PLACE-BASED EDUCATION IN THE CLASSROOM: A STUDY OF CHILDREN'S EMPATHY AND CONNECTEDNESS TO CORAL REEF ECOSYSTEMS

Mark Traxler

Earth Expeditions – Belize III

Miami University- Ohio

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Abstract

In order to protect and save the earth from continued degradation, humans must foster feelings of empathy and connection towards the planet. An environmental identity is essential in developing empathy and stewardship and despite the fact that it is a life-long process it begins in childhood (Kals & Ittner, 2003). This paper explores how combining inquiry based lessons and building a coral reef tank in the classroom to act as a place-based education can affect the empathy and connectedness to coral reef ecosystems in students. A questionnaire was developed to measure the students connection to coral reefs, their relationship with coral reefs, and their inclusion of coral reefs in self. The data showed an increase of student connectedness to coral reefs after the traditional and inquiry place-based lessons. The students' relationship to coral reefs was not significant until after the inquiry place-based work. This study demonstrates the efficacy of inquiry and its importance of having an experience within the classroom.

Introduction

The world's oceans are constantly changing whether for the good, bad, or the indifferent; the constant is change. Unfortunately, science shows us that humans are affecting our oceans ecosystems in a negative way (NRC, 2010). Yet there are still those who debate, those who choose not to look, and those who do not care. Perhaps the question we should be asking ourselves is "How do we get people to care, therefore creating a positive change?"

Empathy is one way that we can create change. Researchers in developmental psychology focus on empathy as being a feeling or emotion that is shared and perceived for another person (Eisenberg & Strayer, 1987). When one has empathy there is a connectedness to the feeling and an understanding of another's need, that is when there is a desire postured for change. Hungerford and Volk (1990) concluded in their model of environmental citizenship that in order to develop responsible pro-environmental behavior, one must possess sensitivity or empathetic feelings toward the environment. Clayton and Myers (2009) also found that when a person feels empathy for the environment they will more likely be driven to act with intention, compassion and to investigate, and participate in environmental conservation in a more purposeful way. This is further supported by the ideas of deep ecology, which argues that nature has certain inalienable rights to live and grow and possesses feelings and intelligence (Goodpaster, 1978; McDanile 1983; Naess, 1973). Therefore, when empathy is fostered alongside of environmental awareness, positive change can occur to the natural world.

In order for the world and its people to do more than just get by, educators should go beyond simply teaching about environmental issues, they must discover new ways to nurture empathy and engage student's minds (Calder & Smith, 1993). Developing environmental sensitivity is a major factor in the molding of students who will grow into adults with the desire to maintain a diverse and beautiful planet for generations to come (Tanner, 1980). Teachers have an opportunity to spark caring and action within their students for environmental conservation through the combination of inquiry based projects and place-based education.

David Kolb (1984) described in his model of experiential learning that the learning process was interconnected between the concrete experience, reflective observation, active experimentation, and abstract conceptualization. Research has revealed that hands on materials, open-ended questions, active participation and purposeful play are key for a child to develop in all areas of the learning process, which is even more essential in the early childhood years (Edwards, 2013). One way to achieve this according to Lonergan and Andressen (1998) is through place-based education where students can develop a better understanding of the natural world not from textbooks and ancillary presentations but through first person experience. Additionally, scientific inquiry can enhance a student's understanding of an environment. The National Research Council (2012) defines scientific inquiry as the ability to examine, collect evidence and form hypothesis to explain learned concepts and understand how to study the natural world. Inquiry projects combined with place-based education provides students the opportunity to practice science by thinking critically, working as a team, practicing measurement, performing statistical operations, and making connections through their work.

Children are natural stewards who want to be a part of and take care of things including their environment. This is a perfect opportunity for students to develop responsibility toward the environment, which helps them define their place in the community and the larger world (Vaske and Kobrin, 2001). Inquiry and place-based classroom lessons can help fill the void of not being connected to our ecosystems. This particular study was conducted to assess whether students are more likely to increase their empathy and connectedness to coral reef ecosystems, by comparing results between a traditional lesson using a book with associated worksheets and a modified inquiry place-based inquiry lesson where the students actively research and build a reef tank in the classroom to experience that environment.

Methods

To begin the project, the author researched the established practices of the Nature Relatedness Scale (NR-6) (Cheng, 2008), the Connection to Nature Index (CNI) (Mayer & Frantz, 2004), and the Inclusion of Nature in Self Scale (INS) (Clayton, 2003), all which measure levels of empathy and connectedness. These tested tools were compiled and contextually modified in order to survey feelings towards coral reef ecosystems of elementary students (ages nine to twelve years old) from Central Montessori Academy in Cincinnati, Ohio.

The Connection to Nature Index (CNI) presented sixteen questions that measured how the student felt when observing a coral reef ecosystem, their perception of human-to-coral reef relationships, and their concern for animals in the coral reef (Appendix A). The Nature Relatedness Scale (NR-6) short form, presented six questions that measured how connected the student felt to coral reefs (Appendix B). Both the CNI and the NR-6 are Likert based scales with a rating of 1-5; 1 being the least connected and 5 being the most connected. The Inclusion of Nature in Self scale (INS) was a Venn diagram used to identify the students connectedness to nature based on a scale of five pictures (Appendix C). The INS scale shows five pairs of circles showing various levels of connection; 1 being two circles not overlapping (no connectedness) and five being two circles that completely overlap (very connected).

The questionnaire was distributed three times to 32 participants middle childhood elementary students (ages nine to twelve year-old) at Central Montessori Academy. A letter describing the study and a consent form was sent home with the students (Appendix D). In order to obtain a baseline measurement, the questionnaire was given (Q1), for the first time prior to any lessons or discussion about the coral reef ecosystems.

After the completion of the questionnaire, a traditional lesson on coral reefs and ecosystems was given by reading a book to the students about the coral reefs. The students were then given a workbook about the habitat. The workbook included information on: how reefs are formed, what is coral, the economic benefit of a coral reef, the symbiotic relationship of a coral reef ecosystem and coral reef facts. Upon completion of this work, the questionnaire was given for a second time (Q2) to measure if there was a change in their responses.

The students were then given inquiry work, focusing on the same subject matter as the traditional lesson to complete. This included individual inquiry and inquiry work as teams researching 16 questions about coral reef ecosystems and how to build a salt water reef tank. The groups collaborated on answering a few of the questions and wrote more questions they discovered during their research. These questions were compiled and added to the original set and eight groups of four students presented their findings to the other groups using PowerPoint presentations. A place-based activity of building a coral reef tank took place in the classroom was integrated into the inquiry work. After the work was completed (the reef tank being a work

in progress), the same questionnaire was distributed a third (Q3) and final time in order to measure if there was a change in their responses yet again.

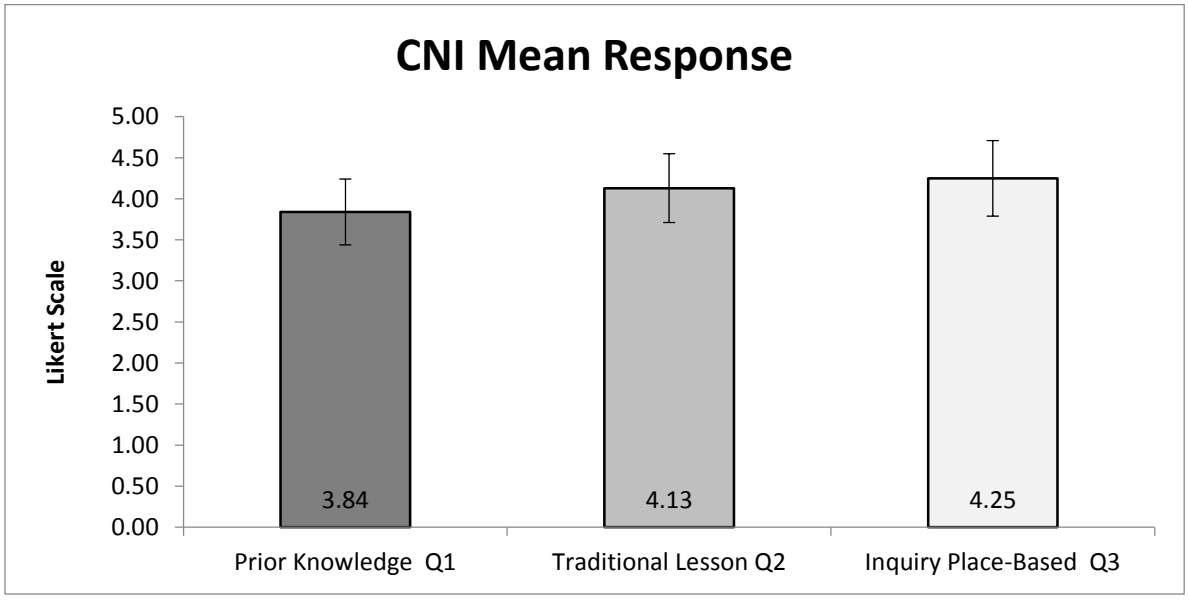
Results

All 32 students in the middle childhood program at Central Montessori Academy participated in this study. The first questionnaire (Q1) was presented before any lessons were given and the results were dependent on their prior knowledge. After the traditional lesson was given, the second questionnaire (Q2) and their responses were recorded. The third questionnaire (Q3) was distributed after the inquiry work was completed.

The CNI mean response (Figure 3.1), using the Likert scale of 1-5, for questionnaire one (Q1) was (M = 3.84, SD = .40). Comparatively, the mean response for questionnaire two (Q2) was (M = 4.13, SD = .42) and the mean response for questionnaire three (Q3) was (M=4.25, SD = .46). The post-test results demonstrate an increase in student's feelings, concerns, and perceptions of human to coral reef relationship after both the traditional and the inquiry place-based lessons. It is difficult to ascertain whether the traditional lesson influenced the inquiry place-based lesson but the mean average shows continued growth after each methodology was used.

Figure 3.1

CNI Mean Response



There was a significant statistical change (Table 3.14) between Q1 and Q2, $t(31) = 3.46$, $p < .05$, but the t-test results showed no statistically significant change in the students' affective and cognitive attitudes towards their connection to the coral reef ecosystem between Q2 and Q3, $t(31) = 2.03$, $p = .05$. The overall comparison of Q1 and Q3, $t(31) = 4.30$, $p<.05$ showed a statistically significant change in responses.

Table 3.14

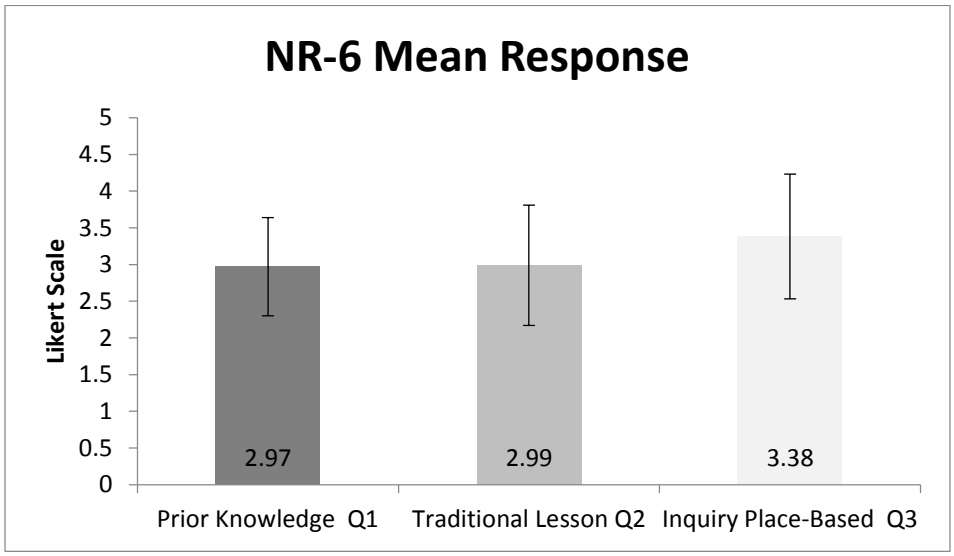
P-value of Connection to Nature Index

CNI Questionnaire		**df**	**t-value**	**P-value**
After Traditional Lesson	Q1-Q2	31	3.45	.0016
After Inquiry Place-Based	Q2-Q3	31	2.03	.051
Overall	Q1-Q3	31	4.30	.0002

The NR-6 mean response (Figure 3.2), using the Likert scale of 1-5, for Q1 was (M = 2.97, SD = .67). The mean response for Q2 was M = 2.99, SD = .82) and Q3 was (M = 3.38, SD = .85). The students mean response did not greatly change after the traditional lesson but increased more significantly after their inquiry place-based work.

Figure 3.2

The NR-6 Mean Response



After the traditional lesson, the results (Table 3.2) showed very little increase in students' connectedness to the coral reef ecosystem and therefore the null hypothesis is true Q1 and Q2, $t(31) = .1137$, $p > .05$. However, the results of Q2-Q3: $t(31) = 3.30$, $p<.05$ and Q1-Q3: $t(31) = 2.54$, $p<.05$ show a statistical significance and rejects the null hypothesis. The students' positive change in their cognitive, affective, and physical connection to the coral reef ecosystems was meaningful.

Table 3.2

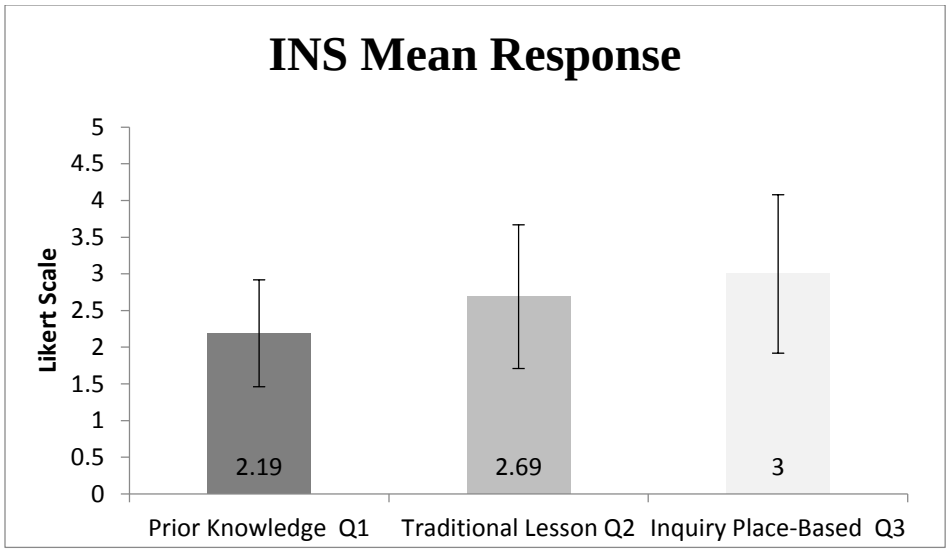
P-value of Nature Relatedness Scale – short form

NR-6 Questionnaire		**df**	**t-value**	**P-value**
After Traditional Lesson	Q1-Q2	31	.1137	.9101
After Inquiry Place-Based	Q2-Q3	31	3.30	.0025
Overall	Q1-Q3	31	2.54	.0164

The INS mean response (Figure 3.3), using the Likert scale to identify 5 sets of circles, for Q1 was ($M = 2.19$, $SD = .73$). The mean response for Q2 was (M = 2.69, SD = .98) and the results for Q3 was (M = 3, SD = 1.08). These results show the students' steady growth in identifying with coral reef ecosystems as part of who they are.

Figure 3.3

The INS Mean Response



The t-test results for Q1-Q2 were $t(31) = 2.88$, $p<.05$, Q2-Q3 were $t(31) = 2.15$, $p<.05$, and Q1-Q3 were $t(31) = 4.00$, $p<.05$. All results reject the null hypothesis and there was a statistically significant change in students' inclusion of self in coral reef ecosystems at all levels.

Table 3.3

P-value of Inclusion of Nature in Self Scale

INS Scale		**df**	**t-value**	**P-value**
After Traditional Lesson	Q1-Q2	31	2.88	.0072
After Inquiry Place-Based	Q2-Q3	31	2.15	.0391
Overall	Q1-Q3	31	4.00	.0004

Discussion

The purpose of this project was to determine if inquiry based learning combined with place-based education created more empathy and connectedness to coral reef ecosystems for elementary students (ages nine to twelve year-old), than traditional based educational practices alone. Sobel (1998) stated that educators and should provide lessons and opportunities for interaction with nature, matching the periods of development with the students. The first step to inspiring empathy is to allow children to study animals in their natural habitats and then to provide them an opportunity to explore that environment. Based on research and experience, the

author suspected that bringing an environment into the classroom not native to the students' knowledge base, which represents an adapted form of place-based education, combined with inquiry based lessons would have a substantial impact on the students' empathy and connectedness to the coral reef environment.

By having the students first explore the inquiry-based lessons and then for them to participate in building the coral reef tank in the classroom as a place-based lesson, a greater level of empathy and connectedness was experienced by the students. When comparing the first completed questionnaire to the second questionnaire there was a small increase in the level of empathy and connectedness to the coral reefs after the traditional lesson. After the inquiry and place-based lessons, the third and final completed questionnaire showed a noticeable change in attitudes.

The development of a reef tank in the classroom served as a bridge which allowed the students to experience the coral reef first person, to identify with the coral reef, and to care for the reef and its environment. Place-based education encourages educators to take their students in nature around their campus to begin to learn and connect with the environment to establish a sense of care and wonder. Empathy and wonder can happen in the classroom as well, provided a space is created and the students are encouraged to discover and connect with the environment.

In the future, to achieve greater relevance, it is recommended to have two separate groups where one group receives the traditional lesson only and the other receives the inquiry place-based lessons only. This would give greater insight into whether the teaching methodology makes a significance increase in the levels of empathy and connectedness to the coral reef ecosystems.

Reflection/Action

This project proved the value of inquiry based methodology and supports the Montessori teaching methods that I so firmly believe in. The students' excitement was contagious when the groups were researching and putting together their presentations. The only directive given to the students was that they were to independently research the questions and present their findings to the other groups and we would collate their findings. The groups inspired each other to do their presentations using PowerPoint as a means for sharing their ideas. Combining the building of

the reef tank in the classroom and the inquiry work created an excited and motivated group of students. The students investigated what the reef tank would need to function properly and as they discovered what and why they needed certain parts, I would give them what they requested. The students assembled and placed the parts in the tank as well as measuring, cleaning and gluing PVC pipe to attach the overflow box to the micron filter in the refugium. The students also choose the fish and coral that went in the reef tank. If the study had been constructed where the class could have been split between a traditional lesson group and an inquiry place-based lesson then the traditional group would have been denied the wonderful opportunity to discover and create a personal relationship to coral reefs that the inquiry place-based clearly provided.

The inquiry inspired deeper thoughts and connections with nature and the coral reefs than the traditional lesson. The worksheets from the traditional lesson increased the students' knowledge of coral reefs and the damage that has occurred but it wasn't until they delved into the inquiry work that the students started to make real and deep connections. They realized that wasteful use of electricity increases CO2 into the atmosphere and how that contributes to the temperature rise in the water. A parent emailed me and wrote that she told her son that she sometimes falls asleep with the television and laptop on to which her son said, "When you do that you hurt the coral reef." She wrote that she asked him how that could be. The boy then relayed all that he had learned in regards to global warming and how we affect the temperature of the oceans because of excessive power usage and a two degree difference in water temperature can harm the coral. The inquiry place-based lesson inspires vested, empathetic and engaged students to deeply care and act about what they have learned and effect change in others.

The reef tank will continue to provide scientific and educational opportunities. The students will continue to use the reef tank to measure salinity, ph., nitrates, nitrites, ammonia and temperature. If we are lucky, at some point, we hopefully will get to see the coral spawning and watch the cycle of life. In the future I would like to increase the size of the reef tank from the current 50-gallon tank to a 130-gallon reef tank to continue encouraging the students to care about and for the coral reef. An opportunity also exists to promote our work to other schools and educate how they can implement a reef tank in their classroom to inspire their students to care for and about coral reef ecosystems.

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APPENDIX A

Connection to Nature Index (CNI)

Please indicate how much you agree or disagree with each of the following statements, by putting a mark in the relevant box.

Statements:	Strongly Agree	Agree	Neither Agree or disagree	Disagree	Strongly Disagree
I know a lot about coral reefs.					
I like to hear the sound of the ocean.					
I like to see animals interact in the coral reef.					
I feel sad when coral reef animals are hurt.					
I like to see coral reef animals living in a clean environment.					
I would enjoy snorkeling among coral reefs.					
Taking care of coral reef animals are important to me.					
Humans have an effect on the coral reefs.					
People cannot live without coral reefs.					
Watching and taking care of coral reef ecosystems are important to me.					
My actions will make the coral reef ecosystems different.					
Picking up trash on the ground can help coral reef environments.					
People do not have the right to change the natural coral reef environments.					
I need to protect coral reefs.					
I think coral reefs are beautiful.					
When watching a coral reef ecosystem, I feel peaceful.					

Was there anything about this section that you did not understand? Yes ☐ No ☐

Please circle any statements you did not understand.

APPENDIX B

Nature Relatedness short form (NR-6)

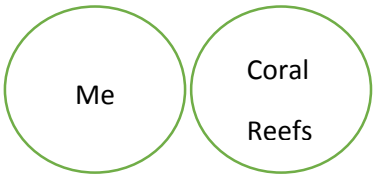
For each of the following, please indicate how much you agree with each statement, using the scale as shown below. Please respond how you really feel, rather than how you think "most people" feel.

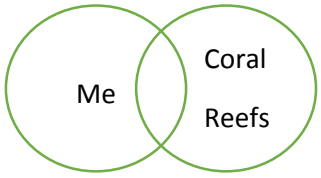
Statements:	Strongly Agree	Agree	Neither Agree or disagree	Disagree	Strongly Disagree
My relationship to the coral reefs are an important part of who I am.					
My favorite place is to watch a coral reef ecosystem interact.					
I think about how my actions can affect the coral reefs.					
My feelings about coral reef systems are a part of who I am.					
I take notice of coral reef animals wherever I am.					
I feel very connected to the coral reefs.					

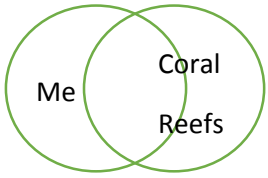
APPENDIX C

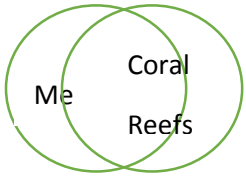
Inclusion of Nature in Self (INS)

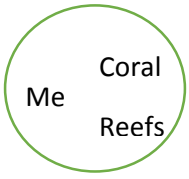
How interconnected are you with coral reefs? Please circle the venn diagram below which best descrbes your relationship with the coral reef environments.











Appendix D

Project Description and Parent/Student Consent Form

September 29, 2014

Dear Central Montessori Academy Upper Elementary families;

Currently I am a Graduate student at Miami University studying Biology with a focus on Conservation Education. I need your help fulfilling an Inquiry Action Project requirement for my master's program. I would like to ask your child questions in regards to how they feel about Coral Reef Systems. I am presenting a traditional classroom lesson and then a guided inquiry based lesson (which is really Montessori) on Coral Reef Systems as well as setting up a reef tank in the classroom. I will be measuring pre and post responses to quantify their empathy and connectedness to coral reef environments despite living far removed from such ecosystems.

Some questions you may have:

- *Do I have to say 'yes' to filling out the questionnaire?*
  No. It is yours and your child's choice. I certainly don't mind if you say no but if you were to change your mind just let me know.

- *How long is the study for?*
  This study will conclude by the end of November 2014.

- *Will I tell anyone what your child said on the questionnaire?*
  No. Your child's identity will be protected and their responses are only for review purposes with my classmates and professors.

- *Can I ask you questions about your research and your course of study?*
  Absolutely, I would love to answer any questions you may have in regards to my studies.

Further information about the study is contained in the attached letter and information sheet for the student and parents/guardians.

- **The attached form must be completed and returned to Mark Traxler in order for the named student to be included in the research stated.**

Thank you for your consideration,

Mark Traxler
Upper Elementary Teacher
Central Montessori Academy
Masters Candidate: Miami University, Oxford, Ohio

- **This form must be completed and returned to Mark Traxler in order for the named student to be included in the research stated.**

Form A to be completed by student:

I agree to take part in the research on Children's Empathetic Responses and Connectedness to Coral Reef Systems and would like to complete a short questionnaire.

I have read and understood the accompanying letter and information sheet. I know what the study is about and how I will be involved. I know that I do not have to answer all of the questions on the questionnaire and that I can decide not to continue at any time.

Name_____

Signature_____Age_____

Form B to be completed by parent/guardian:

I have read and understood the accompanying letter and information sheet and give permissions for my child (named above) to be included.

Name_____

Relationship to child_____

Signature_____Date_____