

https://dspace.org/

Cultural and religious barriers to learning in basic astronomy : A South African study

Cameron, Ann Kathleen

2008-11-25T11:41:42Z
http://hdl.handle.net/10539/5850

Downloaded from a DSpace repository. https://dspace.org/

APPENDICES

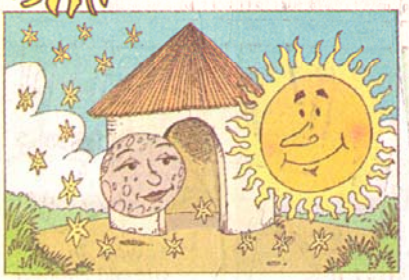
Appendix	Subject	Page
1	Eclipse story	275
2	Summary table: Methodology: pre-instruction questionnaire	276
3	Summary table: Methodology: post-instruction questionnaire	277
4	Copies of pre- and post-instruction questionnaires 4.1 2001 Pre-instruction Questionnaire (pilot study) 4.2 2002 Pre-instruction Questionnaire (College of Science and Geography groups) 4.3 2004 Pre-instruction Questionnaire (College of Science, Geography and Geology mainstream groups) 4.4 2001 Post-instruction Questionnaire (pilot study) 4.5.1 2002 Post-instruction Questionnaire (Geography group) 4.5.2 2002 Post-instruction Questionnaire (College of Science group) 4.6 2004 Post-instruction Questionnaire (College of Science, Geography and Geology mainstream groups)	278 279 284 289 293 295 297 299
5	Notes: explanation to students	306
6	Coding in Atlas.ti Method 1 (worldview): examples	307
7	Coding in Atlas ti Method 2 (code statements): examples	313
8	Network views : examples	322
9	Breakdown of results: different sample groups	324
10	Ethics clearance	327
11	Interview schedule	328
12	Breakdown of responses by students: IKS and religion	330
13	Table: frequency of reference by sample groups to "What did you find hard to understand?"	332
14	Table: frequency of reference by sample groups to "what did you find hard to believe?"	333
15	Glossary of terms and glossary of astronomical concepts	334

APPENDIX 1

Eclipse story

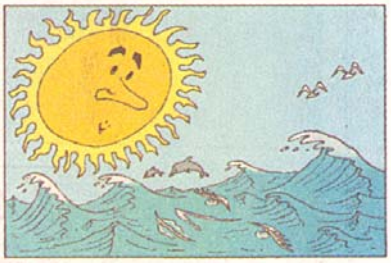
THE SUN and THE MOON

by Gcina Mhlope



Long ago, when the world was young, and the days were long and the nights were short, the sun and the moon were married. They lived with their children, the stars, in a beautiful house in the middle of Africa.

Moon was round and serene and her face radiated love. Sun was warm and charming, and he had such an adventurous spirit! He would explore the world, returning to tell his wife and children everything he had seen. The children would sparkle as they listened to his stories and felt their parents' love.

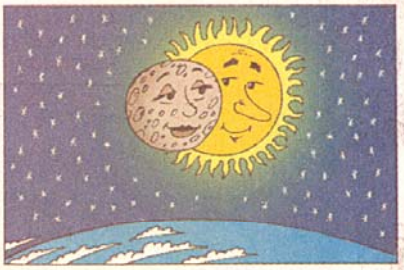


One day Sun traveled further than ever before. Suddenly he saw something shimmering and dancing in his light. "Whooosh, whaaa! Whooooosh, whaaaaa! I am Sea" spoke the stranger. "And these are my children" she said, showing Sun the many creatures living in her body. There were dolphins, sharks, turtles and many others. Sun was so overjoyed at the beauty of the Sea, that he invited her home to meet his family. He rushed ahead to tell them the news, and to prepare a magnificent feast.



Sea wasted no time, whooshing up valleys and over forests until she arrived at the house of Sun and Moon. But when Sea drew near Moon became worried and whispered to Sun, "Don't you think she is too large? Should we not give her the food outside?" But Sun was ashamed by what his wife was suggesting, and pushing her aside, he welcomed Sea.

In rushed Sea, and all her children. More and more of her until the walls of the house could no longer hold her and they broke, and all the food was spoiled with the salt of her water. "Nx! And to think I told him. Hayi!" grumbled Moon, and gathering her children she rose up into the sky.



Sun was angry with himself. He had not meant to chase away his beloved wife. Upset and confused he sat down to think and fell into a troubled sleep. Meanwhile his family roamed the sky, until they too were exhausted and went to sleep. When Sun awoke he searched all day but could not find them. When he slept again, Moon and her children woke up and traveled the world.

And so it is that the sun moves by day and the moon and stars by night. But Sun and Moon's love is too strong to die, and on very rare occasions, called a solar eclipse by humans, they steal a few moments in a hot embrace...
and they throw a cloak of darkness over the world, to prevent anyone from watching.



An initiative of the Department of Science and Technology and managed by the Foundation for Education, Science and Technology. The four eclipse sheets in this series are free and can be obtained from www.madamandeve.co.za . Contact: eclipse@rapidphase.co.za for further information. For additional information on eclipses, visit www.fest.org.za . Madam & Eve is Copyright Rapid Phase (Pty) Ltd. This material may not be modified or altered in any way without the permission of Rapid Phase. The Department of Science and Technology and the Foundation for Education, Science and Technology disclaim any liability for any loss or injury howsoever incurred from viewing the solar eclipse.

APPENDIX 2

Methodology: data collection - Pre-instruction questionnaire

Phase 1

Sample groups	Instruments that were used	Focus of analysis	Method of analysis	Presentation of results
Pilot study G 2001 COS 2002 G 2002	Pre-instruction Questionnaire Appendix 4.1 Pre-instruction Questionnaire Appendix 4.2	Prior knowledge	Manual coding (also computer coded in Phase 2: see below)	Table 5.16 showing conceptual change: responses to six content questions from pre- and post- instruction Questionnaires

Phase 2

Sample groups	Instruments that were used	Focus of analysis	Method of analysis	Presentation of results
G 2004 COS 2004 MS 2004	Pre-instruction Questionnaire Appendix 4.3	Prior knowledge related to worldview	Computer coding of data from **all** sample groups, i.e. from Phase 1 and Phase 2: Method 1 (numbers of students involved with each issue) and Method 2 (frequency of reference to the issues involved)	Tables 5.1 to 5.15. These tables show numbers of students with different worldview positions; and details of the prior knowledge given as "code statements"

APPENDIX 3

Methodology: data collection - Post-instruction questionnaire

Phase 1

Sample groups	Instruments that were used	Focus of analysis	Method of analysis	Presentation of results
Pilot study G 2001	Post-instruction Questionnaire Appendix 4.4	Barriers to learning	Manual coding	Table 5.16 showing conceptual change: responses to six content questions from pre- and post-instruction Questionnaires
COS 2002	Post-instruction Questionnaire Appendix 4.5.1			
G 2002	Post instruction Questionnaire Appendix 4.5.2	Conceptual change and barriers to learning		

Phase 2

Sample groups	Instruments that were used	Focus of analysis	Method of analysis	Presentation of results
G 2004 COS 2004 MS 2004	Post-instruction Questionnaire Appendix 4.6	Barriers to learning	Computer assisted coding of data from **all** sample groups from Phase 1 and Phase 2; Method 1 (numbers of students involved in each issue) and Method 2 (frequency of reference to each issue)	Tables 5.17 to 5.37: numbers of students who responded to the issues in different ways. Figures 6 to 13: pie charts showing the relative frequency of "code statements" to a number of issues.

APPENDIX 4

Copies of examples of pre- and post-instruction questionnaires:

Pre instruction questionnaires
4.1 2001 (used for pilot study - Geography Preliminary sample only)
4.2 2002 (used for Geography Preliminary and College of Science samples)
4.3 2004 (used for Geography Foundation, College of Science and Geology mainstream samples)

Post instruction questionnaires
4.4 2001 (used for pilot study - Geography Preliminary sample only)
4.5.1 2002 (used for Geography Preliminary sample)
4.5.2 2002 (used for College of Science sample)
4.6 2004 (used for Geography Foundation, College of Science and Geology mainstream samples)

APPENDIX 4.1

Pre instruction questionnaire
2001 (used for pilot study - Geography Preliminary sample only)

University of the Witwatersrand
Geography Prelim

Earth in Space 2001

Pre-course questionnaire

DO NOT WRITE YOUR NAME ON THIS QUESTIONNAIRE

The Earth in Space course deals with many natural phenomena which are part of our daily experience. Questions such as "what is a star" and "why does it get cold in winter" often get asked by young children who are still curious about their natural environment. The understanding they develop usually comes from several sources, for example, their parents or grandparents, and later on from school.

The purpose of this questionnaire is to try to find out what you presently know and understand about some natural phenomena. I am also interested in where you got this information from. Your responses will contribute to my understanding of people's thinking about these concepts and will help in the development of this course to make it more meaningful for future students.

Please answer each question as fully as you can under the heading of

1) 'scientific explanation' (as given at school or for example on scientific TV programmes, in magazines or newspapers etc) and
2) 'personal explanation' (any other understanding you might have which may come from family or friends or traditional understanding).

If you are not able to give any answer to a question, leave the space blank and go on to the next question.

What is a star?

Scientific understanding .....

.....

.....

.....

Source of this information.....

Personal understanding .....

……

……

……

Source of this information……

Why is it generally colder in winter than in summer?

Scientific understanding ……

……

……

……

Source of this information……

Personal understanding ……

……

……

……

Source of this information……

What causes day and night?

Scientific understanding ……

……

……

……

Source of this information……

Personal understanding ……

……

……

……

Source of this information……

Why does the moon change its shape?

Scientific understanding ……

……

……

……

Source of this information……

Personal understanding ……

……

……

……

Source of this information……

There was recently a solar eclipse. What is a solar eclipse and what causes it to happen?

Scientific understanding ……

……

……

……

Source of this information.....

Personal understanding .....

.....

.....

.....

Source of this information.....

What happens to the stars during the day?

Scientific understanding .....

.....

.....

.....

Source of this information.....

Personal understanding .....

.....

.....

.....

Source of this information.....

Thank you very much for taking the time to
these phenomena. Please also fill in the follc

1. **Up to what level did you do Geogra**
   matric)

   .....

2. When you were a child, can you remember asking questions such as "what i the sun?". How did your parents/grandparents respond? How do you thinl they gained this understanding?

3. Were you given explanations to these questions at school that were different to the understanding that you already had? Explain:

4. Did your teachers use any models or visual aids (eg charts, posters, videos) t help you understand concepts or did you mainly work from notes or text books? Please describe as fully as you can:

Thank you for your time and effort in answering these questions!

APPENDIX 4.2

Pre instruction questionnaire
2002 (Geography Preliminary and College of Science)

University of the Witwatersrand
College of Science – Geol 122

Earth in Space (2002)

Ideas on natural phenomena

The "Earth in Space" course deals with many natural phenomena which are part of our daily experience. Questions such as "what is a star" and "why does it get cold in winter" often get asked by young children who are still curious about their natural environment. The answers they get depend on who they ask.

What are your ideas?

I am interested in your present knowledge and understanding about some natural phenomena. I am also interested in where the ideas you have came from.

Please answer each of the following questions as fully as you can. If you are not able to give an answer to a question, leave the space blank and go on to the next question.

1. What is a star?

.....

.....

.....

Where / how did you get this information?.....

.....

Please write down any other explanation for this question that you might have heard or read about:

.....

.....

.....

Source of this information.....

2. Why is it generally colder in winter than in summer?

……

……

……

Where / how did you get this information?……

……

Please write down any other explanation for this question that you might have heard or read about:

……

……

……

Source of this information……

3. What causes day and night?

……

……

……

Where / how did you get this information?……

……

Please write down any other explanation for this question that you might have heard or read about:

……

……

……

Source of this information……

4. Why does the moon change its shape?

……

……

……

Where / how did you get this information?

……

Please write down any other explanation for this
read about:

……

……

……

Source of this information……

5. What is a solar eclipse and what causes it t

……

……

……

Where / how did you get this information?

……

Please write down any other explanation for this
read about:

……

……

……

Source of this information……

6. What happens to the stars during the day?

……

……

……

Where / how did you get this information?

……

Please write down any other explanation for this
read about:

……

……

……

Source of this information……

Thank you very much for taking the time to shar
these phenomena. Please also fill in the followin

1. **Up to what level did you do Geography**
   2] or matric).

   ……

2. **When you were a child, can you remen**
   the sun?".

……

……

……

3. Were you given explanations to these questions at school that w
to the understanding that you already had? Explain:

.....

.....

.....

.....

.....

4. (a) Teachers often just use notes or textbooks when they teach.
teachers use any models or visual aids (eg charts, posters, videos
understand concepts?

.....

(b) If your answer to Question 4 (a) was yes, list those visual a
remember which helped you understand the work being taught

.....

.....

.....

.....

Thank you for your time and effort in answering these questions!

APPENDIX 4.3

Pre instruction questionnaire
2004 (Geography Foundation, College of Science and Geology mainstream)

NAME.....

THE EARTH IN SPACE:

RECOGNITION OF PRIOR UNDERSTANDING 2004

In the space provided below, draw a simple diagram to show what you think the Earth looks like from space.

Now draw in the following:

1. The position of the North Pole (NP) and the position of the South Pole (SP)
2. Draw in 4 stick figures standing on the Earth: one at the North Pole, one at the South Pole, one in the vicinity of the equator in the West and one in the vicinity of the equator in the East.
3. Near the head of each stick figure, draw a little cloud, and show rain falling from this cloud
4. Draw in the position of the atmosphere
5. Draw in the position of the Sun
6. Indicate where it would be night and where it would be day on earth
7. Draw in the position of the Moon
8. Draw in the position of the stars

Please answer each of the following questions as fully as you can. If you feel that a drawing or diagram would help your explanation, please use the space provided.

Please note: this is NOT a test. You are not expected to know the "correct" answer. We are interested in everything that you know on the subject , which may include both scientific and personal understanding.

1. What is a star?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

2. What causes day and night?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

3. What causes the seasons?

(a) Your understanding of the scientific explanation

The source of this information

(b) Your personal understanding

The source of this information

Diagram

4. What happens to the stars during the day?

(a) Your understanding of the scientific explanation

The source of this information

(b) Your personal understanding

The source of this information

Diagram

5. Why does the moon appear to change its shape during the course of a month?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

6. What is the universe?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

APPENDIX 4.4

Post instruction questionnaire
2001 (pilot study: Geography Preliminary group only)

Earth in Space 2001

Post course questionnaire

DO NOT WRITE YOUR NAME ON THIS QUESTIONNAIRE

In the last few weeks you have been presented with many theories developed and used by scientists to explain and understand the natural phenomena of the universe.

You may have been familiar with some of these ideas before the course, or perhaps they are all new to you. I would like to know what your response is to these ideas about the universe, the solar system and the earth. In other words, I would like to know how you feel about these ideas and what you think about them. To help me understand your thinking, please would you answer the following questions:

1. Has the way you think about natural phenomena (such as stars, the tides, the changing shape of the moon, eclipses, the movement of the continents etc) been changed? Give examples and please explain in as much detail as possible.

2. What concepts (explanations or ideas) did you find the hardest to accept or believe? Please also explain why you found them hard to believe or accept.

3. Do you feel that any of your original (personal) ideas explain some of the phenomena in a more convincing or better way? Please give examples and explain why.

THANK YOU FOR YOUR TIME IN ANSWERING THESE QUESTIONS!

APPENDIX 4.5.1

Post instruction questionnaire
2002 (Geography Preliminary group only)

GEOGRAPHY PRELIM: POST COURSE QUESTIONNAIRE 2002

Has the way you have thought about natural phenomena changed in the last three weeks? Please would you answer the following questions to help me understand how you have dealt with the information in this course:

1. Was there anything in the Earth in Space course that you found hard to understand? Please explain your answer by telling me why.

.....
.....
.....
.....

2. Was there anything that you learnt about in the Earth in Space course that you found hard to believe? Please explain your answer.

.....
.....
.....
.....

3. Was there anything that you learnt about in the Earth in Space course that replaced any understanding or belief that you had of natural phenomena before you did the course?

   If your answer is "yes":
   (c) please give an example of where or how this happened and
   (d) please try to explain why you decided to change this understanding or belief.

.....
.....
.....
.....

   If your answer is that you are "not sure",
   is it possible that you accept both ways of thinking (the way you thought before and what you were taught in the course)?

   Please explain your answer as clearly as you can and say whether you are comfortable with being able to think both ways or whether this causes some problems for you.

.....
.....

4. Do you think the science that is taught in the Earth in Space course (eg Big Bang theory, Nebula Theory, Plate tectonic Theory) is the real truth about natural phenomena and how the world and the universe works?

.....
.....
.....
.....

5. Do you think that the scientific explanations taught in the Earth in Space course are true for all situations and for all people or do you think that there are other explanations that are also valid or useful or true? Please answer as fully as you can.

.....
.....
.....
.....

6. Did you find that any of the things you learnt about in the Earth in Space course suddenly made something that you had either
    1. previously wondered about -
    2. maybe not <u>understood</u> before -
    3. maybe not <u>thought</u> about before -

   become more clear to you or suddenly make sense to you? Please explain and if possible give an example.

.....
.....
.....
.....

7. Does your family think it is important to follow traditional customs (eg marriage, coming of age ceremonies etc)

Yes	No

8. When you have children, will you teach them both traditional as well as scientific explanations for natural phenomena?

Yes	No	Not sure	Other

Please explain your choice:

.....
.....
.....
.....

Thank you for helping me by answering these questions

APPENDIX 4.5.2

Post instruction questionnaire 2002 (College of Science only)

RESEARCH INTO LEARNING

Please note that this is NOT a test. You completed the "Earth in Space" course when you wrote the exam in June and so the following questions are NOT for marks.

I am wanting to find out how much of what you learnt in the Earth in Space course has gone into your long term memory. The responses you give me will be used to help my research into understanding the process of learning, so please answer the questions as fully and as honestly as you can

1. What is a star?
2. Where do the stars go in the daytime?
3. Why does the moon change its shape?
4. Why is it generally colder in winter than it is in summer?
5. What is an eclipse and how does an eclipse happen?

Please would you also answer the following questions:

a). Was there anything in the Earth in Space course that you found hard to understand? Please explain your answer.

b) Was there anything that you learnt about in the Earth in Space course that you found hard to believe? Please explain your answer.

c) Was there anything that you learnt about in the Earth in Space course that replaced any understanding or belief that you had of natural phenomena before you did the course?

If your answer is "yes":
(a) please give an example of where or how this happened and
(b) please try to explain why you decided to change this understanding or belief.

If your answer is that you are "not sure",
is it possible that you accept both ways of thinking (the way you thought before and what you were taught in the course)?

Please explain your answer as clearly as you can and say whether you are comfortable with being able to think both ways or whether this causes some problems for you.

d) Do you think the science that is taught in the Earth in Space course (eg Big Bang theory, Nebula Theory, Plate tectonic Theory) is the real truth about natural phenomena and how the world and the universe works?

e) Do you think that the scientific explanations taught in the Earth in Space course are true for all situations and for all people or do you think that there are other explanations that are also valid or useful or true? Please answer as fully as you can.

f) Did you find that any of the things you learnt about in the Earth in Space course suddenly made something that you had either

1. previously wondered about -
2. maybe not understood before -
3. maybe not thought about before -

become more clear to you or suddenly make sense to you? Please explain and if possible give an example.

Thank you for helping me by answering these questions.

Last bit of information that I need!

Please will you also fill in the answers to the following questions which will help me link your present ideas with your background.

1. While you were growing up, who was your primary care giver? (tick your answer)

Parents	Grandparents	Other (state)

2. How would you describe the type of school(s) you attended while growing up:

Urban	Township	Rural	Other (state)

3. Please complete the following table about your matric subjects and symbols

Matric subject	Matric (symbol)	Taken to end Grade 9
Geography		
Science		

4. Does your family think it is important to follow traditional customs (eg marriage, coming of age ceremonies etc)

Yes	No

5. Who are the people who most influence the way that you think?

Parents	Other family	Friends	Teachers	Other

6. When you have children, will you teach them both traditional as well as scientific explanations?

Yes	No	Not sure	Other

Please elaborate on your answer to question 6:

APPENDIX 4.6

Post instruction questionnaire
2004 (Geography Foundation, College of Science and Geology mainstream)

RESEARCH INTO LEARNING: POST COURSE QUESTIONNAIRE 2004

Please note that this is NOT a test.

I am wanting to find out how much of what you learnt in the Earth in Space course has gone into your long term memory. The responses you give me will be used to help my research into understanding the process of learning, and what makes learning difficult. Please answer the following questions as fully and honestly as you can.

In the space below, draw a simple diagram to show what you think the Earth looks like from space.

Now draw in the following

1. The position of the North Pole (NP) and the position of the South Pole (SP).
2. Draw in 4 stick figures standing on the earth, one at the NP, one at the SP, one near the equator in the West and one near the equator in the East.
3. Near the head of each stick figure, draw a little cloud, and show rain falling from this cloud.
4. Draw in the position of the atmosphere
5. Draw in the position of the sun
6. Indicate where it would be night and where it would be day on earth
7. Draw in the position of the moon
8. Draw in the position of the stars

Please answer each of the following questions as fully as you can. If you feel that a drawing or diagram would help your explanation, please use the space provided.

Please note: this is NOT a test. You are not expected to know the "correct" answer. We are interested in everything that you know on the subject , which may include both scientific and personal understanding.

1. What is a star?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

2. What causes day and night?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

3. What causes the seasons?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

4. What happens to the stars during the day?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

5. Why does the moon appear to change its shape during the course of a month?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

6. What is the universe?

(a) Your understanding of the scientific explanation

The source of this information _____

(b) Your personal understanding

The source of this information _____

Diagram

Please answer the following questions as fully as you can. They are to help me

- understand how you have dealt with the information in the course:
- see if the way you think about certain natural phenomena has changed as a result of the course
- understand any difficulties or problems you may have had with the content of the course

1. Was there anything in the Earth in Space course that you found **hard to understand**? Please explain your answer by telling me what and why.

2. Did any of the things you were taught **conflict** with ideas or beliefs you already had before you started the course? Was there anything that you learnt about in the Earth in Space course that you found **hard to believe**? Please explain why.

3. Did any of your ideas change as a result of the course? Please explain what changed and why.

4. Do you think the science that is taught in the Earth in Space course (eg Big Bang theory, Nebula Theory, Plate tectonic Theory) is the real truth about natural phenomena and how the world and the universe works?

5. Do you think that the scientific explanations taught in the Earth in Space course are true for **all situations** and for **all people** or do you think that there are other explanations that are also valid or useful or true? Please answer as fully as you can.

6. Did you find that any of the things you learnt about in the Earth in Space course suddenly made something that you had either
    1. previously wondered about -
    2. maybe not <u>understood</u> before -
    3. maybe not <u>thought</u> about before -

   become more clear to you or suddenly make sense to you? Please explain and if possible give an example.

Last bit of info needed to help me link your present ideas with your background:

7. While you were growing up, who was your primary caregiver?

Parents	Grandparents	Other (state)

8. How would you describe the type of school(s) you attended while growing up?

Urban	Township	Country	Other (state)

9. Who are the people who most influence the way you think?

Parents	Other family	Friends	Teachers	Other (state)

10. Does your family think it is important to follow traditional customs (eg marriage, coming of age ceremonies etc) (Tick your choice)

Yes	No

11. When you have children, will you teach them traditional / religious / scientific explanations for natural phenomena? (Tick those appropriate for you)

Traditional	Religious	Scientific	Not sure

Please explain your choice:

.....

.....

.....

.....

Thank you for helping me by answering these questions!

APPENDIX 5

Record of colleague's notes on the introduction of GEOL 122 to the course and the pre-course questionnaire.
(Monday 11th February 2002)
The following points were made:

- When you are a small child, your parents would answer your questions. Maybe they would redirect the questions; maybe answer the questions from their own experience, or maybe you were snubbed "don't ask too many questions".
- The questionnaire you are going to fill out is not a test at all – just wanting to know/hear what your understanding is – want to know what you know. What is presented in the 'Earth in Space' course is a "story" with a number of theories; we are wanting to know *your* stories (your understanding), *your* knowledge, not your neighbours! Please remember – this isn't a test!

The questionnaire was then explained in detail, question by question. Students were asked to explain their ideas and where they got their ideas from and any other sources of information. They were told to take as much time as they liked to answer the questions.

The students were also asked to write down their mother and father's names on questionnaire so that it would be possible to identify the questionnaires if necessary for later discussion, perhaps interview. They were not to write their own names on the questionnaires, so they could remain anonymous.

APPENDIX 6

Coding in Atlas.ti Method 1

P151: 04.104.35.M.PRE.rtf

Path:	C:\Documents and Settings\Ann\Desktop\Ann Ph...\04.104.35.M.PRE.rtf
Media:	RICHTEXT
Printed:	2006-12-05T09:38:53
By:	Super
From HU:	What is a star Simplified coding HU
HU-Path:	[C:\Documents and Settings\Ann...\What is a star Simplified coding HU.hpr5]
Codes:	6
Memos:	0
Quotations:	6
Families:	Frequency Tier 3 concepts pre-instruction questionnaire
Comment:	<none>

CODE: 04.104.35.M..PRE.D

1. What is a star?

1.1 It is a planet that resembles the sun in its characteristics. It is a sun to other undiscovered planets

1.2 Friend

1.3 It is light emitting planet that brightens the sky at night

1.4 Bible

WMS simplistic and AB everyd

2. What causes day and night?

2.1 The motion of the earth where the half exposed to light is day and the other night (diagram show scientific explanation, but rotation is not mentioned)

2.2 geog Grade 9

2.3 same as above

2.4

2WMS simple

3. What causes the seasons?

3.1 I don't know. Never took time to read or find out.

3.2

3.3 God

3.4 Bible, Book of Job

3AB religious

4. What happens to the stars during the day?

4.1 They disappear or rather are not visible because the sun shines greater light, this make it harder 4 us to see them. (diagram given but doesn't add to explanation)

4.2 logic

4.3 same as above

4.4

5AB everyday

5. Why does the moon appear to change its shape during the course of a month?

5.1 I don't know

5.2

5.3 There is a planet that runs just before the moon on a different orbit that covers some part of the moon (diagram shows ball with shading to give crescent moon but no labels)

5.4 Understand because of eclipse

4 Unclassifiable

6. What is the universe?

6WMS simple mesoview

6.1 Do not know

6.2

6.3 A whole planets that array themselves in ordered was to make life possible on earth (diagram shows what looks like picture of atom: nucleus with electrons running around but nucleus labeled sun: does not add any sense to explanation)

6.4

P135: 04.104.27.M.PRE.rtf

Path: C:\Documents and Settings\Ann\Desktop\Ann Ph...\04.104.27.M.PRE.rtf
Media: RICHTEXT

Printed: 2006-12-05T09:37:36
By: Super

From HU: What is a star Simplified coding HU
HU-Path: [C:\Documents and Settings\Ann...\What is a star Simplified coding HU.hpr5]

Codes: 6

Memos: 0

Quotations: 6

Families: Frequency Tier 3 concepts pre-instruction questionnaire

Comment: <none>

CODE: 04.104.27.M..PRE.D

1. What is a star?

1.1 A star is a mass of hydrogen and helium gas that is ignited. It is composed of harder elements in the centre ie iron, because of inner pressure. A burning ball of gas that has evolved over millions of years

WMS correct idea

1.2 Books TV

1.3

1.4

2. What causes day and night?

2.1 Day and night is caused by the position of the earth relative to the sun, in position meaning the rotation of the earth. The side of the earth facing the sun would be experiencing day and on the opposite side the earth would be experiencing night. Night is caused due to the earth's own shadow (diagram shows scientific understanding)

2WMS correct

2.2 TV encyclopedias

2.3

2.4

3. What causes the seasons?

3.1 The seasons are caused due to the position of the earth in its orbital with relation to the sun (diagram shows shift in sun's position over tropic lines, with comment: ' summer is experienced when the sun is in its most southern point over Capricorn, ie high temperatures, longer days. Winter it occurs during N hemisphere summer, when the sun has moved to the most northerly point' - no mention of tilt or orbit: appears to confirm movement of the sun rather than the earth, but implies tilt)

3WMS simple

3.2 School

3.3

3.4

4. What happens to the stars during the day?

4.1 The stars are still present, yet because of the overpowering brightness of th sun, it is almost impossible to pick up the faint glittering of the stars. i.e.

5AB everyday and WMS simpl

its like having an H.T.I. light burning in front of a halogen light, the halogen light would not seen present, because the H.T.I. light is much stronger

4.2 Physics.

4.3

4.4

5. Why does the moon appear to change its shape during the course of a month?

5.1 this is due to how much sun the moon receives, and what parts are exposed (behind the earth's shadow) and is illuminated.

4WMS problem

5.2 TV Books

5.3

5.4

6. What is the universe?

6.1 The universe is an ever expanding body that consists of galaxies and solar systems (i.e. planets and stars, stars, debris)

6WMS simple macroview

6.2 TV / Books

6.3

6.4

APPENDIX 7

Coding in Atlas.ti Method 2

P122: 04.104.24.M.PRE.rtf

Path:	C:\Documents and Settings\Ann\Desktop\Ann Ph...\04.104.24.M.PRE.rtf
Media:	RICHTEXT
Printed:	2006-12-05T09:17:16
By:	Super
From HU:	PhD data
HU-Path:	[C:\Documents and Settings\Ann\Desktop\Ann PhD\data for...\PhD data.hpr5]
Codes:	23
Memos:	0
Quotations:	24
Families:	Precourse documents Geol 104 Pre-instruction Questionnaire Pre Phase II samples Precourse documents
Comment:	<none>

CODE: 04.104.24.M..PRE

1. What is a star?

1.1 A star is a sun. A ball of burning gas
1.2 School - geography teacher
1.3 A source energy which is necessary in order to sustain life on earth
1.4 personal logic

- burning ball of gas
- star is
- School
- source of energy
- sustains life
- personal understanding

2. What causes day and night?

2.1 Day and night is caused by the rotation of the earth
2.2 Geography teacher
2.3 Day and night is due to the movement of the earth as well as the relationship to the movement of the moon.
2.4 Uncertain

- rotation
- teacher
- moon position causes day / ni
- rotation
- can't remember

3. What causes the seasons?

3.1 Can not recall
3.2
3.3 Relates to the positioning of the earth as it completes a revolution
3.4 Uncertain

- can't recall
- position of earth
- revolution
- Don't know

4. What happens to the stars during the day?

4.1 Due to the intensity of the sun's light rays other stars are not visible to us.
4.2 Geography teacher
4.3 Brightness of the sun's light blinds us to a certain extent to view stars with the naked eye during the day
4.4 personal logic

- sunlight bright and overwhelm
- teacher
- sunlight bright and overwhelm
- My understanding

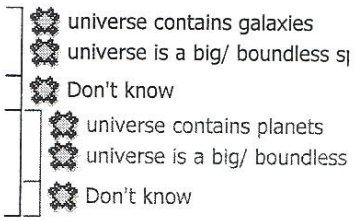
5. Why does the moon appear to change its shape during the course of a month?

5.1 Due to its rotation and positioning in association to the sun
5.2 uncertain
5.3 As the moon rotates, certain areas are exposed to sunlight, which we are able to view and some areas are shaded, which we are unable to see
5.4 personal logic

- moon rotates
- position of moon relative to th
- Don't know
- moon reflects light of sun
- moon rotates
- My understanding

6. What is the universe?

34 6.1 The universe is composed of planets, galaxies, all matter within space.
35 6.2 Uncertain
36 6.3 A body of infinite proportion, composed of planets, etc.
37 6.4 Uncertain



P94: 04.122.28.M.PRE.rtf

Path: C:\Documents and Settings\Ann\Desktop\Ann Ph...\04.122.28.M.PRE.rtf
Media: RICHTEXT

Printed: 2006-12-05T09:11:48
By: Super

From HU: PhD data
HU-Path: [C:\Documents and Settings\Ann\Desktop\Ann PhD\data for...\PhD data.hpr5]

Codes: 22

Memos: 3

Quotations: 24

Families: 2004 Geol 122 PRE
College of Science Pre-instruction Questionnaire
Pre Phase II samples
Precourse documents

Comment: <none>

CODE : 04.122.28.I.B.PRE.D.B

1. What is a star?

1.1 Is the thing that light during the night but not too much. It breaks from sun. (diagram shows little cartoon type stars with caption: "showing the stars in space")
- broken bits of sun
- gives light at night

1.2 I saw it in daily sun
- newspaper

1.3 I think the stars were the part of the sun due to some process in the sun therefore the star were formed because of the process
- part of the sun
- some process broke bits off th

1.4 from my mind
- My understanding

2. What causes day and night?

2.1 I think what causes day and night its because of the earth rotation to the sun, as the other side goes to far of from place where the sun can light (diagram shows earth with sun shining on northern hemisphere: day / night separated by equator)
- equatorial circle of illuminatior
- rotation
- muddled idea day / night

2.2 From books
- books

2.3 I also think that day is called by the side facing the sun and night is caused by the side not facing the sun. Day is cause by the part of the earth that is facing the sun. Night is cause by the side that is not facing on the side of the sun.
- light = day darkness = night

2.4 From my mind
- My understanding

3. What causes the seasons?

3.1 Is cause by climate of a particular place and the side that is far from sun side furing rotation (diagram shows earth with seasons marked at points of compass: NP summer with sun shining over head, SP winter, W spring and E autumn)
- season is caused by climate
- seasons linked to points of cor

3.2 from books
- books

3.3 I think what causes the seasons is the side of the earth is moving away from the sun during rotation the season changes due to the processes of particular over.
- rotation
- language undecipherable E - (

3.4 My knoled.
- own knowledge

4. What happens to the stars during the day?

4.1 The star during the day are being blinded the shiness of the sun they are become invisible because of the light
- invisible during day
- sunlight bright and overwhelm

of the sun. (diagram shows sun with rays, stars in rays with caption star less shine because of the sun)
4.2 Books
4.3 They are blind because of the light of the sun
4.4 From my mind

books
stars are blinded by the sun
what I think

5. Why does the moon appear to change its shape during the course of a month?

5.1 Because of the rotation and it appearance to the planet earth
5.2 TV
5.3 I also think because of its appearance in, as it is rounding.
5.4 From my mind

rotation of earth
TV
answer doesn't make sense
what I think

6. What is the universe?

6.1 The universe is the planet we are living in where life exists because of oxygen. (diagram shows earth with N,S,W,E and equator marked in)
6.2 from book
6.3 I think it's the place that we are living in it is also known as the earth.
6.4 From my mind

universe is a place of living or
universe is our earth / environ
books
universe is our earth / environ
narrow view of universe
what I think

Path: C:\Documents and Settings\Ann\Desktop\Ann PhD\...\04.GF.16.POST.rtf
Media: RICHTEXT

Printed: 2006-12-05T09:44:03
By: Super

From HU: PhD data
HU-Path: [C:\Documents and Settings\Ann\Desktop\Ann PhD\data for...\PhD data.hpr5]

Codes: 12

Memos: 3

Quotations: 8

Families: 2004 Geog Prelim POST
Geography Foundation Post-instruction Questionnaire
Post Course documents
Post Phase II samples

Comment: <none>

CODE: 04.GF.16.B.I.POST.B

1. Was there anything you found hard to understand?

Yes, I think Nebula, Big Bang, star formation, all those things I still do not understand or maybe its also because I don't believe it.

- Big bang theory
- don't understand because don
- Nebula Theory
- belief and understanding

2. Was there anything you found hard to believe?

Yes, the galaxies are moving away from each other or that there is no space, I'm really battling to believe what I've learnt.

- expansion of universe

3. Was there any replacement of knowledge?

No - honestly, I don't believe anything that I have learnt.

- I don't believe anything I have
- No

4. Are the WMS explanations / theories given in the E in S course the real truth about natural phenomena?

I don't think so, especially the Big Bang theory and a disc, it all a bit hectic for me.

- Big Bang and Nebula theories

5. Are there other explanations that may be valid?

Honestly, I don't believe we as human beings are meant to know everything. I mean what is the truth? And true or real according to who????

- human are not meant to know
- what is the truth anyway?
- what is the truth anyway?

6. Did the scientific explanations promote simultaneous collateral learning?

I'm always wondering about things - I still do. I want to know who measured the distance from earth to the sun (that person is brave and it's a miracle that he still came back to earth alive)

- I learnt about the distance fro
- how did the guy get back alive

7. While you were growing up, who was your primary caregiver?

8. How would you describe the type of school(s) you attended while growing up?

9. Who are the people who most influence the way you think?

10. Does your family think it is important to follow traditional customs?

Yes

yes

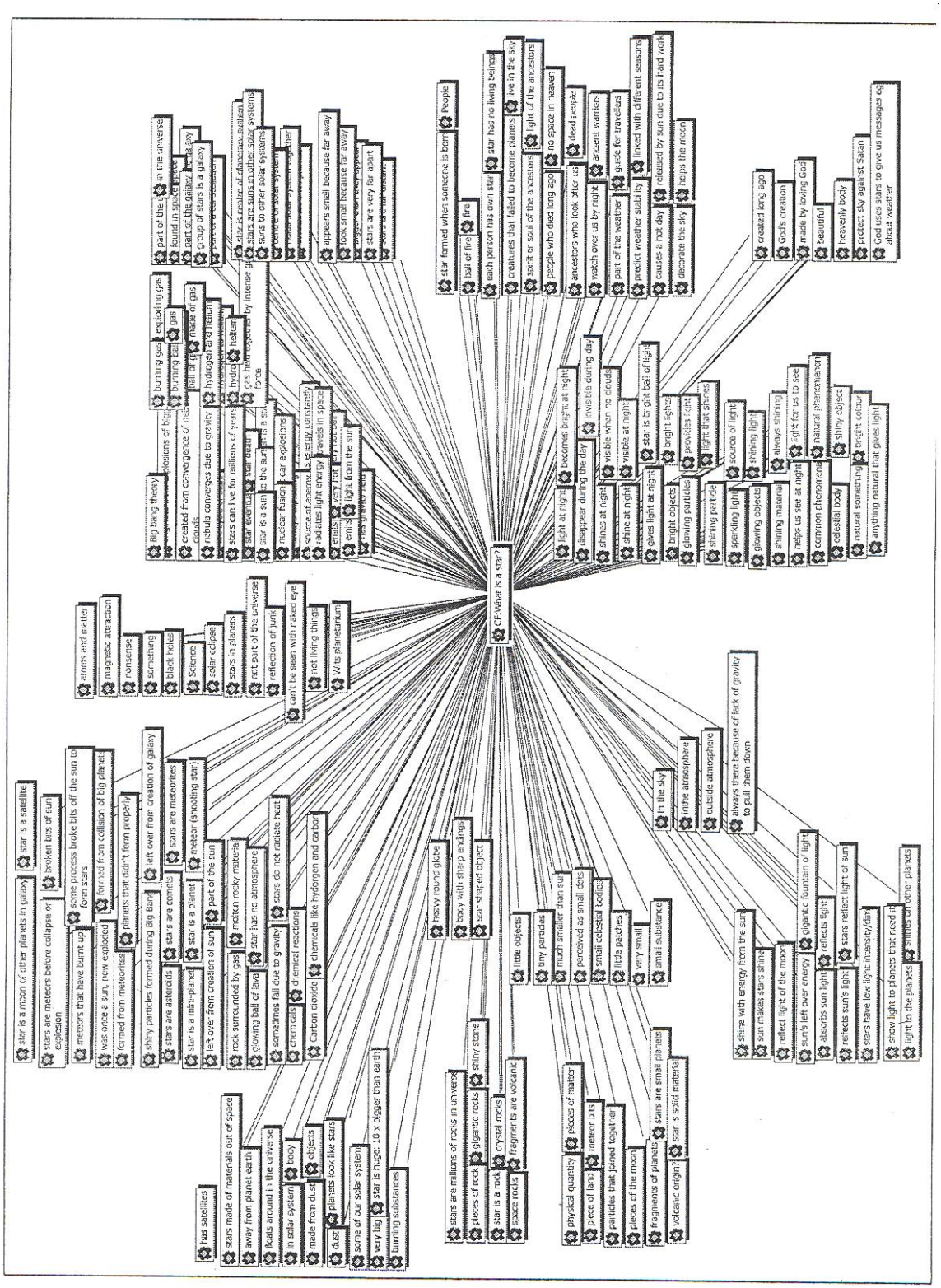
11. Will you teach your children both scientific and traditional explanations?

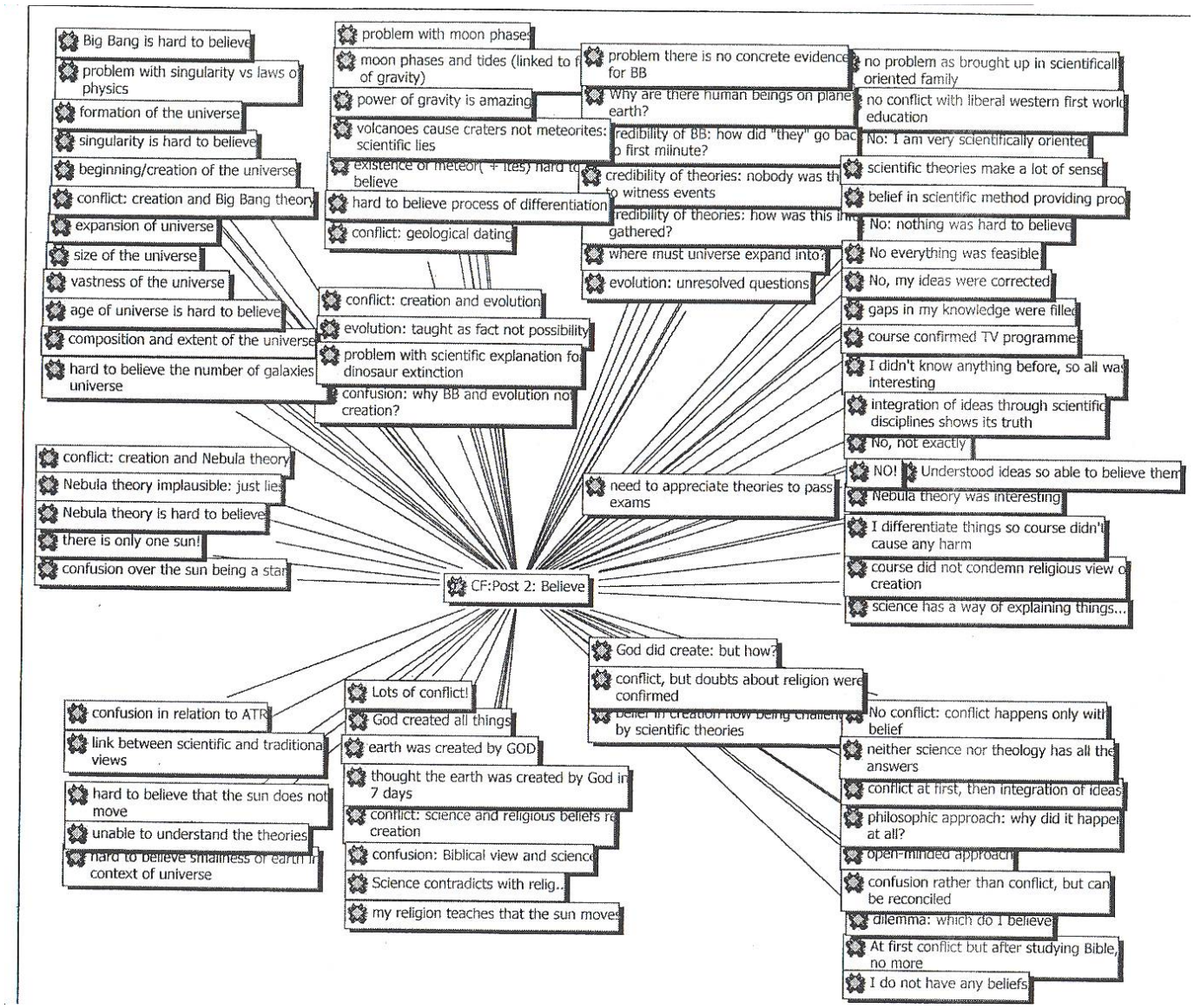
I can't teach my children something I don't believe in. I think I will be contradicting myself and insulting their intelligence.

can only teach them what I be

APPENDIX 8

Network views example from Atlas.ti




CF:Post 2: Believe
Big Bang is hard to believe
problem with singularity vs laws of physics
formation of the universe
singularity is hard to believe
beginning/creation of the universe
conflict: creation and Big Bang theory
expansion of universe
size of the universe
vastness of the universe
age of universe is hard to believe
composition and extent of the universe
hard to believe the number of galaxies universe
problem with moon phases
moon phases and tides (linked to f of gravity)
power of gravity is amazing
volcanoes cause craters not meteorites: scientific lies
existence of meteor(+ ites) hard to believe
hard to believe process of differentiation
conflict: geological dating
conflict: creation and evolution
evolution: taught as fact not possibility
problem with scientific explanation fo dinosaur extinction
confusion: why BB and evolution no creation?
conflict: creation and Nebula theory
Nebula theory implausible: just lies
Nebula theory is hard to believe
there is only one sun!
confusion over the sun being a star
problem there is no concrete evidence for BB
Why are there human beings on planet earth?
redibility of BB: how did "they" go bac first milnute?
credibility of theories: nobody was th to witness events
redibility of theories: how was this i gathered?
where must universe expand into?
evolution: unresolved questions
need to appreciate theories to pass exams
no problem as brought up in scientifically oriented family
no conflict with liberal western first world education
No: I am very scientifically oriented
scientific theories make a lot of sense
belief in scientific method providing proo
No: nothing was hard to believe
No everything was feasible
No, my ideas were corrected
gaps in my knowledge were filled
course confirmed TV programmes
I didn't know anything before, so all was interesting
integration of ideas through scientific disciplines shows its truth
No, not exactly
NO!
Understood ideas so able to believe them
Nebula theory was interesting
I differentiate things so course didn't cause any harm
course did not condemn religious view o creation
science has a way of explaining things...
confusion in relation to ATR
link between scientific and traditiona views
hard to believe that the sun does not move
unable to understand the theories
hard to believe smallness of earth i context of universe
Lots of conflict!
God created all things
earth was created by GOD
thought the earth was created by God in 7 days
conflict: science and religious beliefs re creation
confusion: Biblical view and science
Science contradicts with relig..
my religion teaches that the sun moves
God did create: but how?
conflict, but doubts about religion were confirmed
by scientific theories
No conflict: conflict happens only with belief
neither science nor theology has all the answers
conflict at first, then integration of ideas
philosophic approach: why did it happen at all?
open-minded approach
confusion rather than conflict, but can be reconciled
dilemma: which do I believe
At first conflict but after studying Bible, no more
I do not have any beliefs

APPENDIX 9

Breakdown of results by sample groups

QUESTION 1: "What is a star?"

Categories	Total	College of Science n = 55	Geology mainstream n = 92	Geography Foundation n = 44
Alternative Conceptions: descriptions				
composition	23	9	10	4
Light	192	48	97	47
Location	25	6	10	9
Shape	21	4	12	5
Size	19	13	4	2
source of light	34	15	12	7
Total	**314**	**95**	**145**	**74**
Alternative Conceptions: cultural				
IKS	37	7	18	12
Religion	22	4	14	4
Total	**59**	**11**	**32**	**16**
Western Modern Science				
composition	78	20	48	9
Location	83	34	41	8
Process	138	29	71	13
Total	**299**	**83**	**160**	**30**
Misconceptions				
composition	42	13	18	11
Location	9	2	6	1
Origin	39	8	22	9
Total	**90**	**23**	**46**	**21**
Can't be classified	21	6	9	6

QUESTION 2: "What causes day and night?"

Categories	Totals	College of Science n = 55	Geology Mainstream n = 92	Geography Foundation n = 44
Alternative conceptions				
IKS	15	2	10	3
Religion	31	10	16	5
Total	**46**	**12**	**26**	**8**
Western Modern Science				
correct ideas	259	82	112	65
confused ideas	90	29	50	11
Total	**349**	**111**	**162**	**76**
Misconceptions				
Earth goes around the sun	94	28	45	20
Intuitive view: sun moves	45	9	22	14
Total	139	37	67	34
Can't be classified	**10**	**3**	**3**	**4**

QUESTION 3: "What causes the seasons?"

Categories	Total	College of Science n = 55	Geology mainstream n = 92	Geography Foundation n = 44
Alternative Conceptions				
IKS	18	8	9	1
Religion	6	1	4	1
Confused ideas	13	4	8	1
Total	**37**	**13**	**21**	**3**
Western Modern Science				
Correct idea	170	51	93	23
confused idea	68	20	32	16
Total	**238**	**71**	**125**	**39**
Misconceptions				
position on orbit	10	3	5	2
climate related	117	36	40	41
confusion rotation / revolution	117	34	58	25
distance concept	111	33	46	31
Total	**355**	**106**	**149**	**99**

QUESTION 4: "What happens to the stars in the day time?"

Categories	Totals	College of Science n = 55	Geology Mainstream n = 92	Geography Foundation n = 44
Alternative conceptions				
IKS	28	3	11	14
simple description	111	32	54	25
position of stars	10	5	1	4
process of shining	32	15	9	8
Total	**181**	**55**	**75**	**51**
Western Modern Science				
blue sky	11	6	3	2
stars are still there	113	34	58	21
Total	**124**	**40**	**61**	**23**
Misconceptions				
sun is too bright	202	65	98	38
environment / climate perspective	10	3	4	3
star position	10	6	1	3
Total	**222**	**74**	**103**	**44**
Can't be classified	**3**	**1**	**1**	**1**

QUESTION 5: "Why does the moon appear to change its shape?"

Categories	Totals	College of Science n = 55	Geology Mainstream n = 92	Geography Foundation n = 44
Alternative conceptions				
IKS	35	13	10	12
religious	7	0	5	2
Total	**42**	**13**	**15**	**14**
Western Modern Science				
correct idea	55	14	29	11
Total	**55**	**14**	**29**	**11**
Misconceptions				
characteristics unrelated to revolution	59	18	27	14
ideas linked to eclipses	35	9	20	6
position and process	103	25	53	25
Total	**197**	**52**	**100**	**45**

QUESTION 6: "What is the universe?"

Categories	Totals	College of Science n = 55	Geology Mainstream n = 92	Geography Foundation n = 44
Alternative conceptions				
earth based perspective	47	17	26	4
Religious	26	6	15	5
Total	**73**	**23**	**41**	**9**
Western Modern Science				
galaxy and bigger perspective	149	21	89	16
solar system perspective	123	22	82	19
Total	272	43	171	35
Can't explain	10	3	6	1

APPENDIX 10

Ethics clearance

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Cameron

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER 41106**
PROJECT	The Influence of Prior Knowledge, Culture and Religion on First Year
INVESTIGATORS	Mrs AK Cameron
DEPARTMENT	School of Geography/Geography
DATE CONSIDERED	04.11.25
DECISION OF THE COMMITTEE*	Approved unconditionally

This ethical clearance is valid for 2 years and may be renewed upon application

DATE 05.01.31 **CHAIRPERSON** .....
(Professor C Penn)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof M Rollnick
College of Science

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

This ethical clearance will expire on 1 February 2005

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 11

The Interviews

The interviews all took place in my office at the university during normal office hours. All the interviews were conducted at pre-arranged times. My office door, which was always left open when I was available for informal consultation, was closed during the time of the interview to signal to colleagues and other students that I was not available and should not be disturbed. This also served to give a quiet and private space for the interviews to be conducted. The interview questions were used as a guide to stimulate discussion.

Interview schedule

Introduction:
(*use points 1 to 5 as a reminder to myself to make sure student understands what the interview is about and that they are comfortable with the procedure)*

1. Greet the student and ask them how they are. Welcome them and thank them for coming to speak to me.

2. Remind the student about the purpose of the interview, i.e. that we would be discussing the answers to their pre- and post-instruction questionnaires, and that I was interested in finding out what their thinking had been regarding the course; whether they had experienced any difficulties, what they might have done or thought to do about these difficulties, and how they had felt about the course.

3. Show them how the tape recorder (Dictaphone) works. Get the student to switch it on and read a small section from one of their questionnaires, then play it back in order to let them hear how they sound on tape and whether they are speaking loudly enough for me to be able to hear what they were saying when I transcribe the tape. Explain that when I have done the transcription, a copy would be given to them to read to verify what they had said and add any further explanations if they so desired. They would also then be able to indicate if they were prepared to give me permission to use what they had said for the purpose of my research project. Explain that they could at any time ask me to switch off the tape recorder if there was something they wanted to discuss that they did not want to have recorded.

4. Explain that they were not obliged to answer any questions and remind the student that they had written off the course. This means that nothing they say in the interview can be used in any way in terms of the assessment of their work.

5. Ask the student if they have any questions before we begin with the interview.

Interview questions

1. Some of your Geography courses (e.g. Climatology / Geomorphology / Earth in Space) may present information that is different to the ideas or understanding that you already have.This information may be

*** neutral** to you - for example - how running water causes erosion
* **challenging** to you - understanding how T-phi grams work
* **confusing** for you, because it is different to what you already understood
* **conflicting** for you, because it goes against or contradicts what you already believe.

Is this true for you? Can you give me any examples? (use prompts if necessary: suggest geologic time, plate tectonics, dimensions in space, Big Bang theory…)

2. When you come across information that challenges your previous beliefs, what is your reaction? (use prompts if necessary: do you contextualize it, reject it, be pragmatic with it - e.g. deal with it later, learn for exams now?)

3. What are the beliefs that are being challenged? (prompt if necessary: are they related to religion, to culture, to tradition?)

4. How do you rate yourself in terms of tradition / culture / religion? Is it very important; important; not important to you, or are you not sure?

5. Who or what carries authority for you with regard to how you think and what you believe? Has this changed for you at university? How do you feel about the authority of your lecturers by comparison to other authority figures in your life and how will you react if what your lecturers are teaching you conflicts with your previous beliefs?

6. If you find that what you are being taught is changing how you see things, how do you react? What is the personal cost that may be involved in terms of changing how you think? What kinds of things may make you change your mind?

7. Is there somebody that you can talk to about conflict caused by theories such as Big Bang theory? How do you deal with confusing ideas / dilemmas?

8. Are there subjects you would not carry on studying because they cause conflict for you?

9. What knowledge do you trust and what makes you trust it?

10. What knowledge matters to you? How does it matter?

11. What for you is the connection between believing something and learning it? If you don't believe it does it make it harder to learn?

12. Do you think it is possible to hold different ways of thinking, even if those ideas clash?

13. Do you see any connection between or what do you see as the differences between scientific understandings and traditional understandings? And scientific and religious understandings?

APPENDIX 12

BREAKDOWN OF RESPONSES BY STUDENTS WHO REFERRED TO IKS AND RELIGION

PD	What is a star?	Stars in the day?	Rotation	Revolution	Moon phases	Universe	IKS	Religion
2	IKS	IKS	ABp + ABr	WMS clim.	Blank	Blank	2	1
3	Abp	WMSc	IKS + WMSp	WMSp + ABr	ABp	WMSp	1	1
6	WMSp + ABr	ABe	WMSp	WMSp	ABr	Blank		2
15	ABe	Blank	ABp + ABr	WMS clim.	IKS	Blank	1	1
16	Abp	ABe + Abp	WMSc	Blank	WMSp + IKS	Blank	1	
21	ABe	ABe + Abp	ABp + ABr	WMSp	WMSp	Blank		1
35	WMSs	WMSs	WMSp	WMSs	WMSs + ABr	WMSs		1
37	ABp + ABr	WMSs	ABe + WMSp	WMSs	Blank	WMSc		1
40	WMSc	IKS + ABe	WMSc + IKS	WMSp	WMSc + ABp	Blank	2	
41	WMSs + IKS	ABe + WMSp	WMSp + IKS	WMSs + clim.	WMSs	Blank	2	
43	Abp	ABe	Abp	WMS clim.	ABr	Blank		1
46	Blank	ABe	WMSp	WMS clim.	IKS	Blank	1	
49	ABp + WMSp	IKS and ABe	WMSp	WMS clim.	WMSp + ABr	WMSc	1	1
51	ABe	ABe	WMSp	WMS clim.	IKS	Blank	1	
52	Blank	IKS	WMSc + WMSp	ABe	Blank	WMSs	1	
53	ABe + ABr	WMSp	WMSs	WMSp	ABp	Abp		1
54	WMSc	ABe + ABp	WMSc + ABr	WMSc	WMSp	ABr		2
59	Abp	WMSs + ABp	WMSp	IKS	WMSs	WMSmacro	1	
60	WMSs + IKS	ABe	WMSs	WMSc	WMSp	ABr	1	1
61	WMSs	ABe + WMSs	WMSc	WMSs	WMSs	WMSmacro + ABr		1
63	Abp	ABe + Abp	WMSc	WMSp	WMSp	WMSmacro + ABr		1
69	ABp +WMSp	WMSp + Abp	WMSp + IKS	WMSs	ABe	WMS meso	1	
89	Abp	ABe	WMSp	WMSc	ABp	WMS macro + ABr		1
90	WMSp + ABe	WMSs	WMSp + IKS	WMSs	WMSs + ABp	WMS meso	1	
91	WMSs + ABe	Blank	WMSp + IKS	WMSc	ABe + ABp	WMS micro	1	
92	WMSp + ABe	WMSs	WMSc + ABr	WMSc	WMSs	WMS macro		1
93	WMSc	ABe + WMSs	WMSc	Blank	WMSp+ ABr	WMS macro		1
98	ABe	ABp + IKS	ABp + ABe	WMSp	IKS	WMS meso	2	
100	ABe	Blank	WMSp + IKS	WMSs	ABp	WMS micro	1	
130	Abp	ABe	WMSp	WMSc	IKS	WMS meso	1	
131	WMSs + ABe	ABe	WMSc + ABe	WMSp	WMSs	WMS macro + ABr		1
133	WMSc	ABe + WMSs	WMSc	WMSc	WMSp	WMS macro + ABr		1
146	ABe + IKS	ABe	WMSc	WMSs	IKS	WMS meso	2	
148	ABe	ABe + ABp	ABp + ABr	ABr	ABp	WMS macro		2
149	ABe + IKS	IKS + ABe	WMSc + IKS	WMSp + ABr	WMSs	WMS macro	3	1
151	WMSs + ABe	ABe	WMSs	ABr	Blank	WMS meso		1
162	Abp	ABe + ABp	WMSp+ ABp	WMSs	WMSp + IKS	ABp	1	
164	WMSc + ABr	ABe + WMSs	WMSp + ABr	WMSs + ABr	Blank	WMSp		3
169	ABe	ABp	WMSc + ABr	ABp	ABr	ABp + ABr		3
170	ABe	ABe	ABp + ABr	WMSp	WMSp + ABr	WMS micro		2
171	WMSp	ABe + ABp	WMSc	Abp	ABp	WMS macro + ABr		1

173	WMSc + ABr	ABp	ABp	Abp	WMSc	WMS macro + ABr		2
174	WMSs + ABe	WMSs + ABe	ABe + WMSp	Blank	Blank	WMS meso + ABr		1
180	Abp	ABp	WMSc + ABr	WMS clim.	ABp	WMS micro		1
186	WMSs	WMSs + Abp	WMSc + IKS	WMSs	WMSs	WMS meso	1	
188	WMSs + IKS	ABe	WMSp	WMSp	ABp	WMS meso	1	
192	WMSs + ABe	ABe + WMSs	WMSc + ABr	WMS cl. + IKS	Blank	WMS macro	1	1
198	WMSp + ABe	ABp + IKS	WMSp	Blank	WMSp	WMS meso	1	
199	ABe	ABe + ABp	WMSp + ABr	WMSp	WMSp	WMS micro		1
214	WMSs + ABe	ABe	WMSp	WMSp	IKS	ABp	1	
217	WMSs + IKS	WMSs	WMSp	ABp	ABp	WMS meso	1	
220	WMSp + ABr	ABp	WMSc + ABr	ABe + ABr	IKS	WMS micro + ABr	1	4
222	WMSc	ABe	WMSc	WMSc	WMSp + ABp	WMS macro + ABr		1
223	ABe	ABe + ABp	WMSp	WMSp	IKS	WMS meso	1	
224	ABe + ABr	ABe	WMSp + ABp	WMS clim.	IKS	WMS micro	1	1
225	ABe	ABe	ABe	ABp	IKS	WMS meso	1	
229	ABe	ABp	WMSc	WMSp	Blank	WMS macro + ABr		1
231	WMSs + IKS	ABp + IKS	WMSp	WMSp	WMSp	WMS meso	2	
236	ABe + IKS	WMSp	WMSc	WMS clim.	WMSp	WMS micro	1	
239	IKS	WMSp	WMSc	ABp	ABp	WMS meso	1	
240	Abp	IKS + ABe	IKS + WMSs	ABp	WMSc	WMS meso	2	
						Total	44	47

Key:
PD = primary document number in *Atlas.ti*
Western Modern Science (WMS)
- WMSc = correct
- WMSs = simple
- WMSp = problem
- WMS clim. = climatology
- WMS micro = earth based conception of the universe
- WMS meso = solar system conception of the universe
- WMS macro = bigger picture – beyond the solar system – conception of the universe

Alternative Beliefs (AB)
- ABp = personal
- ABe = everyday
- ABr = religion
- IKS = indigenous knowledge systems

APPENDIX 13

Comparative table different sample groups: what did you find hard to understand?

QUESTION 1: "What was hard to understand?"

Categories	Total	Ave (%)	College of Science	Geology mainstream	Geography Foundation
Issues related to content					
Big Bang Theory	51	25%	12	26	13
Nebula Theory	28	13%	4	18	6
Cosmic Body movement	23	11%	4	9	10
Space link	7	3%	0	5	2
Earth link	11	5%	2	6	3
Issues related to epistemology					
Singularity	17	8%	2	12	3
Prior knowledge	16	8%	5	10	1
Issues related to learning					
Personal miscellan.	14	7%	2	4	8
No problem understanding	42	20%	12	18	12

APPENDIX 14

Comparative table different sample groups: what did you find hard to believe?

QUESTION 2: "What was hard to believe?"

Categories	Total	Ave (%)	College of Science	Geology mainstream	Geography Foundation
Issues related to content					
Big Bang Theory	79	36%	15	28	36
Nebula Theory	26	5%	6	12	8
Evolution	12	5%	7	4	1
Earth link	8	4%	0	8	0
Issues related to epistemology					
Credibility of theories	11	5%	2	5	4
Beginning of doubt	3	1%	1	2	0
African Traditional Religion	6	3%	0	3	3
Conflict with religion	15	7%	3	9	3
Open minded	10	5%	3	7	0
Issues related to learning					
No problem understanding	49	22%	14	30	5
Fatima's rules	1	0%	0	1	0

APPENDIX 15

GLOSSARY OF TERMS

Ontology
A term which refers to the branch of metaphysics which studies, questions, analyses and criticizes assumptions and theories about the **nature of being and existence** (Pence, 2000). In the context of this thesis, ontology is important in considering how you view what is important to you, what you value and how you will make judgements. Do you believe yourself to be a creation of God? Do you believe that you are created in the image of God? Is the world / universe a creation of God? Do you believe in an afterlife and in ancestors who play a role in your life on earth? Is individualism or community more important to you? These questions all relate to a religious ontology, but stand in contrast to a belief that denies the existence or need for a creator or spiritual force. In the context of this study, African ontology is religious. It is very different to a scientific ontology which considers only matter and the evolution of matter into the physical universe that we live in.

Epistemology
The branch of philosophy that studies **the nature of knowledge** - how it is acquired, and whether the knowledge is true knowledge, if that is possible (*Ibid*.). In the context of this thesis, pertinent questions that relate to epistemology include to the source of knowledge: does it come from a trusted Elder or parent? Is it indigenous knowledge that has been passed down over generations, shaping the way phenomena are viewed in relation to a particular culture? Is it personal knowledge - does it comes from your senses - the result of your own experience, viewed with your own eyes? Or does it come from a 'colder' source: books, videos, the internet? Is it believable in relation to your experience? Does that source care whether you believe it and live by it or not?

Anthropocentricism
Regarding or viewing humans as the centre of existence.

Anthropomorphism
The representation of nonhuman creatures, for example, animals, nature, God, as having human characteristics - the attribution of human characteristics to non-human things.

Animism
The belief that inanimate objects and natural phenomena have souls.

Monism
The metaphysical view that all of nature is composed of only one substance. Monism is usually contrasted with dualism, which sees the universe as being made of two substances: mind and matter, or body and spirit.

Teleology
The study of the purpose or goal of all things.

GLOSSARY OF ASTRONOMY CONCEPTS

Rotation (day and night)
The rotation (spinning) of the geo-spherical earth on its axis, completing one spin in a period of 24 hours, progressively turns each part of the earth's surface towards and away from the light of the sun. Those parts of the earth turning into the light will experience dawn (sun rise) as they cross the circle of illumination, progress through the day light hours, and turn into the period of darkness or night, with dusk and 'sun set' experienced with the crossing again of the circle of illumination, away from the sun's light.

Revolution (seasons)
The revolution (orbit) of the earth refers to the movement of the earth around the sun on the plane of the ecliptic. The path of revolution is elliptical, with one revolution being completed in a period of 365 ¼ days. The axis of the earth is tilted at 23 ½ degrees to the perpendicular in relation to the plane of the ecliptic (constant parallelism), causing either the northern hemisphere or the southern hemisphere to be tipped towards the sun, depending on the position along the orbit. For the period that the northern hemisphere is tilted towards the sun, that hemisphere will experience more direct insolation (incoming solar radiation), resulting in increased heating of the atmosphere and the earth's surface, the season or period known as summer. During the same time, the southern hemisphere, tilted slightly away from the sun, will experience winter, with the sun's rays being received at more of an angle, resulting in the diffusion of the sun's energy through a greater volume of atmosphere and a larger surface area. This results in winter in the southern hemisphere. As the earth progresses along its orbit from one hemisphere being tilted towards the sun, to the other being tilted towards the sun, the seasons change, progressing through autumn, winter and spring, before returning to summer.

Geocentric vs heliocentric models of the solar system
'Geo' refers to the earth, while 'helios' refers to the sun: a geocentric view of the solar system is one in which the earth is seen as the centre of the solar system, with the sun and other planets orbiting around the earth, while a heliocentric view sees the sun as the centre of the solar system. Our human experience leads to a geocentric view, while science, since it was first proposed by Copernicus, has proved the heliocentric view.

Stars
Stars are balls of burning gas in space. This most commonly involves the conversion of hydrogen to helium. The radiant energy that is released as a result of this conversion is visible as star light, or in the case of our closest star, the sun, sunlight.

Stars during the day
The atmosphere that surrounds the earth scatters the sun's light on the side of the earth that is facing the sun. This scattering of light in the atmosphere causes the atmosphere to appear blue and opaque, creating a visual 'dome' of blue sky. At night, when no light from the sun is being scattered, the atmosphere appears transparent and it is possible to see stars that are outside of the solar system.

Moon phases
The moon orbits the earth, and together they orbit the sun. The moon's orbit is tilted at 5.9 degrees to the plane of the ecliptic. The side of each of these spheres facing the sun is lit up by the sun's light. Moon phases refer to the changing amount of lit up surface of the moon that can be seen from the earth as the moon orbits the earth. 'Full' moon refers to the entire lit up half of the moon being visible from earth, while 'new' moon is when the moon is situated between the earth and the sun, when none of the lit up surface of the moon is visible from earth. During the period from new moon to full moon, the moon is said to be 'waxing', as the amount of lit up surface that can be seen increases, while the period from full moon to new moon is known as the 'waning' of the moon.

Universe
The term universe has different meanings in different contexts. In terms of astronomy, the universe refers to all matter and energy in existence. In terms of a course in basic astronomy in Earth Science, knowledge of the composition and structure of the universe, including dimensions in space, the solar system, the Milky Way and other galaxies, and the basic scientific theories concerning the formation and evolution of the physical universe, would be important.

Big Bang Theory
The Big Bang model of the universe describes the universe as expanding explosively from a singularity, defined as an "unimaginably hot compact state which marked the beginning of time and space, and of all matter and its associated energy" (Barrett, 2000, 116). While the model "remains coherent to within a trillionth of a trillionth of a trillionth of a second of the Big Bang" (*Ibid*., 117), beyond that any account is "boldly speculative" and lies "outside of the realms of science" (*Ibid*.). The model accounts for the formation of stars and galaxies, and all the physical elements out of which these have been formed.

Solar Nebula Theory
This theory explains the formation of a star (in the case of the Solar system, the sun) out of a nebula (a cosmic cloud of gas and dust). Contraction and gravity feed the formation of a dense ball of gas, which ignites to form a star. As the gas is drawn in to the developing star, the cloud contracts and begins to rotate, forming a disc of gas and dust around the star. Planets are formed within the disc through accretion, with small, dense, rocky planets being able to exist at the temperatures close to the sun, and larger gas planets forming at sufficient distances from the sun that they do not vaporize. The planets so formed are held in their orbit around the sun as a result of the gravitational attraction between the sun and the planets.