and sorting through them into a coherent argument may be difficult.

My supervisor also suggested that the investigatrons ideas were too simple, it would be better to elaborate in more detail so it covers the full scope of what I am looking into. With a more specific investigation a satisfactory argument can be made.

I discussed the risk assessment with my supervisor, as I know I am required to conduct a risk assessment. I think there are no or very low risks associated with my project. My reseach is secondary research and I do not intent to conduct any primary reseach for my project. My supervisor suggested that I have sufficiently considered any risks posed by my reseach and project by discussing it with them, however if my research proposals were to change in any way I would need to revisit my risk assessment to deterime if there were any risks with a change of research.

Modifications I have made as a result of my discussion with my supervisor (and specialist consultant if applicable).

As a result of my discussion, I decided that as some of my investigations only search into a massive host of pressures that cause Pandas to become what we know of today, I should focus on how big of an impact this specific point or cause has led Pandas to become who they are today. Looking into the investigation points I have realized that for some of them the points were too broad and were limiting and weakening my whole argument should I write about it like that.

Specifically, I will change the investigation "food sources were low due to competition from other type of predators" to "To what extent has pandas been affected by competition from other species and how does this relate to why they eat bamboo?" The other investigations will follow a similar change.

Please append any relevant planning documentation or tools that you have used.

Date 22nd February 2016

Comment [A10]: Very ambitious working plan in Planning Review reduced in scope to aid achievability after consideration of supervisor advice. (AO2)

Candidate number

Candidate's full name

45678

Toby Davies

Mid-project review

To be completed by the candidate

This page records your outline plan when you have completed your research.

Is my project following my original plan? How has my plan developed?

Successes

Recently I have managed to travel to Ocean Park and successfully gained information on the pandas by talking to the staff that are employed there. I recorded the conversation and in the middle of analysing the conversation for use in my essay. While there I also recorded the panda and plan to analyse the behaviour they show. As the Ocean Park has sections dedicated to pandas, I have also taken pictures of the fact sheets and the panda skull that was on display. This data can be used as my primary data. I had obtained a bamboo plant so I can experiment on it.

Reading several books on natural selection and evolution has increased my understanding of how it is possible animals have adapted to their surroundings. As there is a lot of information regarding the topic it was easy to obtain information about it.

Failure

Finding specific data regarding the climate of the late Pliocene or the early Pleistocene, where pandas as we know it first appeared, has been a frustrating endeavour. Information is difficult to acquire as it either requires money I do not have or in another language. The information I do find is set in a way which makes it hard to understand without further knowledge and expertise in the subject. I have to compromise in finding data that while not in the area of China where pandas live is relatively nearby. I thought to compare against other types of bears such as the grizzly bear and the black bear so I tried contacting the Yellowstone Park through email however no reply have been given and I have been forced to pursue books on the matter.

Changes

I have realized the main focus of my project is bamboo and the scientific aspect of pandas. Looking for the landscape of Qinling around the Miocene period when pandas first appeared is difficult due to the fact that no one is researching it. Not many changes occurred to the overall plan as everything stayed mostly predictable. What I mainly did was research and compiling the information into an argument. The investigation titles have changed from the ones in the planning review into:

- Investigation one: To what extent has food sources where the Giant Panda's ancestor lived been affected due to a period of unsuitable climate, forcing the ancestors of the Giant Panda to adopt a bamboo diet?
- Investigation one (a): To what extent has the Giant Pandas been affected by competition from other species and how does this relate to why they eat bamboo?
- Investigation on (b): To what extent has micro-organisms affected the Giant Panda's ability to eat bamboo?
- Investigation one (c): How likely is it that Giant Pandas became confined through changes in landscape and due to the lack of suitable food or difficulty in hunting resulted in a bamboo diet?
- Investigation one (d): To what extent did changes in the Giant Panda's genomes cause pandas to feed on bamboo?

My summary of the comments and advice from my supervisor (and specialist consultant if applicable).

My supervisor suggested that I write down a plan for what I am going to write in the essay as I may have lost a bit in skill in terms of writing an essay over the couple of years I stopped taking English. In particular I should also add an introduction for each section as even though the investigation is stated in each section, without a follow on from it, it will be hard for any other person to follow what my main focus is.

Another point she suggested is to set goals for myself. With only myself, it may be hard to motivate myself into achieving what I need so it would be best to focus on one target and then move on to another so I succeed in completing my essay over a number of targets. She also mentioned that even if I work out the nutrient value of bamboo I will need to relate it to my essay.

Comment [A11]: Monitoring of progress is evident here. Whilst not quite comprehensive, it is reasonably detailed.

Comment [A12]: Monitoring of progress and subsequent modification of plan – detailed and justified. (AO2)

Modifications I have made as a result of my discussion with my supervisor at this stage (and specialist consultant if applicable).

Looking over my topic, I have always split up the topics into smaller questions which I can individually focus on. However the lack of planning on how the essay will be written will make it difficult to write so I intend to outline what each paragraph will be about and use that as a basis for my argument.

In each of my investigations I will include an introduction specifically for that investigation. It will include basic information and a lead in to the topic. As I have an introduction for each investigation, a conclusion for each one will be appropriate as well. Once I finished writing the conclusions for each investigation, the final paragraph will sum up all the previous conclusions.

As for goals, I Will set the number of words I must have written in the essay at the end of each week. That way I will focus on making sure I write enough.

Comment [A13]: Again, evidence of project development here – detailed and justified. (AO2)

My final title, aims and objectives.

Why do Giant Pandas eat bamboo?

Explore a number of investigations to answer this question, focusing on food sources and climate change; competition from other species; influence of micro organisms; changes in landscape and difficult in hunting; and genome changes.

My planned next steps to achieve my project's aims and objectives.

Now that research is mostly completed, what remains is to finish up the essay. As it has been a couple of years since I last wrote up an essay I felt it was necessary to look up my old English essay and identify what made that piece successful. While looking at the mark scheme there were phrases that I didn't fully understand how to show such as "Critical analysis" or "sound evidence and reasoned judgement" in my essay so I plan to research into that by reading up examples on the Internet.

Although I have research material, organising all of it will make it easier when using it in an argument. To do this I will split up my research into categories of which investigation they belong to, that way I will know which points I need to address while saving time trying to find specific facts. If they can be used for multiple investigations then it will be in another category.

Another problem I have to resolve is the references. Although I have recorded each link and book that I have used, I have not matched up which fact goes with which reference so I need to go back through my research and my references and see which reference relates to which information I recorded.

Please append any relevant planning documentation or tools that you have used.

Date 24th May 2016

Candidate number

45678

Candidate's full name

Toby Davies

Project product review

To be completed by the candidate

This page records the near completion of your project product. Outline the successes, failures, additions and/or changes you made as you followed the plan in your mid-project review.

Did my project follow my revised plan from the mid-project review?

Success

In the end I managed to organise my data and write up an argument. The outline of what I was planning to write and what evidence to back it up helped tremendously in what direction I should take the essay. It also cut down the time it would have taken for me to write the essay as I am naturally a slow writer. Writing up my bibliography, while tedious was completed as it was a simple endeavour and if I was unsure what to write I simply adapted around by either not including the point or write in a substitute that represents that reference.

Failure

Looking into the critical analysis and implementing it into my work was difficult due to the straightforwardness of the topic so I had to. I misjudged the fact that climate involves more than temperature and as a result did not have research on any of the other aspects, I had nearly no time left to research the other factors so I had to change my investigation from climate to temperature. As I didn't organise the data I collected it made looking for facts difficult.

Time was wasted due to this and if I had properly sorted my information I wouldn't have taken so long to write up the essay. I didn't end up experimenting on my bamboo plant as I was unsure how to do so; I also don't have any way to compare it to a bamboo in China as the variables for China and England are very different.

Investigation one is to look into climate, however I focused on temperature and ignored the other factors of climate such as precipitation, wind and other conditions due to the lack of information I had on the topic and the unknown effects on bamboo so instead I focused only on temperature and changed climate to temperature. Throughout the essay I encountered more ideas to use for my argument so whenever I reached a point like that, I needed to look for a piece of information and I would stop writing my essay and look for any data in that regard. It made me realise that even if you think you thought up everything, there's always something more to write and I needed to pick which ones I wanted for my essay.

Comment [A14]: Monitoring of progress is comprehensive.

My summary of the comments and advice from my supervisor at this final stage (and specialist consultant if applicable).

Everything was mostly on track so there wasn't much more to add other than finish the essay on time. My supervisor suggested letting someone else read it and see if they understand what's being conveyed to them. It would also let them spot any mistakes I may have overlooked the first time. She also said to redo my bibliography as I had wrote on the essay numbers that corresponds with the source, but as I am not quoting directly from the source I should just remove the numbers and put in the links I used into the bibliography. I should upload my video of the Giant Pandas onto the internet so it would be easier to reference as my primary data.

Comment [A15]: This is not good advice from the supervisor – it appears to have resulted in the referencing being taken out of the report.

Modifications I have made as a result of discussion with my supervisor (and specialist consultant if applicable) at this final stage.

n/a

Do I need to do anything else to complete my project?

I removed the references as they are in the incorrect context. I also added more detail about the URL so it would be easier to understand. I edited my essay to make any corrections I have spotted. I will upload the video of Giant Pandas eating bamboo.

Please append any relevant planning documentation or tools that you have used.

Date 7th September 2016

Candidate number

Candidate's full name

45678

Toby Davies

Presentation record part A

To be completed by the candidate

This page records your presentation and its preparation.

Planned format of my 10 minute presentation (eg audience, use of visual aids, slides, use of notes, etc).

I am going to use slides for my presentation. On each slide I will have bullet points about the topic and explain in more detail about it. Pictures will be on the slide that is appropriate for one to avoid making my presentation look plain. The background will also have some unique design to keep the viewer's attention.

I plan to tell an anecdote of how I decided to pick my project; it will have to be short as there may not be enough time to go into full detail due to the maximum limit of 15 minutes. I add a slide for each of my investigations and I'll be going over points and arguments that my essay has. Though I need to shorten it down or put it more simply so I don't have to run over the time limit. Notes are written with what my main points are and what I should focus on.

Planned content of my presentation.

- **Project process:**

Title
Introduction
Project aims
Research methods
Skills I used
My investigations
Graph of fluctuating temperatures
Pictures of animals
Conclusion
Questions

- **Project findings and conclusions:**

I looked into the reasons why Giant Pandas eat bamboo, there are many factors at play and I investigated different causes and how much it contributes. The topics I am investigating are the temperature, micro-organisms, competition, genomes, their effects and how this relates to the Giant Panda's diet. In conclusion, the most important is the micro-organisms, followed by genomes then competition and finally temperature. This is due to how much each of these effects can influence Giant Pandas.

Comment [A16]: AO2/AO4 –
Presentation is well planned/structured

Modifications I have made as a result of rehearsal and/or discussion with my supervisor (and specialist consultant if applicable):

I had a brief conversation with my supervisor about my presentation and she suggested that I may not have enough time to go over everything about my project. In the presentation there was a limit of 15 minutes maximum, it was decided to focus on two investigations so I can fully explain what I did, how I achieved it and what my conclusions are.

Date 15th September 2016

Candidate number
45678

Candidate's full name
Toby Davies

Presentation record part B

To be completed by the supervisor

Record and comment below on the delivery of the presentation.

	Supervisor's record/comments
The nature of the audience should be a minimum of two adults including supervisor (include numbers of staff, students and others present).	The IPQ coordinator, supervisor and four sixth form students were present during this presentation.
The nature of the presentation (include use of notes, use of display items, and use of presentation software).	Student spoke with the aid of a PowerPoint presentation and notes.
Comment on the content and delivery of the presentation (for example clarity of ideas, structure of presentation, pace, engagement with audience).	Student spoke confidently on the reasons behind his choice of project. He drew links between this and his A2 Biology and the focus on the taste of bamboo. He clearly outlined the aims of his project and spoke about some of the problems he overcame in light of difficulties in accessing primary research. Student spoke about his visit to a zoo in Hong Kong where he was able to speak to the zoo keepers about pandas and he also contacted various institutions for further information but received a mixed response. He sought to investigate the different diets adopted by the Giant Panda, who were originally meat eaters. He compared temperature changes to assess whether this was a likely cause of the diet changes. Student believes that the bamboo diet adopted was due to scarcity of meat during ice ages. He also considered the competition for food from martens, bamboo rats and tigers. Student was confident in drawing conclusions on his project.

Comment [A17]: Communication of findings is clear and reflect a sound grasp of the subject matter. (AO4)

Please append any relevant planning documentation or tools that you have used.

Candidate number

Candidate's full name

Presentation record part B

To be completed by the supervisor

Record and comment below on the delivery of the presentation.

Comment on the response of the candidate to questions that demonstrated understanding and grasp of the project and/or its production. Give examples of five questions asked and answers given.	1. How much evidence is there that avoiding competition was the main reason for the change in food supply? Student stated that there is no direct evidence that suggested that this was the sole reason for the change in diet. However, it has been deduced that pandas can climb, bamboo grows quickly, following the logic it does to an extent explain why bamboo was the diet choice.
	2. Have scientists agreed on the main cause of bamboo eating? The most likely reason is competition and this is generally agreed by specialists within the field, although there is limited scientific research in this area. Scientists do disagree on the other mitigating factors but mostly agree on competition is the most significant.
	3. What made you focus on competition and temperature? Genomes and bacteria are straight forward and have been investigated thoroughly. Student stated that he chose to focus on temperature and competition because this was the focus of his research base. It enabled him to analyse and evaluate in more detail an original concept
	4.
	5.

Comment [A18]: Responses to questions are clear and show a sound grasp of the subject matter.

Comment [A19]: A minimum of five questions is required to be recorded.

Supervisor signature

Date 28th September 2016

Candidate number

Candidate's full name

45678

Toby Davies

Summary and reflection

To be completed by the candidate

This page records your summary, reflection and evaluation when you have completed your report and given your presentation.

Some questions you may wish to answer in this section include, what have I learned from completing this project? What new knowledge or expertise have I enjoyed or found valuable? What are the strengths and weaknesses of my project (including planning and organisation)? What skills have I improved? What changes would I make if I undertook such work again? What advice would I give to others undertaking such a project?

I looked into the reasons why Giant Pandas eat bamboo, there are many factors at play and I investigated different causes and how much it contributes. The topics I am investigating are the temperature, micro-organisms, competition, genomes, their effects and how this relates to the Giant Panda's diet.

Comment [A20]: Nice summary of strategy taken. (AO2)

In conclusion, the most important is the micro-organisms, followed by genomes then competition and finally temperature. This is due to how much each of these effects can influence Giant Pandas. There are still elements that remain unexplored that may even relate to other points and certain assumptions must be made but micro-organisms ability to adapt quickly is what allowed the Giant Panda's ability to digest cellulose, the potential of change in genomes allowed the possibility of adapting. The other influences encouraged the development of consuming bamboo.

Comment [A21]: Example of a well-evidenced conclusion (AO4)

Briefly summarise your main learning from completing this project. You might include new knowledge or expertise that you enjoy or find valuable, a consideration of your planning and organisation, changes you would make if you undertook such work again, advice you would give to others undertaking such a project.

The main point of this project is to satisfy my curiosity as to why Giant Panda's eat bamboo, however even with this project I feel what I had wrote is still not enough to explain why. However, unless there is new discovery regarding the development there most likely will not be a definitive answer in the near future. There are many people who specialise in these fields that have a better grasp of this topic than I do so it is probable that these people have already thought up my arguments or disproved it. At the start finding motivation to begin was a challenge as I felt I had plenty of time to do it. Though this was true, the pressure to finish the project stayed at the back of my head and it was irritating to continue to put it off. If I had another opportunity I would definitely focus on it first and finish it much sooner.

It was enjoyable to look at the adaptations of these animals and how the Giant panda fit in with the ecosystem. The most enjoyable part of the research was perhaps looking at the genomes and mutations as that relates to what I am doing in Biology now. I was pleased to know these things ahead of the timetable to when it was taught. A lot of research was spent also looking into competition. Again this relates to my biology and helped assure my knowledge in the subject. Though it was only a small part of my essay, looking into farming was enlightening.

There's a lot more to the subject than I initially thought and it was a pleasure to look further into the topic. A lot of time was also spent looking into the conditions of how well bamboo grow, although I'm not particularly interested in gardening I now am a bit more knowledgeable in the subject. At one point I wanted to investigate into the conditions that are favourable to bamboo and as a result I obtained a bamboo plant. However as I had only one sample I didn't bother looking into it as I would not be able to compare the results. It now lives inside my house and it is rather enjoyable to water the plant.

Organising the work was a challenge and a chore but it was necessary due to the fact that without being organised it was difficult to find specific data. I learnt to sort through the data into a coherent form but it was better to plan out sections where bits of information would go. If I had a chance to redo this project I would make sure all the data was in sections where appropriate for them. A lot of the research papers were restricted or in another language so I had no choice but search for other ones. There also the problem of finding no direct evidence to prove or disprove my investigation, at best I have supporting evidence which I can use to reason for the possibility of it occurring. Many assumptions had to be made for the possibility to even existence; the more assumptions made the weaker the argument so I feel even though I did manage to write up an essay, it is shaky at best.

Comment [A22]: Evaluation of process and own learning. (AO5)

Research into biology was a major motivation in choosing my project. I succeeded as I have found out many interesting information like how termites contain protozoa that assist them in eating through wood. In particular

learning about earthquakes and tsunamis were a gratifying experience as it reminded me of the sheer power of nature, though not related to biology their effects on people and landscape brought me a new perspective in how the people and animals responds to it. My most favourite part of my research is looking at landscape changes, though I never implemented it into my essay I looked into tectonic plates shifting. The world looked so different millions of years ago and it will continue to change millions of years into the future, there some hypothesis of what the future continent will look like and it was delightful looking through these.

Time management was a very important factor in completing the project. Without I would find it difficult to find the see what I have to complete which by when. Planning the way the essay was set up also helped but it changed as the essay went on due to thinking up new ideas or finding a better way to phrase an idea. During each of the reviews I would always look at the plan I had wrote then and would try to implement it however difficulties arose from lack of preparation. For example, I wanted to look into the nutritional value of bamboo but I didn't take into account variables that can't be replicated easily like the climate of China and the age of the bamboo plant itself. Also, unless I bought more bamboo I wouldn't be able to compare it to another bamboo. When I did end up buying a bamboo plant I didn't check to see whether the type of bamboo was a type that Giant Pandas can eat, I just merely assumed that they can eat it. By the time I thought to check I had realised I knew nothing on how to check its nutrients and had no equipment necessary to even do so. Preparation was a key part of this and I had failed badly at it with how terribly I handled it.

Comment [A23]: Review of own learning – detailed. (AO5)

Essay writing skills are something I wanted to improve upon and this essay provided me with the chance to learn skills regarding it. Even with the opportunity, I feel I did not take advantage of this as well as I could have as I invested time into the research itself. As I had missed the opportunity, if I could redo this project I would complete research as quickly as possible and focus directly on how to draw up and essay. Writing up an outline of what the paragraph will contain helped in regards to what I will be writing, I recommend any other future candidates to do the same as it will keep you focus on the question and you know where to head with the argument

Evolution is a topic that is complex and even though I researched it I only scratched the surface, because of this I only touched the basics of the subject though I looked into a few higher level knowledge as well. I would like to learn more about the topic in the future at my own pace. Learning about the full names like the Bashania Fargesii or Panthera zdanskyi was an entertaining endeavour, even though the names were easy to find but attempting to pronounce them correctly during the presentation was an educated guess as I had no other comparison to go off.

Learning to reference is a very important skill as I wouldn't have been able to complete the project. I never referenced before or wrote a bibliography before the essay. It was an experience to try something basic, yet with many rules on. I managed to complete it however, though easy it was tedious and the information wasn't where you would normally think it would be. For any future candidates I recommend to have a file with every resource you use. It will also help to add a description after the link so you can tell what it contained in case you would forgot where that resource leads to. Arranging it in alphabetical order will also make it easier to organise and decipher you references so you can easy find a specific resource.

Prepare in case you have a rare opportunity to ask for information, I learnt this the hard way as I missed the opportunity to talk with the employee who worked at Ocean Park. The page of questions in Chinese was w1ere I was staying and because it was undecided when I would go I didn't have the sheet of questions on the day I went to visit the park. The employee I did talk to did speak English but wasn't good enough to speak technical words. I contacted the Yellowstone bear world through email to ask several questions about grizzly bears, even though it wasn't successful it's worth still asking specialists as they may reply back and offer new resources and avenues to look into.

Presentation was the most uncertain part of this whole project as even though I prepared my presentation and have notes ready, I was anxious about how well I would deliver it. As it turns out, I feel I succeeded well in the presentation. As soon as I started the presentation, I found myself relaxing into a comfortable pace and the notes I had helped me focus on what topics to mention. The presentation itself was a rather simple design, made shortly within 15 minutes. However there exist presentations that looked much more professional than mine. though I feel spending hours on a 15 minutes presentation is not worth the time spent. Aesthetics are not my strong suit; I simply picked one of the designs that were already programmed on. Pictures were simple to get as a simple search in Google allowed me to find the images.

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- The report is of an appropriate format, though the style is rather more conversational than scientific
- The report is organised well - material is relevant and structured to reflect the planned study
- The final plan is implemented in the report and the aim (just about) achieved - the planned investigations were carried out logically, information and data analysed thorough and reasoned conclusions drawn based on it and that addresses the aim (though synthesis between sources is implicit)
- Lack of referencing in the report - which makes it difficult to assess which sources were actually used (see Supervisor's unhelpful advice in PPR)

Why do Giant Pandas eat bamboo?

Introduction

The near infinite variation between species has led to many interesting twists between organisms. One such is the Giant Panda where over 99% of their diet is entirely on bamboo. The famous icon of China, the Giant Panda (*Ailuropoda melanoleuca*), is a well-known animal that is best remembered for its unforgettable endearing quality as well as feeding on bamboo. The depths of why they eat bamboo are buried under the physiology and the adaptations that have evolved over when they separated from their evolutionary branch. There are several investigations to look into to discover why Giant Pandas decided to prey on bamboo. I will be investigating the ones listed below:

Investigation one: To what extent has food sources where the Giant Panda's ancestor lived been affected due to a period of unsuitable temperature, forcing the ancestors of Giant Panda to adopt a bamboo diet?

Before Giant Pandas devoted their diet to grass bamboo, they were carnivores as evidenced by their carnivorous digestive system, but pressures caused the bear to become specialised in digesting bamboo. Temperature has a large influence on every organism, however it is deciding how forceful it is on Giant Pandas that requires investigating.

The first point to look into is when Giant Pandas as we know it first appeared. The second point to look into is what are the limitations of bamboo. The earliest known fossil that's related to the Giant Pandas was discovered in Spain, dating around 11 million years old, however these Pandas were small and likely were omnivores. The closest fossil to Giant Panda of today is estimated to be 500 thousand to 700 thousand years old and is around 1/8 smaller than the current Giant Pandas, so it appears an event occurred between those time period to cause the species to adapt into a bamboo diet. I have chosen to investigate the temperature conditions during the late Pliocene and the early Pleistocene as there is a fossil of a branch of the Giant Panda family that was discovered and was dated during the late Pliocene or the early Pleistocene.

The Bamboo (Bambuseae) is an adapted type of grass with over 1,000 types of species. Using *Bashania fargesii*, one of the major food sources for Giant Pandas, as an example, we can look at the level of tolerance for temperature. They can survive temperatures as cold as 0°F. The results of these limits stem from pressures on the environment. The temperature must have dropped to a lower level for an extended period of time otherwise these adaptations would not exist.

Measurements of temperatures will come from Eryuan. As Eryuan is around 1300 km away from Qinling Mountains and that they are both places far from the coast meaning that are not affected by ocean currents, they are relatively nearby, there will not be a large difference in climate. At around the late Pliocene, the mean temperature of the warmest

month (MTWM) is 24.6°C-27.5°C while the mean temperature of the coldest month (MTCM) is 1.9–12.1°C. It is important to take these temperatures as the same of the Qinling Mountains during the late Pliocene with some scepticism. This is because Qinling is a mountainous range and depending on the position on the mountain there will be variations on the temperature. However, as there is little to none data on the temperature in those specific areas we must assume that the temperature is at least similar.

As the MTCM range is much higher than the cold tolerance of *Bashania Fargesii*, it is likely that the temperature dropped to a level where it is colder than during the late Pliocene. As such, organisms must adapt to the new temperature. The ancestor of the Giant Panda are smaller than today's but have a similar style of teeth and skull suggesting that their diet is such that they are omnivores like many other modern bears. Their small size and mixture of teeth suggest it is more likely that they scavenge fruits, insects and plants while consuming meat from carcass.

A colder temperature would result in the extinction, or at least a reduction in population in plants. The fact that such a large biodiversity of plants exists in China today suggest that many types of plants succeeded in the environment. As such it is unlikely that Giant Pandas were forced into feeding on bamboo only as there were many other plants to feed on. However it is highly probable that hunting animals became more strenuous. As temperatures drop more energy is needed to maintain body temperature hence more resources are consumed. This causes more hunting or scavenging which means less resources which results in the ancestor of the Giant Pandas relying on other plentiful sources of energy.

On the other hand, temperature change has always been unstable, since the last interglaciation, the average global temperature has many sudden drops over the period of 150 thousand years. With such an unstable temperature, it will be difficult predicting how the ecosystem responds to it. There is also no direct proof that animals died as a result of the temperature change. This also assumes that Giant Pandas did not improve their ability to hunt and that plants act similarly to how they act now.

Another assumption is that bamboo is growing all around China. During the Pleistocene period the Giant Pandas were distributed all around China so if they were feeding on bamboo there must have been bamboo around at that time as well. The large plant biodiversity today may also stem from a few species; therefore we can't be sure how many plants survived any temperature drops.

Overall it is unlikely that Giant Pandas adapted to eating bamboo as a direct result of a cooling climate. It is likely that the cold climate encouraged the ancestor of the Giant Panda to gather food that is obtained effortlessly. However, though the climate may have contributed to the change in diet as there are many other plants, it would not have been enough to cause the ancestors of the Giant Pandas to directly eat bamboo.

Investigation one-a: To what extent has Giant Pandas been affected by competition from other species and how does this relate to why they eat bamboo?

Competition is always a force that steers the direction of evolution, and Giant Pandas are no different. From competing resources to being victims of attacks from predators, there is always a force acting and influencing the behaviour of each organism. What it is important to discover is how this contributes to the Giant Pandas eating bamboo.

Giant Pandas, like various other animals, are victim to hunting for other species. Today, young Giant Pandas in the wild are hunted by Jackals, Yellow-Throated Marten and snow leopard. Despite Giant Pandas appearing slow, they are quick when prompted and aggressive should they be provoked. Young Giant Pandas are hunted instead of adults due to adult males Giant Pandas weighing 85-125 kilograms while females weigh 70-100 kilograms making it difficult to hunt, and with strong jaw muscles powerful enough to break bamboo that are as strong as steel, a single bite will likely be life threatening.

The basic defence of any young Giant Panda in the wild is to climb trees. This lets them escape from predators, however this also allows them access to more bamboo in higher areas. What is notable about bamboo is that they hold the world record for the fastest growing plant at an astonishing 91cm per day. Its ability to replenish itself so rapidly may contribute to its survival. *Bashania fargesii* grows up to 25 feet, with so much bamboo it is natural that Giant Pandas take advantage by climbing the mountain to reach for more. The escape mechanism for climbing away merely encourages this behaviour.

The main other competitors for bamboo is the Red Panda and the bamboo rat. All rats reproduce quickly, they are known as pests due to the sheer quantity of their numbers after they reproduce in a short amount of time. This suggests that with rats eating bamboo, Giant Pandas must have developed a higher efficient means of gathering them. This assumes that the bamboo rat has been constantly consuming bamboo since the late Pliocene era.

Giant Pandas will fiercely protect their young but they cannot afford to waste energy as bamboo does not offer much nutrition. To maximise survival chances and conserve energy, female Giant Pandas vigorously defend its territory from competition to protect its resources for future use. Territory of Giant Pandas consists of a dense area of bamboo grass; hence with a defended territory there will be more access to bamboo. However, as competition does not affect pregnancy directly, this behaviour of protecting territory may not be due to the predator's threat to any future offspring but to protect its resources from other organisms.

However common bamboo appears to be, Giant Pandas today only feed on around 42 types of bamboo. The niche of the ancestor of the Giant Panda was to scavenge. As such any rival would come from any animal that also scavenge. To switch to a bamboo diet, there must have been another competitor that outcompete the animal's ability to scavenge. Following

this reasoning, the possibility of a type of bear where that are suited to scavenging arises. Competitions for sustenance and territory are a common occasion among the wildlife and bears are no different. It may very well be possible that the one species of bears branched off to focus on general scavenging skills while another branched off to eat the accessible bamboo. The bear that focused on scavenging may explain the existence of the Asiatic black bear.

What Asiatic black bears feed on mainly depend on the season, but in general they consume plants, acorns, insects, nuts, berries and small mammals. Adaptations suited for this include curved claws developed for digging and climbing trees. With Asiatic black bears being better adapted to collect these resources, the ancestor of the Giant Pandas were likely out competed and were forced to search for an alternate means of sustenance.

While these bears branched off to become more adapted into scavenging, it is possible that the ancestor of the Giant Pandas branched off and became more adapted into consuming the plant food that are nearby. Giant Pandas are mainly herbivores but can consume meat and though they aren't specifically designed to eat plants they have the digestive system that allows them to harness energy out of it. This brings us as to why eat bamboo over other plants?

Despite bamboo having a low nutrient, the lack of competitors that consume bamboo may also contribute in pressurising Giant Pandas to eat bamboo. Advantages of bamboo are that it is evergreen, can rapidly spread, and grow quickly. These advantages are what made bamboo stand out from other types of plants.

Why the ancestors of the Giant Panda didn't adapt to becoming more successful in hunting animals can be explained by the presence of greater predators. The *Panthera zdanskyi* is a tiger that lived during the early Pleistocene from 2.55–2.16 million years ago and was found in Longdan, Gansu Province, China. This was around the same time period when the ancestors of the Giant Pandas were still thriving around China. Though considered primitive, the *Panthera zdanskyi* is similar to modern day tigers. They are powerful predators, competing with them will be difficult due to the tiger's agility and ability to ambush.

As competition occurs constantly, it is one of the largest influences on the evolution of the Giant Pandas. With the existence of superior animals in various methods of collecting resources, Giant Pandas were forced to focus and specialise on gathering bamboo.

Investigation one-b: To what extent has micro-organisms affected the Giant Pandas ability to eat bamboo?

Every being deals with micro-organisms; whether they are harmful depends on the organism's ability to repel its negative effects. As micro-organisms have diverse abilities, some may hold the power to digest bamboo and support Giant Pandas.

When comparing herbivore's digestive system to a carnivore's, it is obvious that there are key major differences, the main one being that herbivores have a large caecum which allows the herbivores to digest plants through the use of bacteria. In order for these bacteria to exist, there must be a special region where they can grow; this region is called the caecum. The caecum functions by allowing bacteria to reproduce and ferment, it is found at the beginning of the large intestines in every animal, however carnivores are shrunken or missing while herbivores are enlarged.

As the ancestor of Giant Pandas were carnivores, as evidenced by evolving from Miacids which are prehistoric carnivores, and the digestive system of a carnivore cannot digest cellulose, which is mainly what bamboo is made of, they must have had some added advantage to assist in digestion. As every herbivore rely on bacteria to aid in digestion, it is reasonable to suggest that Giant Pandas have bacteria within them that aids in digesting plant matter.

The world works in probabilities, so when surroundings favour the increasing amount of bamboo, bacteria that takes advantage of this flourish. When bacteria replicates, genes are identical to each other and in optimal conditions, some bacteria can double every 20 minutes. Every time it replicates itself a chance of mutations can occur. When an advantage appears in the bacteria it will have a higher chance of survival and passing on its genes, bacteria can also share its genes through the use of taking up plasmids from the nearby bacteria. As the conditions in the intestines grow more accustomed to cellulose, bacteria will quickly adapt to break it down for energy. This versatility allows more suitable bacteria to form that will digest bamboo better. Hence, without bacteria Giant Pandas cannot consume bamboo.

Cows have many bacteria that live in a symbiotic relationship. Similar to Giant Pandas, cows have a large cellulose diet. However, as Giant Pandas have a carnivore's digestive system unsuited for an herbivore diet, the majority of the cellulose in bamboo will be undigested. There is no evidence of any vertebrates naturally producing cellulase (the enzyme that breaks down cellulose). It was hypothesised that in the intestines there are specialised bacteria that help break down cellulose. It was confirmed that there exist at 85 types of micro-organisms which were discovered in the faeces, 14 of which never described before.

As the intestines of Giant Pandas are short compared to herbivores, the bacteria must be quick acting to release the energy content within the bamboo. Bacteria break down cellulose through the use of enzymes they secrete. Most of the bacteria do this through anaerobic respiration so it can occur in the intestines where there is no oxygen. Without the use of these bacteria, every single herbivore will not be able to survive on herbivorous diet.

Although Archaea is also a classification of micro-organism, little is known about it. It was discovered in the human colon, but there is no further evidence of their existence inside panda's large intestines. Protozoa, another classification of micro-organism, is discovered to

exist in termites helping its host digest cellulose, but there is no evidence supporting that they assist the Giant Pandas ability to digest bamboo.

Bacteria has a large involvement in the ability of Giant Pandas to consume bamboo. Without bacteria herbivores cannot exist unless they develop the enzymes necessary to digest the plant matter. Though other micro-organisms offer an alternate path for Giant Pandas to digest cellulose, without further proof it remains as speculation.

Investigation one-c: How likely is it that the ancestor of the Giant Pandas became confined through changes in landscape and due to the lack of suitable food or difficulty in scavenging resulted in a bamboo diet?

Locations can vastly change, whether by earthquake, landslide or fire, the surrounding ecosystem is affected by it. Resources change and some animals are forced to use one food source. To choose between scavenging and consuming the seemingly never ending stationary bamboo, typically the path of least resistance is the direction animals' aim.

Many unique species develop from being isolated from other competitors. Organisms found on remote places often have traits never seen anywhere else. For Giant Pandas they have the design of a carnivorous digestive tract yet survive on a diet with 99% of bamboo, a unique condition. The fact that Giant Panda feed on bamboo suggest that bamboo was accessible in all the time the Giant Panda was evolving, meaning that it was easier to consume the bamboo there rather than scavenge around. In contrast, grizzly bears are scavengers where they consume a whole range of food from fruits to meats. Scavenging becomes difficult when there is little to none resources to take advantage of, this either happens because another outside force is preventing the organism from effectively scavenging or the location the individual depend upon is not providing any more resources or a combination of both.

There have been 15 earthquakes in China that had more than 1000 deaths between 1900-2000, each of these earthquakes resulted in landscape changes. Using this as a basis from 3.6 million years ago to the year 2000 there would have been 540,000 earthquakes on that scale. However as the number of earthquakes counted depend on the number of deaths some of them may be only counted due to hitting an area with a high population density, as such the 540,000 is only an estimate of how many on that scale there has been. Earthquakes often result in landslides, rock-slides and if sever enough cause tsunamis which can then lead to flooding. Landslides by itself are not enough to force Giant Pandas to adopt a bamboo diet as they can simply move to another area more suitable for them. Unless a powerful earthquake or multiple earthquakes causes enough damage then it is possible.

The magnitude of the strongest earthquake, the 1960 Valdivia earthquake, is 9.5 on the moment magnitude scale; often there are foreshocks and aftershocks that also have a high magnitude. Though there exists the possibility of powerful earthquakes on the same

strength occurring during the late Pliocene to early Pleistocene, strong earthquakes are rare enough that the unreliability of when they occur, as well as transpiring in the same region and the unknown amount of damage they cause suggest that earthquakes are not responsible for diet change of the ancestor of the Giant Pandas. As the pressure to cause the ancestor of Giant Pandas from scavenging to being herbivores is not constant, it is improbable that earthquakes caused the change in diet.

Flooding provides new challenges to scavenging and only those at elevated ground remain unaffected. However, flooding is more likely to affect the coast than further inland so it is possible the ancestors of Giant Pandas moved inland to search for available resources. As bamboo begins to flower and produce seeds when its environment is threatened, any floods, landslides or damage to the area will not cause the bamboo to completely die out from the area. Other plants will propagate to the area as well once the area is suitable and therefore animals will be attracted. Giant Pandas can move back to the area to scavenge, hence floods are not influence that causes Giant Pandas to consume bamboo. This assumes that the damage is slow enough that the plant had the time necessary to respond.

Minshan Mountains and mountains in south Gansu are just two areas where wild Giant Pandas occupy. Deserts are found in north Gansu, as deserts have at most 250 mm of precipitation per year, bamboo is unlikely to grow there. Instead bamboo develops in the mountains as orographic lift occur allowing precipitation. As deserts spread out over time, the land became more difficult to manoeuvre and scavenge; the predecessor of Giant Pandas continued occupying areas that are easier to scavenge, never venturing into the deserts as the forests have all its resources. Eventually due to being isolated Giant Pandas only can only benefit from the same resources and allowed the possibility of specialised in bamboo to occur. This can only happen if the climate of the desert is stable. Desert landscape can remain stable for long periods of time as long as precipitation has difficulties transporting there.

However, the desert only accounts for a small part of China, today recent renovations have resulted in many cities and urban areas that forced Giant Pandas to live in fragmented bamboo forests as the settlement grew. This wasn't always the case as Giant Pandas used to settle in a larger area of land than where they are distributed today. The desert north most likely caused Giant Pandas to expand their distribution south, away from the desert. As Giant Pandas used to have a larger range of distribution which deserts cannot cover on all sides, this indicates that deserts are not responsible for causing Giant Pandas to feed mostly on bamboo.

Humans impact the terrain and reduced the amount of bamboo for agriculture; as a result many Giant Pandas were forced to migrate to a higher altitude to gather enough bamboo to sustain them. This may have occurred to the ancestor of the Giant Pandas causing them to feed on bamboo. The earliest piece of evidence of human existence in China dated back to around 1.7 million years ago; this at least proves they had a chance to affect the evolution

line. Two stone tools and two incisors were discovered in Yuanmou showing that humans were intelligent enough to use tools. However, the stone tools are not the type needed for agriculture. Rice and millet farming date back around 12,000 years ago, much too late to noticeably affect the ancestors of the Giant Panda. As far as the predecessor of humans affecting the landscape enough to force the ancestor of the Giant Pandas to adopt a new area seems improbable, hence it seems unlikely they had a diet change from the effects of humans.

While landscape always change whether by natural or man-made, with China being a large area, it is unlikely for any species to become confined unless there is deliberate human intention. The presence of the desert however do restrict any scavenging so it is likely to have encouraged Giant Panda to spread away from the north and scavenge elsewhere allowing the conditions necessary to cause Giant Pandas to feed on bamboo. Forefathers of humans did not have the tools necessary to effectively affect landscapes. Natural disasters are rare enough that when they do affect the terrain, it does not last long enough to cause Giant Pandas to develop a more specialised diet. Not all natural disasters like fire and hurricanes were covered so the possibility of these being factors affecting Giant Panda's diet exists.

Investigation one-d: To what extent did changes in the Giant Panda's genomes cause it to feed on bamboo?

According to the theory of evolution, the event of extinction regularly occurs. Those not suited well to the environment are wiped and those that survive pass on their traits. Changes occur and what remains are the DNA of millions of years' worth of evolution and within that code, contain instructions as to everything that makes the organism.

Genomes are responsible for the way an organism function. The variety between species occurs as different genes code for different protein. In order for there to be a modification in function, there must be an alteration in the genomes. Hence, any variation between species can be attributed to changes in the genetic material.

Mutations are changes in the structure of a gene; they constantly occur in every species, most are harmless while some are detrimental to the host. Occasionally, there will be a useful trait that will be successful and will be passed. Eventually the gene frequency would increase to the point where every member of the species would have a variation of that expression of genes. Giant Pandas, evidently, are successful in obtaining useful traits to survive as their existence proves. Over the many generations, useful traits get passed on; eventually the majority has skills that develop onto specialisation.

This specialisation leads to the adaptations that we see in Giant Pandas today. Each adaptation has a specific function that allows a more efficient means towards survival. In Giant Pandas, their adaptations that provide the means of acquiring bamboo, one such is

the fact that Giant Pandas are defecating up to 40 times a day, this ensures that their digestive system has enough space to consume more bamboo. Other adaptations are the surface area of the Giant Pandas teeth. The large surface area of the teeth allows more bamboo to be crushed into smaller pieces allowing more to be digested at once. Giant Pandas also have powerful jaw muscles to crush the bamboo which can be as strong as steel. Another layer in adaptations is the thumb of the Giant Panda, although similar to a human thumb, it is not a true digit as it is merely an extension of the sesamoid bone. This sesamoid bone can be used to easily strip off the leaves of a plant, allowing more to be collected. All these adaptations point towards a single goal of specialised in ingesting bamboo. These adaptations are a result of the instructions coded in the genome, hence without changes in the genome, the forefather of Giant Pandas would have never adapted to consume on bamboo.

At some point a mutation occurred in the T1R1 gene in the lineage of Giant Pandas, the gene is responsible for the taste in glutamates, which is found in meat. Due to those mutations, it has caused the gene to become a pseudo gene. Animals often favour food that rewards them, taste is a mechanism designed to encourage that species to pursue that type of nutrients so the lack of taste in meat may discourage them consuming meat. If that is the case then the ancestor of the Giant Pandas would begin to look for alternate means of obtaining sustenance. However this may have been the result of the organism eating less meat and relying on other food sources.

Taste alone is not enough to switch to another diet; conditions must be unfavourable for scavenging as well otherwise Giant Pandas predecessor would have continued scavenging. The mutation in the T1R1 gene is also passed on leading to another step towards the forefather of Giant Pandas feeding on bamboo. As the next generation will have traits suitable for scavenging, they must have not developed enough to compete. The genomes potential to change permitted the variations of Pandas to survive and specialise in eating bamboo.

To see if it is possible for Giant Pandas to adapt to consume bamboo through mutations, we must see how often the genome mutates. In humans, up to 1,000,000 molecular lesions (damage to biological molecule that results in reduction, absence of a function or rarely obtaining a new function) can occur per day for an individual cell and as Giant Pandas have a larger mass than humans, they have more cells in their body. Hence there are at least 1,000,000 molecular lesions in Giant Pandas. However our body has mechanisms to fix any damage to our DNA, any ones that are missed are kept and replicated into the next generation. The number of mutations that survive the DNA repair system is unknown but there is enough that according to American Cancer society there is a total of 1,638,910 new cases of cancer in 2012 diagnose in the US.

However, a mutation is a process that increases, decrease or does not affect the chances of survival. Without influences the gene frequency will remain constant. Hence, there must be

a condition that favours certain alleles. As the genetic material is responsible for everything that makes up the individual, it stands to reason that any change in the genetic material results in changes in the species. This means that the ancestor of Giant Pandas switched to consuming bamboo due to altered DNA.

It is certain that changes in the genome resulted in any changes expressed in a species. Without stress acting on a component, that component won't change. Hence, by itself the genome will not specialise if no influences act on it. The mechanisms responsible for variation allow this specialisation to be possible.

Conclusion

All in all, the greatest reason for why Giant Pandas eat bamboo is bacteria and potential changes in the genome. Without bacteria no herbivores would exist. Potential changes in genome are what allowed Giant Pandas to evolve to consume bamboo leading to adaptations suited to consuming bamboo. Competition is an important influence as it is constant and forces organism to specialise their traits.

Temperature has a smaller effect in that the temperature reduction caused organisms to exert more effort. The colder temperature motivated behaviour that gathered resources for least amount of energy spent. As bamboo was plentiful and evergreen the forefathers of Giant Pandas collected those. Certain assumptions must be made however such as prehistoric bamboo being similar to current bamboo and that they were widespread as well as Giant Pandas forefather were omnivores.

Landscape changes have the least effect when concerning Giant Panda's diet. It is unlikely for earthquakes to contribute due to unpredictability of when they occur and the fact that they are not constant. Humans nowadays can manipulate landscape with technology but our predecessors did not possess the tools to alter the terrain on a large scale so it is unlikely to have affected Giant Panda's diet. Desert made it difficult to travel for all organisms so the restriction created conditions where Giant Pandas focused on their habitat to further develop the traits to specialise in consuming bamboo.

The answer to why the Giant Pandas eat bamboo is inconclusive. There is a lack of direct evidence definitively proving the answer. There are scenarios that are more likely to occur but the fact is that without further evidence and investigation the answer will remain uncertain.

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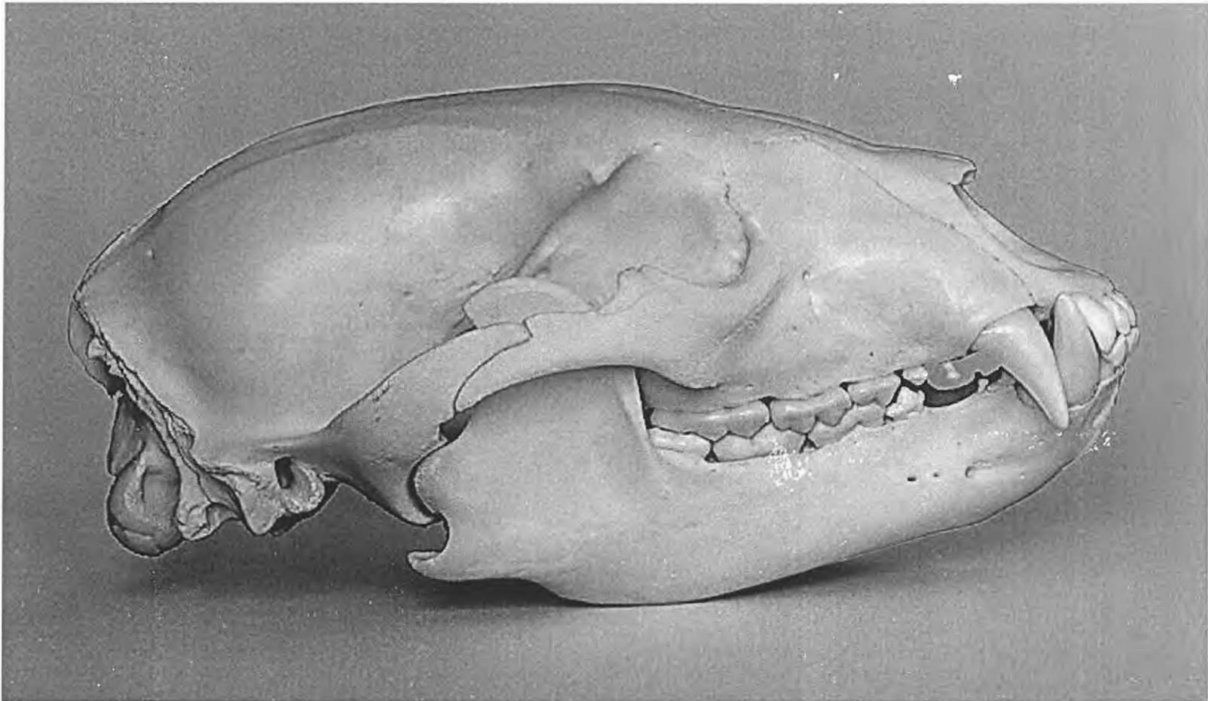
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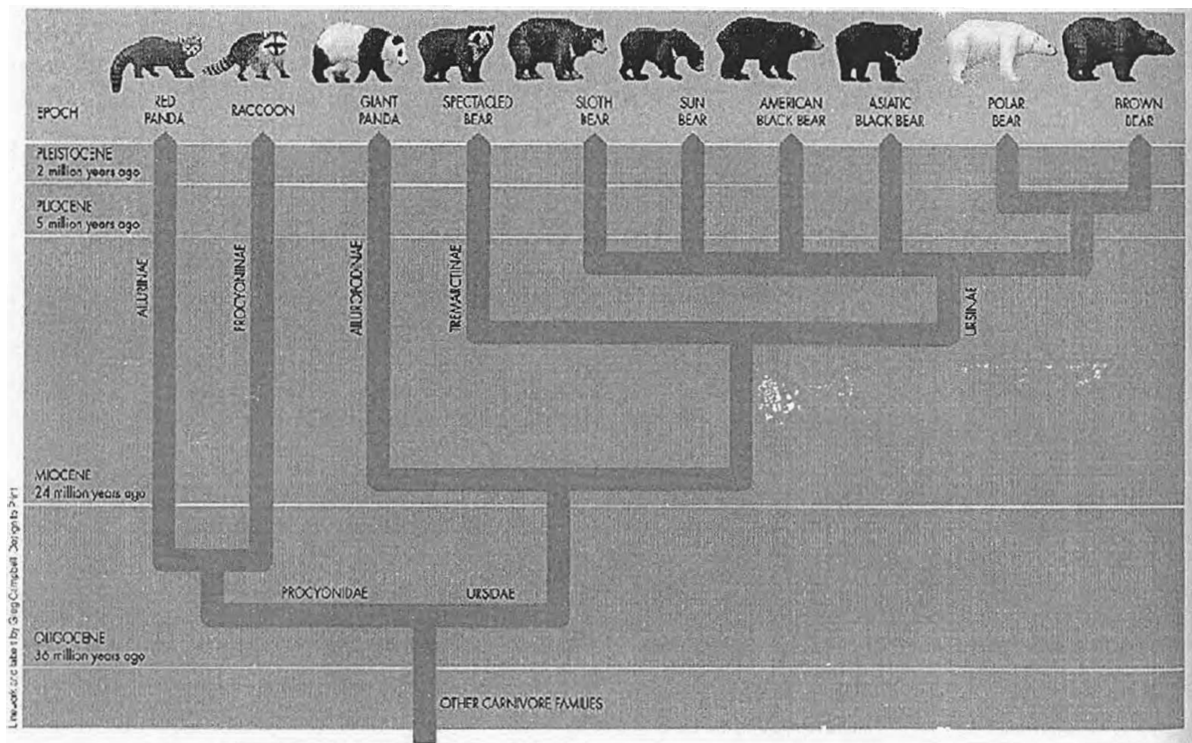
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Appendix



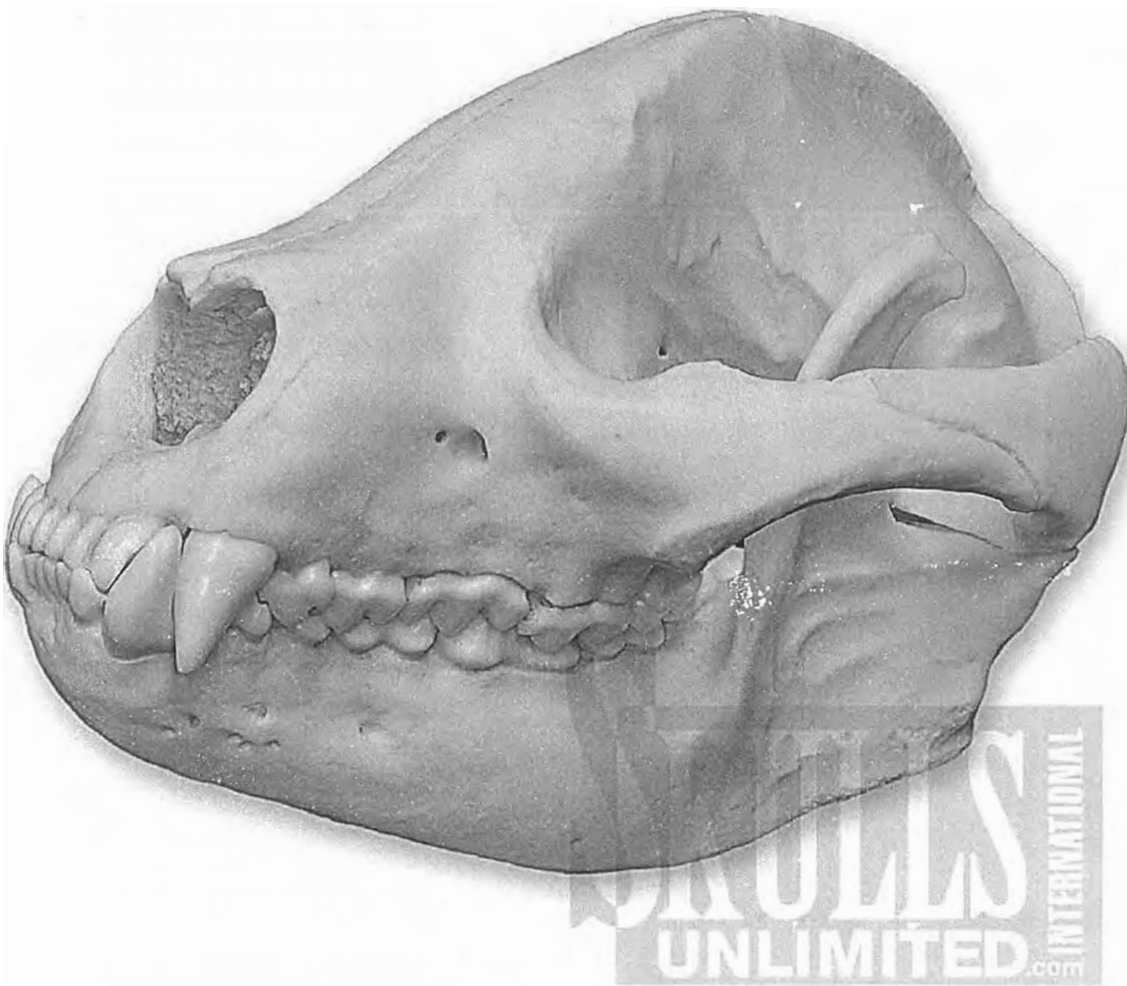
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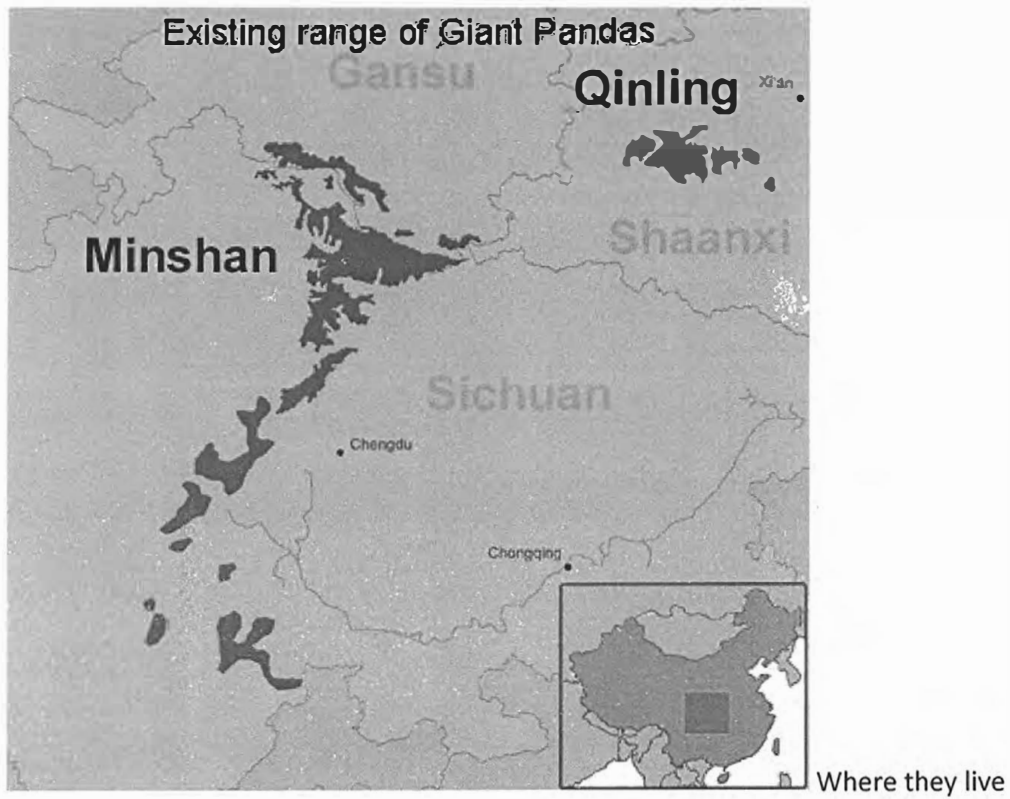


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Look at how pandas sense surroundings

Does bamboo have any smell?

Appendix



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Appendix

Yellowstone Bear World: Contact - Windows Internet Explorer

http://www.yellowstonebearworld.com/contact

File Edit View Favorites Tools Help

Yellowstone Bear ... Panda Zoos | www.Gla... Home Page | San Dieg... physiology definition - ... Page Safety Tools

Find: panda Previous Next Options

or Email us at: info@yellowstonebearworld.com

[Print Friendly](#)

Name:

Captcha: 14 + 4 = 18

Email Address:

Subject:

Message:

How do their physiology and diet differ from black bears and grizzly bears?
 What adaptations help with gathering food?
 What is the general behaviour of grizzly and black bears during the year?
 Why don't pandas hibernate when the other bears do?
 How efficient are they at digesting plant material?
 How efficient are they at digesting meat?

Thank you for taking the time to answer these questions. Any recommended source of information on bears will be much appreciated. I look forward to your reply.

Leave a REVIEW

BEAR WORLD on FACEBOOK

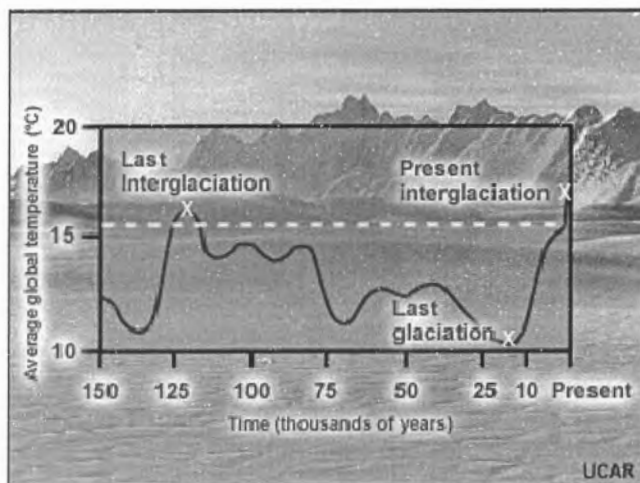
Season Passes

SEASON PASSES NOW AVAILABLE

Admission Tickets

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Appendix



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Appendix



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It is not a necessary requirement for students to submit presentation slides (the primary evidence for the presentation is documented by the supervisor in the Production Log). However, students will often want to include, for example, PowerPoint slides, and this is perfectly acceptable and can count as evidence towards the Assessment Objectives, if they are detailed enough. (However, they are never a substitute for a properly completed Production Log).

28/04/2014

My project

Why do Pandas eat bamboo?

By [REDACTED]

Introduction

- Why did I pick my project
- Patriotism
- Scientific curiosity
- Help with my biology



My project aims

- Understand why it is beneficial for Pandas to eat bamboo
- What conditions caused Giant Panda's to eat bamboo
- What about Pandas makes it so different from other bears

Research methods

- Books
- Internet
- Research papers online
- Contacting professionals



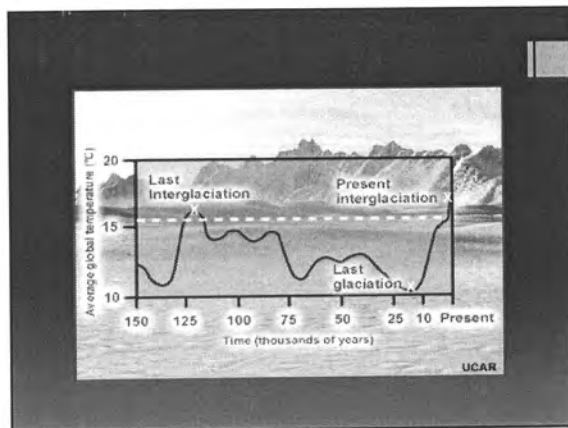
Skills I used

- Time management
- Working independently
- Organising my work
- ICT skills
- Analytical skills



My investigations

- To what extent has food sources where the Giant Panda's ancestor lived been affected due to a period of unsuitable temperature, forcing the ancestors of Giant Panda to adopt a bamboo diet?
- To what extent has Giant Pandas been affected by competition from other species and how does this relate to why they eat bamboo?
- To what extent has micro-organisms affected the Giant Pandas ability to eat bamboo?
- How likely is it that the ancestor of the Giant Pandas became confined through changes in landscape and due to the lack of suitable food or difficulty in scavenging resulted in a bamboo diet?
- To what extent did changes in the Giant Panda's genomes cause it to feed on bamboo?



Conclusions

- Bacteria
- Genomes
- Competition
- Temperature
- Landscape

Any questions?