ENGAGING MIDDLE SCHOOL STUDENTS IN CONTEXT- BASED SCIENCE: ONE TEACHER'S APPROACH

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ABSTRACT

In Australia, there is a crisis in science education with students becoming disengaged with canonical science in the middle years of schooling. One recent initiative that aims to improve student interest and motivation without diminishing conceptual understanding is the context-based approach. Contextual units that connect the canonical science with the students' real world of their local community have been used in the senior years but are new in the middle years. This ethnographic study explored the learning transactions that occurred in one 9th grade science class studying an Environmental Science unit for 11 weeks. Data were derived from field notes, audio and video recorded conversations, interviews, student journals and classroom documents with a particular focus on two selected groups of students. Data were analysed qualitatively through coding for emergent themes. This paper presents an outline of the program and discussion of three assertions derived from the preliminary analysis of the data. Firstly, an integrated, coherent sequence of learning experiences that included weekly visits to a creek adjacent to the school enabled the teacher to contextualise the science in the students' local community. Secondly, content was predominantly taught on a need-to-know basis and thirdly, the lesson sequence aligned with a model for context-based teaching. Research, teaching and policy implications of these results for promoting the context-based teaching of science in the middle years are discussed.

Keywords: *Context-based, middle years, environmental science*

INTRODUCTION

Middle school students (i.e., years 6-9) lose interest in school-science topics and become disengaged in learning science (Logan & Skamp, 2008). Recent National Literacy and Numeracy test results (NAPLAN) reveal Queensland students' performance in science in the middle years of schooling is significantly below those of students in New South Wales, Victoria and the Australian Capital Territory (Masters, 2009). Furthermore, there are decreasing numbers of students choosing to continue to study science in the senior years (Dekkers & de Laeter, 2001; Lyons, 2006; Tytler, 2007). Outdated pedagogical approaches that focus on covering a large body of content often involving routine laboratory work are no longer motivating students in the middle years (Tytler, 2007). There is a need for new pedagogical approaches that connect students' out-of-school lives with canonical science by affording students opportunities to make connections between science concepts and the real-world.

One new approach which is having some success in increasing students' interest in and enjoyment of science lessons as well as helping students see and appreciate more clearly links between the science they study and their everyday lives, is the context-based approach (Barber, 2000; Gutwill-Wise, 2001; Parchmann et al., 2006; Ramsden, 1992, 1994, 1997). In this study, a context-based approach to teaching science in a year nine middle years classroom which centralized the learning around the context of the local creek, was trialled for one 11-week school term. The local creek named Spring Creek (pseudonym) meandered through the school property and nearby suburbs where many of the students live forming a central part of the students' local community. Therefore, the context of the local creek was an appropriate choice for relevance to the students' real-lives. In this context-based unit, the teacher designed a series of learning experiences where students made weekly visits to Spring Creek collecting data on the ecology, environment and water quality of the creek and the surrounding flora and fauna.

Background

There are several interpretations of the context-based approach to teaching (see, for example, King, 2007). This study applies the definition of a context-based approach drawn from prior work on context-based chemistry in the senior years (King, 2009; King, 2007), to a middle years setting. A context-based approach is when the "context" or "application of the science to a real-world situation" is central to the teaching of the science. In such a way, the science concepts are taught on a "need-to-know" basis; that is, when the students require the concepts to understand further the real-world application. This definition is distilled from a significant body of literature (Beasley & Butler, 2002; Bulte, Westbroek, de Jong, & Pilot, 2006; Gilbert, 2006; Sutman & Bruce, 1992) and incorporates two main characteristics; firstly, there is a societal or real-world issue that is central to the teaching; and secondly, the content is taught as the students require the knowledge to make sense of the context. In a middle years classroom, this is possible when the teacher designs a unit of work that centralises the teaching and learning around the real-world issue, like the health of the local creek, and teaches science concepts when required to make sense of the student-generated data.

The context-based approach contains characteristics similar to the Problem Based Learning (PBL) or Project Based Science (PBS) approaches although it is not identical to them. Like context-based approaches, PBL and PBS approaches centralise the teaching around a real-world or societal issue with the canonical science taught to explain the issue as required, however, for PBL and PBS there is one main investigation that structures the whole unit often written as an open inquiry (i.e., students design and plan their own investigation) (Thomas, 2000). While context-based approaches may be structured around one main inquiry, like investigating the health of the local creek, this is not always the case. For example, the context could be "The air we breathe" and students may complete a series of experiments on the different gases in the atmosphere asking questions that require chemistry concepts to be taught to make sense of the context. In such a way, there is not one investigation that structures the whole context-based unit. Moreover, if an assessment task such as a report or extended response task structures the context-based unit then it is more likely to be designed with an authentic inquiry-based investigation as the focus; that is, where students take the initiative in finding answers to real-world problems (Hackling & Fairbrother, 1996; Jones, Simon, Fairbrother, Watson, & Black, 1992). Therefore, content taught on a "need-to-know" basis could be content taught as students ask questions about an inquiry or it could be content taught as students ask questions about the context as a result of individual experiments, their own reading or in-class discussions. Since a teacher-guided inquiry structures the context-based unit in this study, content taught to help students understand the real-world investigation is a priority.

Inquiry-based investigations in science education have become a national focus forming one of the strands of the Australian Curriculum (ACARA, 2010). Despite numerous definitions that can be found in the education literature, there is a lack of a clear or an agreed-upon conception of what science inquiry involves. Many definitions encompass processes such as using investigative skills; actively seeking answers to questions about specific science concepts; and developing students' ability to engage, explore, consolidate and assess information (Barman, 2002; Lederman, 2002; Roth, 1995). Inquiry is student-centred when students generate a question and carry out an investigation; teacher-guided when the teacher selects the question and both students and teacher decide how to design and carry out an investigation; and teacher-centred or explicit when the teacher selects the question and carries out an investigation through direct instruction or modeling (National Research Council, 1996). The teacher-guided inquiry that structured this context-based unit was to determine the health of the local creek. The group work was co-ordinated by the teacher and involved students collecting a variety of data on the ecology, environment and water quality of Spring Creek.

Educational models can be useful tools for teachers when designing context-based units. Beasley and Butler (2002) proposed a context-based unit of work model to support teachers in the design of the units when the new context-based chemistry syllabus was introduced in trial schools in Queensland. The flowchart was adapted by King (2009) for her PhD study and suggests a series of steps that could be adopted for a context-based unit in the middle years that requires students to complete an investigation and present their results via a presentation and report. See Figure 1 below for the model:

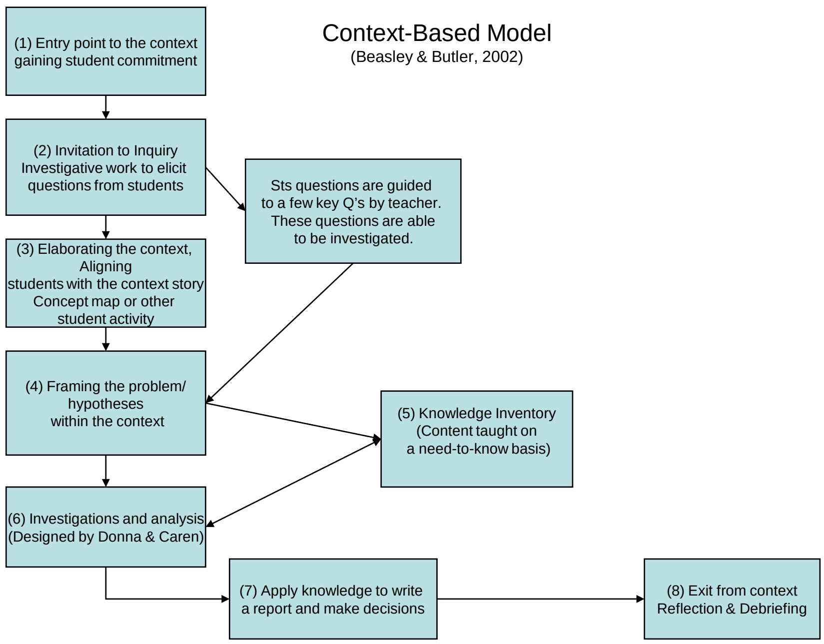

Figure.1. **A model showing the possible steps for a context-based chemistry unit (adapted from Beasley & Butler, 2002).**

The starting point for the design of the unit is an appropriate context. Following this, in the second step, the students are introduced to the investigation and questions are elicited from students. In the third step, a concept map is created which provides the opportunity for meaningful questions to be formulated by the students that may focus student investigations and other learning experiences in the unit (Beasley & Butler, 2002). This model represents a significant change from the previous traditional didactic models of teaching where the transmission of science concepts was the dominant pedagogy. Rather, Beasley and Butler (2002) have suggested a model where concepts are taught when the need arises, in other words, the knowledge inventory (step 5) occurs during the investigations, research and teachable moments (see steps 4 and 6). In such a way, the knowledge is taught on a "need-to-know" basis as the students require the information for the task at hand. While this theoretical model may provide a starting point for the design of context-based units, it can be adapted to suit individual schools. Also, the model will change depending on the assessment task that has been developed for the chosen context. A teaching sequence that follows this model is adopting a context-based approach as defined by Beasley and Butler (2002).

RESEARCH METHOD

We employed an interpretive methodology using ethnographic techniques for this study (Erickson, 1998; Merriam, 1988; Stake, 1994). The study was conducted during one three-month term (April to June) in a ninth grade science class at Spring Creek State High School in Queensland, Australia. The students were in their second term of science studying an environmental science unit based on the local creek on which the school was situated. The average age of the students was 14 years and there were eight boys and 18 girls in the class. Students were from predominantly middle class families.

A single case study design was used to explore the transactions that occurred in the classroom (Bassey, 1999; Erickson, 1998; Merriam, 1988) and to develop a deep understanding of the interactions in one year nine context-based science classroom. This paper reports preliminary fine-grained analysis of the data on the teacher's approach to the context-based unit (Stake, 1994).

DATA COLLECTION

Author One and three collected the data for the 11 week unit. Detailed field notes were recorded based on observations of the classroom and creek visits with a particular focus on two selected groups of students; the teacher in whole-class interactions; and interactions between the teacher and the selected groups. Other data sources included classroom documents, student journals, interviews with students and their teacher, audio recordings of teacher and students; and flip cam recordings created by the focus groups as they undertook their data collection at the creek. Our analytic process began with the categorisation of lessons followed by the transcription of interviews and flip cam recordings. This paper presents three assertions from the preliminary analysis of the data that highlights the teacher's approach to the context-based unit.

THE ENVIRONMENTAL SCIENCE UNIT

The context-based environmental science unit required students to complete a teacher-guided inquiry that assessed the health of the local creek. Students conducted water quality investigations, analysed primary and secondary data sources, and wrote a scientific report that may be communicated to the local community via local government authorities. The report included a summary of the data derived from the water tests, an evaluation of the water quality of Spring Creek based on scientific evidence and a summary of environmental issues affecting the water quality (see Appendix A for the report requirements).

An important feature of the unit was the use of IT throughout since the students owned lap tops and regularly brought them to class to work on the inquiry. The lap tops afforded students opportunities to store data, conduct statistical analysis, search relevant websites and prepare the final report. The integration of IT was well established in this class prior to the study since students were selected into one of two IT - enrichment classes in year eight based on their proficiency with IT in primary school. The class in the study was one of the IT-enrichment classes and during the study the students' demonstrated competence with the use of lap tops and associated software.

The teacher (Edward – a pseudonym) designed the lesson series after conversations with Author One. He conducted his own background research into context-based teaching by reading prior work conducted by Author One on the context-based approach (i.e., King, 2009). While Edward organised the student groups and activities he was prepared to adopt a student-centred learning approach as much as possible as revealed in this quote:

> Whereas the approach for this unit is giving power back to the students and following along what they are coming up with and being flexible as to the where they want to go...how they want to structure things ...as being a lot more demanding of the students but they have responded a lot more positively than expected. (Interview 1, 19/5/10)

Initially, Edward's plan was to "give the power back to the students" by allowing them to direct the learning as required. In such a way, he designed the lesson sequence to be predominantly student-directed after he organised the students for the creek visits.

Edward assigned students to groups and coordinated the creek activities. On each visit to the creek, the groups rotated through the activities which included one of the following: animal population study, plant study, soil sampling and drawing of a site map, water sampling, water testing or pollution study. In Appendix B the procedure for each creek activity is detailed. Once the groups were organised and the tasks clarified, Edward allowed the students to direct the data collection, analysis and write-up by adopting a more student-centred approach.

ANALYSIS

The analysis for Assertion 1 involved summarising the lesson sequence where three interconnected themes describing the learning experiences emerged from this analysis. The second Assertion emerged after categorising each lesson type to find confirming and disconfirming evidence for the characteristics of context-based teaching distilled from the literature. Finally, comparing the lesson sequence for this study with the adapted model for context-based teaching from Beasley and Butler (2002), led to Assertion 3.

RESULTS

Assertion 1: An integrated, coherent sequence of learning experiences that included weekly visits to a creek adjacent to the school enabled the teacher to contextualise the science in the students' local community.

Author One and three analysed the lesson sequence (see Appendix C) based on our ethnographic field notes and audio recordings of the lessons, searching for themes used by the teacher to structure the unit. Three interconnecting themes emerged in the 11-week unit that are explained below:
Theme 1 – The unit included an examination of key aspects of the features of the Spring Creek ecosystem, e.g., plant and animal populations, food chains and food webs, a range of tests on water quality, and human impact on the environment. Also, group sharing of collected quantitative and qualitative data, on-site and back in the classroom were important components of this theme.
Theme 2 – There were eight excursions to Spring Creek conducted throughout the unit to allow the students to engage in the activities described in broad terms in Theme 1.
Theme 3 – Throughout the unit, students continuously reviewed and analysed recently collected data and made relevant comparisons with data collected in previous weeks, as they compiled their individual reports. This theme also included focused activities designed to develop deeper understandings of important concepts such as pH, conductivity, and dissolved Oxygen levels, in order to enable students to elaborate on their findings and enhance their comparisons of data shared between groups on a longitudinal basis.

The analysis revealed that firstly, the teacher designed an integrated, coherent unit of study for the students that consisted of three interconnected themes or learning experiences that included weekly visits to a creek adjacent to the school; and secondly, the real-world issue of the health of the local creek structured the unit.

Assertion Two
Content was predominantly taught on a need-to-know basis

The second assertion emerged after categorising each lesson type to find confirming and disconfirming evidence for one of the central characteristics of context-based teaching distilled from the literature; that is, in a context-based approach, content is taught on a need-to-know basis. Initially, we categorised each lesson type using the definitions below:

Table 1: Description of Lesson Types

Lesson Type		Explanation	Number of Lessons
A.	Teacher-led	Predominantly a one-way exchange of information from the teacher to students. Students demonstrate their knowledge only by answering questions posed by the teacher.	4
B.	Group work	Students work in small groups	2
C.	Laboratory work	Students carry out laboratory experiments in groups	1
D.	Creek visits	Teacher and students went on an excursion to the local creek	9

E.	Individual class work	Students work individually on a class activity	1
F.	Combination of A and B	Teacher-led and group work	8
G.	Combination of D and B	Creek visit and in-class group work	1
H.	Combination of E and B	Individual class work and group work	3

From the analysis (see Appendix C) we found that out of 29 recorded lessons, there were only four lessons that were predominantly teacher-led where the content was determined by the teacher. Two of these four lessons were the first and second lessons in the unit. In the first lesson, Edward introduced the context by gaining student commitment to the inquiry and in the second lesson, he drew on their prior knowledge of creek systems by constructing a road map (see Appendix E). The third of these teacher-led lessons occurred mid-way through the unit when Edward explained the water quality tests of temperature, flow rate, pH and conductivity to the class so they could begin to analyse their data and draw conclusions about the water quality at the creek. In such a way, this lesson was meeting the needs of the students; that is, to understand the water testing data they had collected. The fourth teacher-led lesson occurred in the final week of the unit when Edward showed a video on creek systems stopping the video throughout to revise the science concepts students had learnt previously. While many of the remaining lessons included teacher-led instructions, they did not include teacher-led transmission of knowledge determined by the teacher. Our analysis found that the remaining 25 lessons included a variety of teaching approaches where the context was central to the lesson and content was taught primarily on a need-to-know basis. Therefore, Edward's lesson sequence was consistent with a context-based approach to teaching science as defined in this paper.

Assertion Three

The lesson sequence aligned with a model for context-based teaching

For the third part of our analysis we compared the lesson sequence with the model adapted from Beasley and Butler (2002). The eight steps in the model discussed previously provided one possible template for implementing a context-based unit. The analysis represented below in Table 2 demonstrates how this model sequence corresponds to the context-based unit in this study. The lesson sequence is detailed in Appendix C.

Table 2: Comparison of adapted model from Beasley and Butler (2002) with lesson sequence

Steps in Model	Lessons that correspond to that step (see Appendix C)	Notes
1.Entry point to the context gaining student commitment	1 Brainstorming session and mind-map constructed	Introduction of unit
2.Invitation to inquiry-investigative work to elicit questions from students	3 First creek visit	The order of step 2 and 3 were reversed since Edward chose to introduce students to the creek environment after the road map construction connecting water quality, ecology and the environment
3.Elaborating the context-aligning students with the context or story or concept map or other student activity	2 Road map constructed by teacher with key questions summarizing students ideas from the mind-map in Lesson One	The key questions were summarised by the teacher in the road map
4.Framing the problem/hypothesis within the context	4 - 18	Steps 4, 5 and 6 were interconnected and lessons alternated between these steps in weeks 3-6
5.Knowledge inventory (content taught on a need-to-know basis)	4- 18	Content taught at the creek and in class on a need-to-know basis
6.Investigations and	4-18	Investigation and analysis

analysis		continued in weeks 3-6
7.Apply knowledge to write a report and make decisions	16-27	Weeks 7-10 concentrated on the report writing
8.Exit from context - reflection and debriefing	28,29	Video summary and final creek visit

The analysis revealed the context-based unit designed by Edward adopted the model proposed by Beasley and Butler (2002) except for two differences. The first difference occurred early in the unit when the order of steps two and three were reversed. This was due to two factors, firstly, the connections between the three topics of water quality, environment and ecology and the key questions were paramount in the design of the unit and needed to be explained early in the unit (Lesson 2 - Step 3). Secondly, Edward determined the day of the week that was suitable for creek visits based on the length of the lesson and the weather. In the first week, the most suitable day was Friday (Lesson 3 - Step 2). Consequently, the invitation to the inquiry where students visit the creek to elicit further questions (Step 2) occurred after Step 3.

The second difference between the lesson sequence in the Environmental context-based unit and the context-based model in Figure 1 occurs between Steps 2 and 4 when “students’ questions are guided to a few key questions by the teacher.” Edward guided the students’ ideas from a brainstorming session in Lesson One (see Appendix D) to a few key questions which he presented as a road map in Lesson Two (See Appendix E). Therefore, the key questions were generated between Steps 1 and 3 rather than Steps 1 and 4.

Since these differences are minor, we concluded that the lesson sequence determined by the teacher in this Environmental context-based unit follows the main structure outlined in the model adapted from Beasley and Butler (2002). Therefore, the Environmental Unit can be categorised as following this context-based model.

CONCLUSION

A context-based approach to teaching science was used in this middle years classroom in an attempt to situate the students’ learning in their local community. The preliminary analysis described in this paper highlights the structure of the unit developed by the teacher that centralises the local creek as the context. The analysis revealed three assertions. Firstly, the 11-week unit consisted of three interconnecting themes; that is, an examination of key aspects of the Spring Creek ecosystem, eight excursions to the creek, and data analysis with focused activities on the water quality parameters needed for determining the health of the creek. Secondly, the content was predominantly taught on a need-to-know basis and thirdly, the lesson sequence followed a context-based model adapted from Beasley and Butler (2002).

The teacher in this study was committed to designing a unit that was student-centred and linked science with the students’ local community. He was prepared to broaden his pedagogical approaches as revealed in the mid-point interview:

> We’ve never had the opportunity to run a course as open and free as what is has this time through. And for me, basically, [it] broadened or helped me to remember back to the sheer volume of different types of learning of teaching experiences which [we] can provide, running things like group work more effectively, branching out to all kinds different approaches from group work and how they can relate to others just the whole ...my whole pedagogical approach is improved a lot compared to regular times when I have done this particular unit (Interview 1, 19/5/10)

Context-based teaching is one new approach for re-engaging middle years students in science. In this study, the context of the local creek provided the teacher with the opportunity to plan a unit that linked science with the students’ real-world. The trips to the creek were the highlight as one student described in the interview “it makes you look forward to science.”

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APPENDIX A

Spring Creek State High School

Year 9-Science - Environmental Science

Task:

Over the past 7 weeks, you have been gathering water quality data, animal and plant populations and observations of the creek's surrounding environment. You now have the opportunity to demonstrate your understanding of why these factors are important by producing a multimedia report on the overall health of Moggill Creek. You may choose any multimedia format for you report as long as it effectively represents you understanding of the topic of environmental science and gives a clear justification for your opinion of the creek's health. Further details are provided below:

Task Details:

The major objective of the assignment is to report on the overall health of Moggill Creek in terms of water quality, ecology and the environment. The report should clearly state whether you have decided, if the creek is of good quality/health or not. Your opinion must be justified with evidence from the data and observations you have collected on the water quality, ecology and environment of the creek. This includes tables and graphs (where relevant) of your data. The report should therefore be researched, detailed and give you a thorough explanation of the science which is related to the topic. A checklist is provided below to assist you. Has your report included:

- A clear statement of whether the creek is of good quality/health
- Justification of your statement is provided using evidence from the data collected during the term
- An explanation of the various water quality, ecology and environmental factors that affected Spring Creek
- A summary of how the water quality, ecology and environmental factors are related to each other (e.g., how the environment affects water quality and ecology)

The second part of your assignment is your learning journal, in which you have been recording your observations and data in during the visits to the creek each week. A detailed overview of what to put in your journal is below.

Report Format:

You have the option to pick any multimedia format of your choice. This includes:

- A word document
- A PowerPoint presentation
- Flash media
- Movies
- A website

Remember that the report needs to demonstrate your understanding of the science related to water quality**,** ecology and the environment which you have studied during the course. Therefore, it will need to incorporate the data and observations which you have gathered during the unit along with an anlaysis of this data. Hence, if your chosen format does not allow you to include information and data in a meaningful way, you may struggle to demonstrate your understanding of the topic.

Learning Journal

The learning journal should be a neat, organized record of your trips to the creek and include reflections on what your data indicates. You should also use the journal when planning your report. The planning should include:

- Possible formats to present your report in (e.g., Word, flash media, etc…)
- What information you could include in the report
- How you will represent your data (e.g., graphs, tables)
- Dot-point summaries of research
- How you will structure your reports (e.g., ordering of information, ecology vs water quality, etc..)

Summaries of your research should be put at the back of the journal while planning, observations, reflections, etc..should go at the front.

APPENDIX B

Procedures for Creek Activities

While at the creek, you have been performing a range of tasks related to environmental science. In order to ensure that the data you are collecting is comparable to the data collected by other groups, the instructions for your task are provided below based on the explanation of each task that the class groups put together.

Water Sampling

Procedure for taking water samples for testing.

Step 1: Put on waders

Step 2: Walk towards the assigned area. Site 1 - water under the bridge, Site 2 - water flowing from the concrete causeway, and Site 3 - isolated water pond.

Step 3: walk through the creek until the water reaches just above your knees.

Step 4: Completely submerge the white sample bottle for sampling and fill it to the top. Recap while under water.

Step 5: Hand sample bottle to the group that’s testing the water

Water Testing

Data logger instructions:

Hold down power button, plug the probes into the appropriate sockets. From teh homepage, select the digital format of the results and set it to display 4 readings at a time. Place probes in the creek water samples provided by the sampling groups and wait for a steady reading. Record results in a table such as the one below.

Date:			
	Site 1	**Site 2**	**Site 3**
pH			
Conductivity (µs/cm)			
Temperature (ºC)			
Flow Rate (ft/s)			
Dissolved Oxygen (mg/L)			

Animal/Insect Populations

At each of the 3 sites described in the water sampling procedure, identify as many types of living animals or insects as you can and record the number (population) of hat type in a table similar to the one below (but written into your logbooks). Use a separate table for each site.

Date:	**Site Number:**
Type of Organism	**Population Count**
e.g., Dragonfly	7
e.g., Small fish	2

Plant Population

At each of the 3 sites described in the water sampling procedure, identify as many types of plants as you can and record the number (population) of that type in a table similar to the one below (but written into your logbooks). Use a separate table for each site.

Date:	**Site Number:**
Type of Organism	**Population Count**
e.g., Large Tree	1
e.g., Flat grass	20
e.g., Tall grass	11

Environmental Analysis

Record observations of the creek's surrounding environment for example: dead tress and vegetation and the litter in and around the creek. At each of the 3 sites, pollutants are to be located and counted. Pollutants include metal, wrappers, plastic waste in general and any other foreign object which has been introduced into the creek.

In addition, each group member must create their own site map which should be a "birds-eye-view" of the area being tested and should indicate the location of the 3 test sites along with any other major features of the creek.

Data table for litter at Creek

The amount of litter will be recorded in the table below. At the end of the term, results should be collected from other groups for each week and graphed at the end of the term to sho the results more effectively.

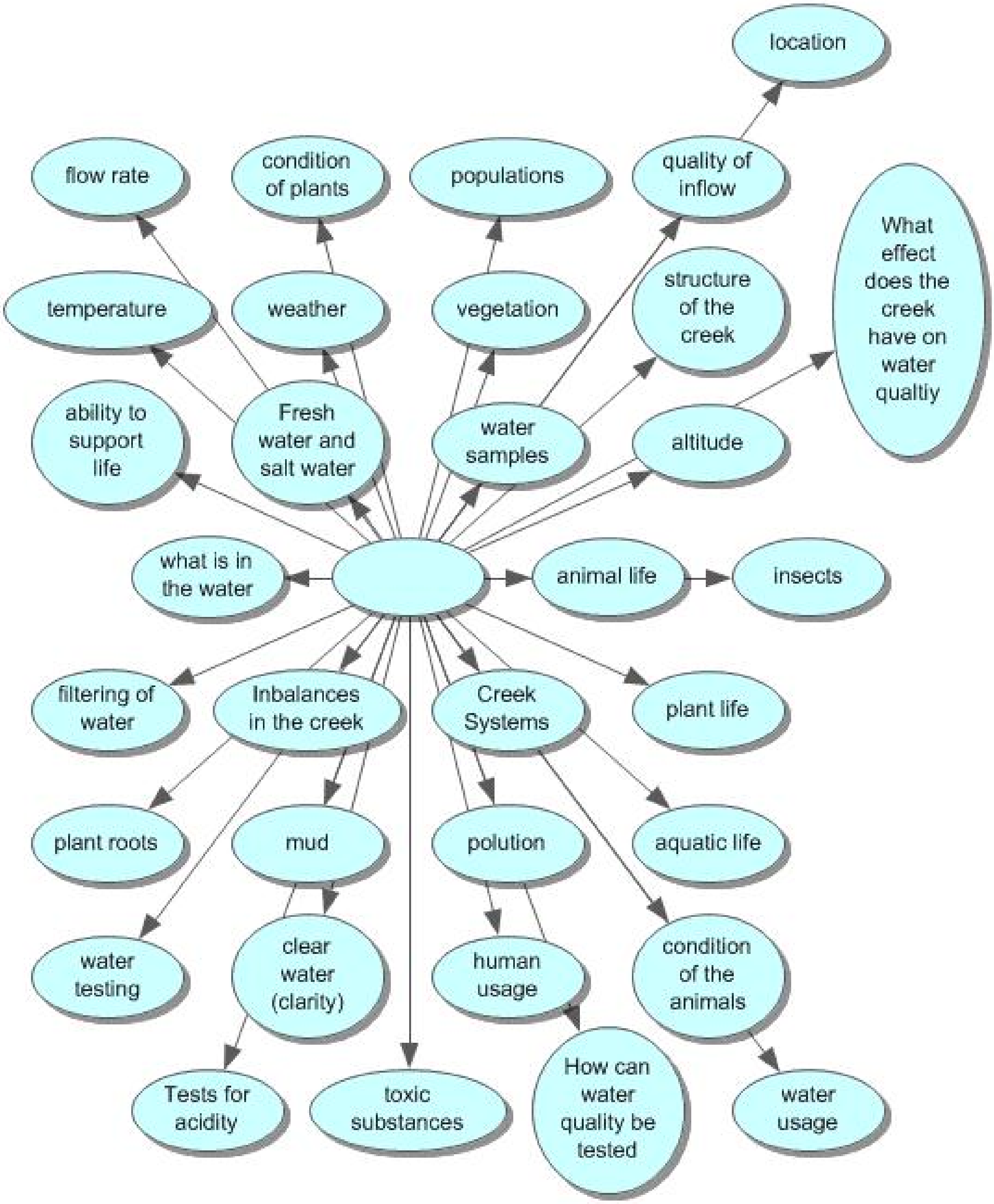
Date	**Number of pollutants in and around the creek**
23/4/10	15

APPENDIX C: Analysis of Lesson Type at Spring Creek High School

WEEK AND DATES	TUESDAY	WEDNESDAY	FRIDAY
1 13/4; 14/4; 16/4	1/A. INTRODUCTION OF PROJECT - MIND MAP OF STUDENT GENERATED IDEAS	2/A. TEACHER SUMMARY AND EXPLANATION OF 3 COMPONENTS DRAWN FROM STUDENTS' MIND MAP: WATER QUALITY, ECOLOGY, ENVIRONMENT	3/D. FIRST CREEK VISIT - TEACHER INTRODUCES STUDENTS TO THE CREEK ENVIRONMENT AND SUGGESTS OBSERVATIONS THEY MAY MAKE.
2 20/4; 21/4; 23/4	4/AB. FOCUS GROUPS FINALISED EXPLANATION OF TERMS ASSOCIATED WITH THE CREEK AND DEFINITION OF CREEK. 6 MAJOR CHARACTERISTICS OF CREEK EXPLAINED	5/AB. WET - EXCURSION POSTPONED STUDENTS BRAINSTORMED KEY TASKS FOR GROUPS TO COMPLETE UNDER THREE HEADINGS WATER QUALITY, LIVING THINGS, THE ENVIRONMENT	6/D. SECOND CREEK VISIT - GROUPS WORKING ON ASSIGNED TASKS
3 27/4; 28/4;	7/AB. STUDENT WORK ON GROUP DATA COLLECTED AT CREEK	8/D. THIRD CREEK VISIT	NO YEAR 9 SCIENCE CLASS
4 4/5; 5/5; 7/5	TEACHER SICK DIDN'T GO	TEACHER SICK DIDN'T GO	9/A. LESSON DISCUSSING WATER QUALITY, TEMPERATURE, FLOW RATE, PH AND CONDUCTIVITY RELATED TO FINDINGS THUS FAR
5 11/5; 12/5; 14/5	10/AB.FOOD WEBS AND FOOD CHAINS TAUGHT	11/D. FOURTH CREEK VISIT	12/C. PRACTICAL LABORATORY LESSON ON PH, CONDUCTIVITY AND DO
6 18/5; 19/5; 21/5	13/AB. POPULATIONS, AND FACTORS AFFECTING KANGAROO POPULATION LINKED TO WORKSHEET	14/D. FIFTH CREEK VISIT - IAN WITH ANIMAL GROUP	15/E. STIMULUS RESPONSE TASK COMPLETED
7 25/5; 26/5; 28/5	16/B. SHARING OF DATA FROM ALL GROUPS	17/D. SIXTH CREEK VISIT	18/DB. EVAN'S VIDEO AND VISIT TO ANOTHER PART OF THE CREEK
8 1/6; 2/6; 4/6	19/AB. GROUP WORK TO COLLECT RESEARCH ON TOPIC AND PLAN FOR TOMORROW'S EXCURSION	20/D. SEVENTH CREEK VISIT	21/B. MULTI-MEDIA DESIGN, CONSTRUCTION AND PRESENTATION ON WORK SO FAR
9 8/6; 9/6; 11/6	22/AB. GROUP WORK ON REPORTS	23/D. EIGHTH CREEK VISIT	24/AB. DRAFT REPORTS REVIEWED BY TEACHER
10 15/6; 16/6; 18/6	25/EB. STUDENTS WORKED ON FINAL REPORTS (TEACHER NOT PRESENT)	26/EB. STUDENTS WORKED ON FINAL REPORTS TEACHER NOT PRESENT	27/EB. FINAL REPORTS HANDED IN

11 22/6; 23/6; 25/6	**I DID NOT GO - TEACHER SAID THEY HAD A STUDY PERIOD**	**28/A. VIDEO ON CREEKS**	**29/D. FINAL WALK TO OTHER PARTS OF CREEK TO MAKE OBSERVATIONS**

APPENDIX D: Student generated Mind Map



APPENDIX E: Creek Systems Road Map