You Asked About Insects: Development of A Resource Book

YOU ASKED ABOUT INSECTS:

DEVELOPMENT

OF A RESOURCE BOOK

FOR PRIMARY AND JUNIOR GRADES

By

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A Project

Submitted to the School of Graduate Studies

in Partial Fulfillment of the Requirements

for the Degree

Master of Science (Teaching)

McMaster University

MASTER OF SCIENCE (TEACHING) (1997) McMASTER UNIVERSITY

(Biology) Hamilton, Ontario

TITLE: You Asked About Insects: Development of a Resource Book for Primary and Junior Grades.

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NUMBER OF PAGES: vii, 146

ABSTRACT

My experience as a presenter of science workshops to elementary school students and teachers led me to believe that there was a need for a resource book that answered the students questions about insects. My studies of curriculum development and in particular transformational education reinforced my philosophy that the students should have answers to the question that are important to them. My project was to produce and evaluate such a document that would be valuable to students and teachers. Elementary school children were surveyed to gather questions for the book. These questions were compiled, culled, categorized and answered to produce the resource book titled You Asked About Insects.

After a pilot of the evaluation, copies of the book along with evaluation questionnaires for teachers and students were distributed to schools. Response to the student questionnaires was not adequate to draw conclusions. To gather more data, I travelled to a school and worked with the students to evaluate the book.

My data shows that the book was well received by the students and the teachers. Teachers generally found it a good resource that had many answers and much information. It included information for which they previously would have had to refer to many different sources. Students were able to find the answers to the questions that they had about insects. They liked the format and were able to use the table of contents and the index to look up the answers to the questions they had.

ACKNOWLEDGMENTS

I would like to thank Dr. Catherine Beattie and Dr. Pat Chow-Fraser for their support, encouragement and advice during this project. I would especially like to thank them for their patience and understanding as I confronted difficulties and distractions outside of this project. I would also like to thank Dr. Barbara Soren , my instructor for curriculum evaluation. Without the knowledge and skills her course and consultations provided to me I would not have been able to complete the evaluation segment of this project. I would also like to thank the students and teachers who participated in this project; without their questions and evaluations it would not have been possible. And last but not least, I would like to thank my best friend and husband, Peter Johnson, for his encouragement and his faith in me.

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INTRODUCTION

Description and Rationale of Project

Carl Rogers (1969) states that empathy is the teacher's ability to understand the students' perceptions and to convey that understanding. In their discussion of the humanistic psychology of transformation education Miller and Seller (1990) explain that this "means trying to put oneself in the student's shoes" or "being aware of the child's perspective" (p.128). It is exactly that philosophy that led me to my approach to creating a resource book on insects. Of the three major curriculum orientations that educators adhere to, the transformation orientation best fits my philosophy of curriculum development. The transmission orientation focuses on transmitting facts, skills and values and stresses mastery and rote learning. Although the transaction orientation sees individuals as rational and capable problem solvers and strives to develop student's intellectual abilities it does not see the role of the student in curriculum development and change to be as significant as does the transformation orientation. In the transformation orientation "the curriculum and the student are seen to interpenetrate each other in a holistic manner "(Miller and Seller, 1990, p.167). It is felt that students should have as much control as possible over their own learning. If the subject matter relates to the students' interests and concerns it will foster intrinsic motivation in the students. By soliciting questions and concerns from the students I wished to foster their intrinsic motivation when studying insects.

For the past six years I ran my own business under the name of "Science is Alive." I visited elementary schools in Ontario and presented science workshops to students. My presentations included "Discover Dinosaurs" and the "Intriguing World of Insects." Both are hands-on workshops that included discussions of "observe and record" as the basis of all science, a background in the topic, and hands-on study stations including artifacts and specimens. I spent a great proportion of my time dealing with primary and junior students. As a result, I became aware of the lack of science training in the primary level teachers. Most primary teachers have a B.A. with little exposure to science, yet they are expected to instill an interest in science in their students, and teach a number of scientific principles.

On occasion I have been given the opportunity to address primary school teachers who are taking the Ministry of Education science upgrading course. These teachers were eager to learn about science and were hungry for ideas, activities, and resources to take back to the classroom. Along with many who have been exposed to my insect program they have asked for a single reference work where they can access the information that I have covered in my program. I have drawn on many years of training and experience as an entomologist to develop this program. Unfortunately, I cannot lead them to any one resource book about insects that would be appropriate to their students. Also many questions that students asked require a broad knowledge to even decide where to look for the answer.

Fortunately, I have found an impressive book on dinosaurs to recommend to teachers and students. This book, The Dinosaur Question and Answer Book, (Funston,

1992) produced in cooperation with Owl Magazine and the Dinosaur Project is valuable not only for its information but also for its approach to selecting and presenting the questions to be included. Owl magazine solicited questions from readers, had the most common and most unusual questions answered by paleontologist and then simplified by a children's writer. The questions and their answers are presented in logical scientific categories and the book is indexed. The object of my project was to develop a similar easy to use resource book on insects. It was obvious from my experience that there was a real niche that needed to be filled.

Elementary schools children across southern Ontario were surveyed to gather questions about insects for the resource book. These questions were compiled, culled, categorized and answered to produce the resource book. The book was designed to conform to the design of scientific references. It was divided into logical scientific categories so that students looking for one question would find related information on the same and neighbouring pages. A good science resource book should, besides transmitting information, also teach problem solving skills and help to develop research skills in the students. Information needed to be easy to find by more than one method. Therefore, the book would need to have a table of contents to guide the reader to general topics, and an index to access more specific information. Language in both the questions and answers would need to be appropriate for the target audience of primary and junior students. Keeping these principles in mind I set out to produce a resource book that would address the students' questions about insects.

PART I: DEVELOPING THE RESOURCE BOOK

I a.) Gathering and Selecting the Questions

To prepare this resource book I did not rely just on my expertise in entomology; I also turned to the students and teachers of many Ontario elementary schools. Readings in transformation education reinforced my feeling that I should consider the questions and concerns of the students. To put myself in the students' shoes I solicited questions and concerns from the elementary and junior students to decide what to include in this book. After compiling these questions I wrote a book titled You Asked About Insects that addresses the most common and most unusual questions. This resource book is the major accomplishment of my project. To determine whether it met certain criteria and to gather suggestions for changes and improvements, I evaluated the book as it was used in the hands of many students and teachers, some who submitted questions and some who did not.

To gather questions for the book I solicited the participation of 100 primary and junior classes in Southern Ontario. After careful consideration I decided only to send requests for questions to schools that had previously experienced my "Science is Alive" program, and teachers who had attended a "Science is Alive" seminar. I felt that I would get a higher rate of response from teachers who had previously shown an interest in the sciences. A package consisting of an introductory letter, questionnaire about the class and

teacher, and suggestions on how to collect the questions were mailed to the teachers of one class per school. Copies of these documents are found in appendix A. Out of the one hundred schools I received responses from 20 schools. Many of the schools that responded included more than one class in the question gathering; a total of 44 classes responded to the call for questions. The total number of students that participated was 1151. A summary of the classes and the grades can be found in appendix B. Some classes submitted individual questions while others submitted a class list. Some classes submitted as few as 12 questions while others sent in almost 90. In all 1047 questions were submitted, an average of nearly one per student. Questions about topics other than insects were discarded, in total 61 questions were discarded leaving 986 questions. Since many questions were repeated the list of distinct questions was actually 396. These questions are listed in appendix C.

These 396 questions were then organized into categories that would make up the topic headings of the book. From these questions I chose 175 to answer in the book. The criteria varied for choosing different questions. Some were chosen because they were asked frequently, others because they were unique or interesting, and many were chosen because the answer to several questions could be part of their answer. The result was a broad spectrum of questions that satisfactorily provided an overview of insects. As a scientist my tendency would be to cover a topic thoroughly so I was pleased to see that the children's curiosity naturally led them to consider a broad range of aspects of the insect world. It might occur to some that if the students questions covered the broad range

of topics I had hoped for was it necessary to survey the students in the first place. Although the questions spanned the range that I hoped for the questions themselves were not what I would have compiled on my own. The students' questions brought a new perspective to the topic of insect and they were presented in the language that the students use.

The grammar and creative spelling were corrected for all questions but I attempted to retain the language that was used by the students. Although it was tempting to convert words like "tinkle" into the more scientific form of urinate, I resisted the temptation. Instead I used the proper terminology in the answer. This way students would find the question in the language they were familiar with, but would be introduced to the correct terminology in the answer.

I b.) Writing the Resource Book

Many hours were spent answering the questions and verifying the answers. I specialized in entomology in my undergraduate degree and was able to rely on general knowledge and familiar references for most of the answers. For some questions I turned to colleagues for clarification and verification.

In preparing the book I imposed several other criteria on its production in addition to answering the questions of the students. Firstly, I felt strongly that this reference although aimed at young students should conform to certain criteria of adult references. Therefore, I categorized the questions into topics that made scientific sense, and included

a table of contents and most importantly an index. Everyone who uses a reference book understands the value of an index. In conversation with school librarians and resource teachers I was informed that many of them will not purchase a children's reference book unless it includes an index. This reinforced my strong sense of the importance of an index. In addition to having a table of contents I indexed topics, types of insects and key words.

Secondly, I thought it was important for students to be able to find their answers by employing different methods or a combination of them. Besides increasing the interest factor, pictures were included to provide an alternate method for students to find a topic. I felt to make the book interesting and easy to understand it had to include pictures. Many pictures and diagrams were hand drawn. I also drew on a wonderful resource of pictures, Animals: 1419 copyright-free illustrations (Harter,1979). Pictures were used to help illustrate answers and to give visual clues to students as they used the book. One hundred and four illustrations were included. To aid students in their search for answers I cross referenced some answers with "see more about..." notes. For example the explanation of butterfly wings on page 18 includes a note to see more about butterfly wings on page 29. This was intended to be especially useful to students who where looking for answers by visual clues. A student looking for information on legs may look legs up in the index, the table of contents, or look for a topic heading, or may just browse through the book looking for pictures of legs. Considering that primary students may not have developed the skills to look topics up in the index I felt pictures would play an important role in how students accessed the information.

Thirdly, but not of lesser importance, I wanted this resource to fill some of the criteria set out in The Common Curriculum (Ontario Ministry of Education and Training, 1993). The science component of this integrated curriculum aims to "foster in students an understanding of the world around them and the importance of protecting the environment." One of the general outcomes states that students will "show concern for living things and ecosystems, and be motivated to protect the environment." A better understanding of insects will lead to more concern for them and other living creatures. Another important outcome included in the area of Inquiry, Reasoning, and Reporting requires that students will "be motivated to ask questions, and know how to look for answers and talk about their findings." The question and answer format of the book was designed to encourage students to ask questions and be able to employ several methods to find the answers.

When formatting the book I considered Rogers' (1972) belief that there are two possible aims for education: to transmit stored knowledge and to nurture the process of discovery. Rogers describes these as two separate ventures. I believe that a well designed resource book can, not only transmit information on to the student, but can foster the process of discovery. Students that can discover the answers to their own questions may thereby be encouraged to explore further into a topic. Therefore, I felt it was important to format the book in a student friendly manner and to include as many as possible ways to find the answers. Once I was satisfied with the book and its contents, copies were printed and bound ready to be shipped out to the schools for evaluation.

PART II: THE RESOURCE BOOK

II a.) Introduction

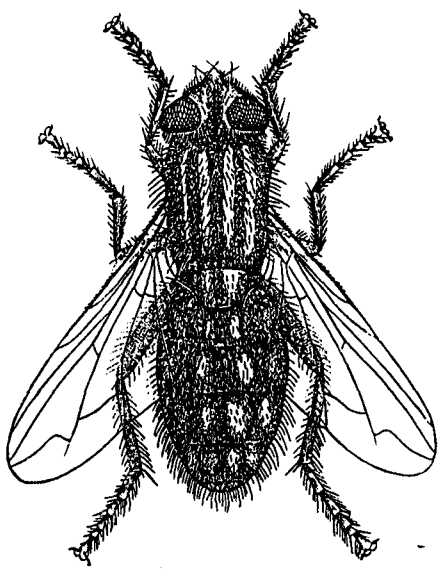
Following is a copy of the resource book You Asked About Insects. The production of this book was the major accomplishment of this project. As presented here, it has been reduced in size to fit the formatting guidelines of this report. Although it appears here as single side pages, the book as it was presented for evaluation was printed on double sided pages allowing for two page sections to be presented on facing pages. Original page numbers have been retained on the bottom center as they are referred to in the table of contents and index.

To develop a true appreciation for the book I would suggest not just reading the book but also trying to use it as a reference. By looking up your questions about insects you will be presented with the opportunity to use all the possible methods of retrieving information.

II b.) You Asked About Insects

You Asked About

INSECTS



by Margaret Pickles

You Asked About

INSECTS

A question and answer book

by Margaret Pickles

Completed as a part of a
Master of Science (Teaching)
project; McMaster University

About the Book

This book is intended to answer the questions and concerns that primary and junior students have about insects. Many primary and junior classes were asked; "If you could ask an expert one question about insects what would it be?" This resulted in over 1000 responses. From those responses, 186 of the most popular and most interesting questions were selected and answered in this book. The material is in question and answer format to make it easier for students and teachers to find their specific questions. I hope you find the answers to many of your questions.

How to find a question?

The questions are ordered into categories that cover a wide range of topics. In order to find your question you could browse for the right topic, use the table of contents, or the index. For example if your question is "Why don't caterpillars have wings?", you could browse through the book to find the section on wings or you could look in the table of contents for "wings". If you look for wings in the index you will find "wings 4, 5, 6, 18-19, 21", one of these pages will have the answer. If you look under caterpillars you would find "caterpillars 14, 17, 19, 39, 40." You will notice that page 19 has both wings and caterpillars, so that is the best place to look.

To the Teachers

For Primary division teachers this book will best serve as a resource for you to look up answers to your students questions. Students in the junior division should be able to read and use this resource on their own. There is a comprehensive index to help readers find subjects.

Evaluation

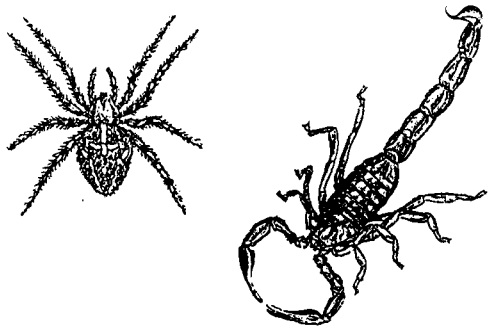
This book and its evaluation is being undertaken as partial requirement of a Master of Science and Teaching degree. Evaluation instructions and questionnaires have been included with this book. Filling in these forms will help me assess whether the question and answer format is effective and if this book was useful in your insect study unit.

CONTENTS

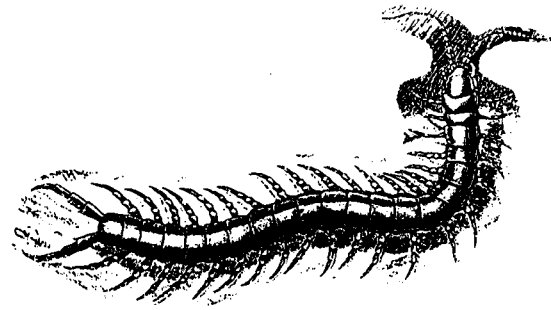
INSECTS AND THEIR RELATIVES: ARTHROPODS

Do insects have cousins?
Insects belong to a group of animals called ARTHROPODS. Arthropods are animals that have an exoskeleton (a hard outer shell that covers the whole body) and jointed appendages. All the other arthropods are closely related to insects.

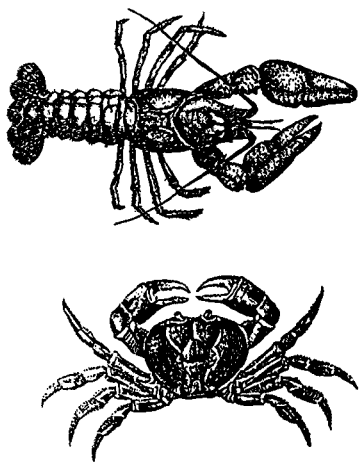
These animals are arthropods:



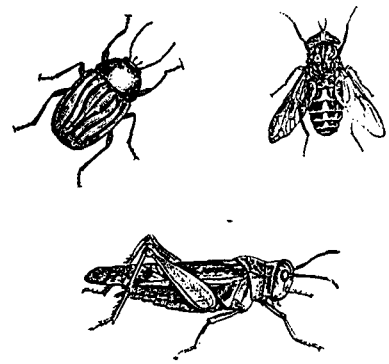
Spiders, mites, and scorpions (Arachnids) have 8 legs and 2 body parts.



Centipedes and millipedes (Myriapods) have 30 to 700 legs, many body parts,and 2 antennae.

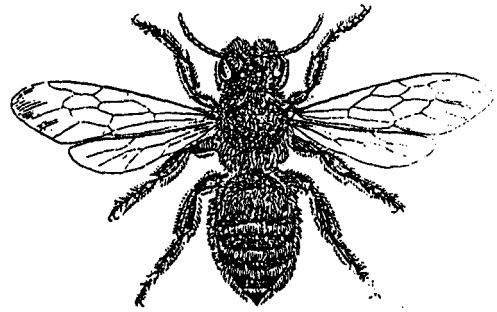


Lobsters, crabs, shrimps and sowbugs (Crustaceans) have 10 to 16 legs, 2 body parts, and 2 antennae.

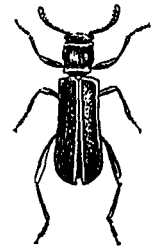


Insects have 6 legs, 3 body parts, 2 antennae, and wings.

What do all insects have in common?
Like all the other arthropods, insects have an exoskeleton, and jointed appendages. They are different from other arthropods because they have 6 legs, three body parts, 2 antennae, and wings.
(See more about parts of an insect on page 6 .)



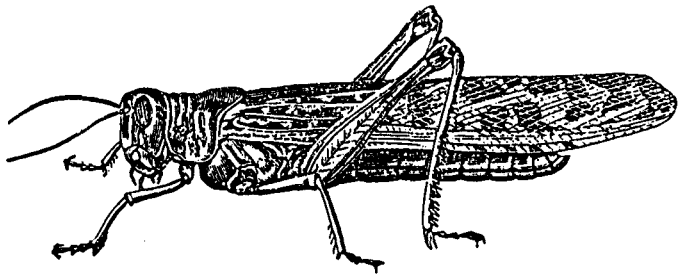
Why is a spider not an insect?
Can you guess?
Insects and spiders are both arthropods, but insects have 6 legs and spiders have 8 legs. Also insects have 3 body parts, spiders have only 2 body parts.



What are bugs?
Some people call insects "bugs"; but bug is a word that is used to describe insects, spiders and mites. In the 17th century people called ghost and hobgoblins "bugs". Since lice and fleas were unpleasant and hard to see they called them "bugs" too.
Scientist call the group of insects, that include stink bugs and leafhoppers, the "true bugs".

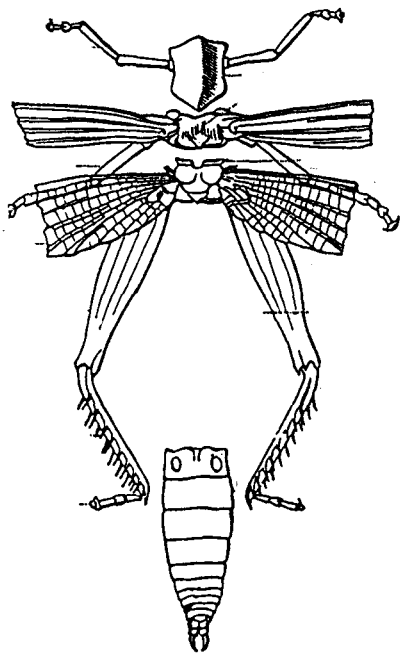
PARTS OF AN INSECT

What makes an insect an insect?



All insects have:

3 body parts
(Head, Thorax, and Abdomen),
6 legs 2 antennae
compound eyes
Most insects have wings.

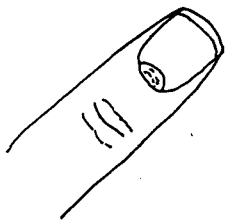


Head
The head is the front body part.
The head has compound eyes,
a mouth, and 2 antennae.

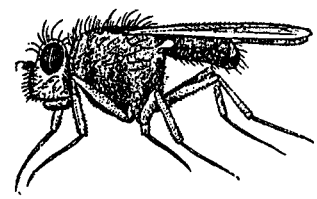
Thorax
The thorax is the middle body part.
The thorax has three sections called segments. The first segment has a pair of legs, the second and third segments each have a pair of legs and a pair of wings.

Abdomen
The abdomen is the last body part.
The abdomen has many segments. It contains most of the body systems:
the digestive, circulatory,
respiratory and reproductive systems.
You could say it has all the "guts".

Do insects have skeletons on the outside of their bodies?
Yes, all insects have skeletons on the outside of their body called an exoskeleton. They do not have bones on the inside. This hard shell covers all parts of the body including the legs, the eyes, the mouth, the antennae, and the breathing tubes.



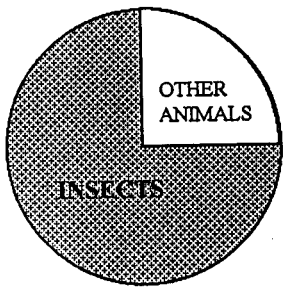
What is their shell made of?
The exoskeleton is made of a substance called chitin. It is similar to our fingernails.



Do insects have hair?
Yes, all insects have some hairs. Some insects, like bees, have so many hairs they are fuzzy. Insect hairs do not grow like human hair!

What do insects feel like?
Since insects have a hard shell they feel smooth, dry and hard. They are not slimy!

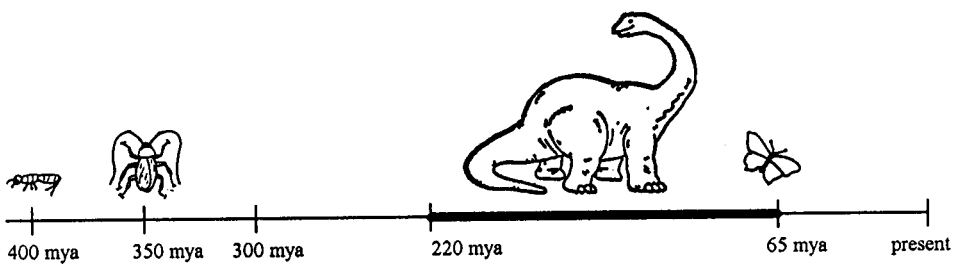
MORE ABOUT INSECTS



How many kinds of insects are there in the world?
There are more kinds of insects in the world than all the other animals added together. More than 3/4 of all known animals are insects. More than a million kinds of insects have been discovered. Scientists think that there are millions more that have not been discovered.

How long have insects been on the earth?
Insects have been around for a very long time. Cockroaches were around 350 million years ago.

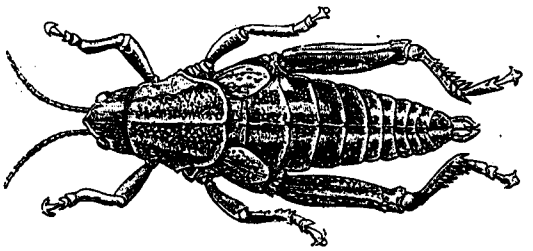
What was the first insect on the earth?
A tiny insect called the springtail was around almost 400 million years ago.



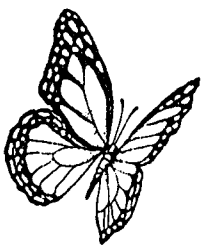
Were there insects at the time of the dinosaurs?
Yes, there were lots of insects at the time of the dinosaurs, but not all of the same ones as are here now. Cockroaches were around before the dinosaurs, but butterflies did not develop until near the end of the dinosaur times.

Are there still insects living from the dinosaur times?
Not all insects that are on the earth now were around at the time of the dinosaurs, but most that were are still here now. Some of the insects that were around during that time were cockroaches, springtails, earwigs, beetles, caddisflies, dragonflies, mayflies, aphids, and true bugs.

What does the word insect mean? And why are insects called insects?
Insect comes from a Latin word "insectus" which means having the body divided into segments. Since insects have bodies that are divided into segments this is a suitable name.



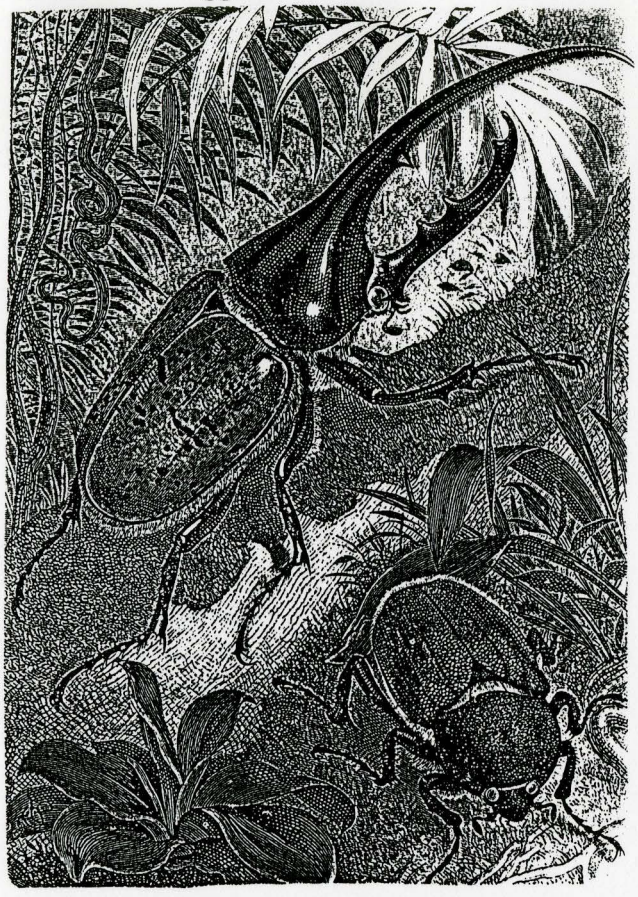
Why do insects have names?
Names are an easy way to describe things. It is easier to say a "honey bee", than the "insect that is about 1.5 cm long with a fuzzy yellow and black body, that buzzes and can sting, and makes honey". Insect names also describe in which group of insect they belong.



Why do insects have scientific names?
Like all plants and animals insects have two part scientific names like *Danaus plexippus*. That is the Monarch butterfly to us, but in Australia they call it the Wanderer. No matter what country a scientist comes from or what language they speak the scientific names are always the same. If we use scientific names we can be sure we are talking about the same insect.

THE -EST INSECTS: biggest, smallest...

What is the biggest insect?

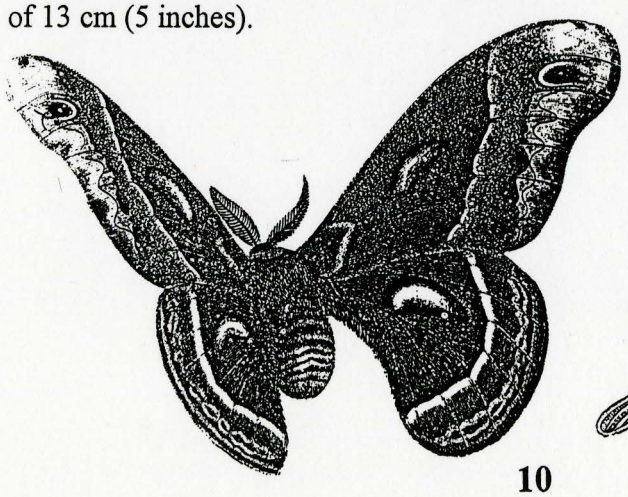


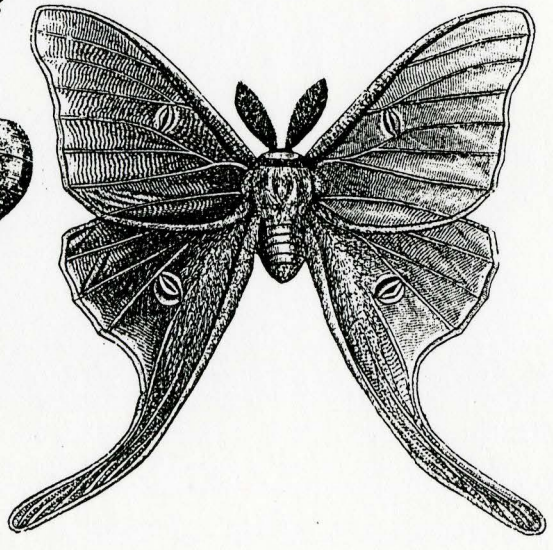
The Hercules beetles in South America and the Goliath beetle found in Africa can be up to 15 cm (6 inches) long and can weigh up to 30 grams. That is bigger than the average mouse.

The Giant Stick Insect of Indonesia can grow to be 33 cm (13 inches) long and twice as thick as a pencil.

The insect with the biggest wing span (13 inches) is the Owlet moth of South America.

What is the largest insect in North America?
The largest moths in NA are the Luna and Cecropia moths. They both have wingspans of 13 cm (5 inches).

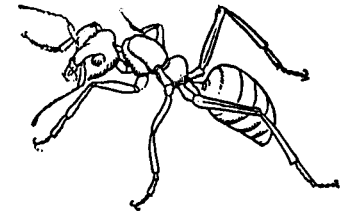


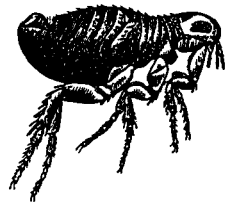


What is the largest insect that ever lived?
The largest known insect lived 310-290 million years ago, before the dinosaurs were on the earth. Its name was Meganeura monyi and it looked like a large dragonfly. Its wingspan was 90 cm (35 inches).

What is the smallest insect?
There are a group of wasps called microhymenoptera (that means tiny wasps) that are about 0.25 mm long and weigh about 1 microgram. That means it would take 500 million tiny wasps to make a half a gram.

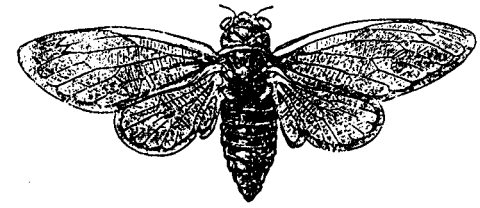
What is the strongest insect?
Ants can lift up to 50X their own weight.





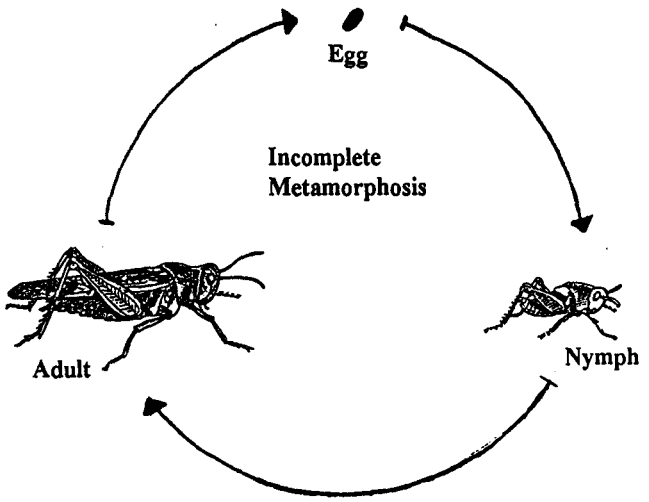
What is the best jumper?
Compared to its size the flea is the best jumper. It is only about 2mm long and it can jump 20 cm. That is 100 times it own length. That would be like you jumping over a very tall apartment building.

Which insect lives the longest?
Some queen ants live up to 17 years. Some termite queens live from 10 to12 years. The 17 year cicada lives in the ground as a nymph for 17 years before it finally emerges as an adult.

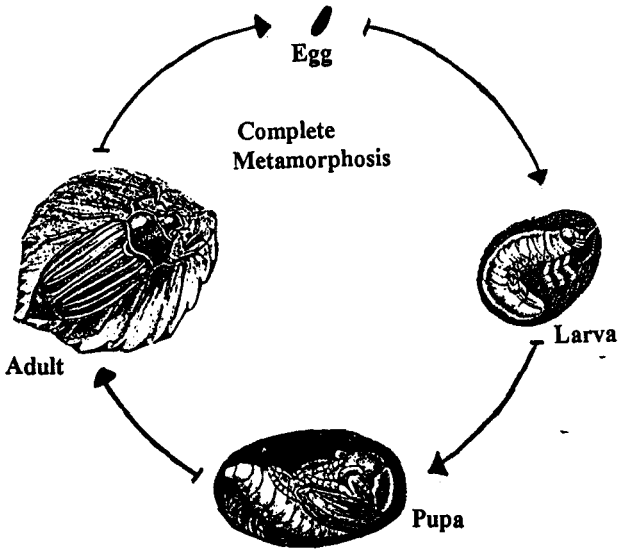


LIFE CYCLES (GROWING UP)

How do insects grow?
Insect go through one of two kinds of metamorphosis.
Metamorphosis means change in body form and appearance.



Incomplete metamorphosis means a life cycle that has only 3 stages:
an egg, a nymph, and the adult. The nymph looks like a small wingless adult.
True bugs, grasshoppers, cockroaches, mantids, crickets, termites, mayflies, earwigs, and dragonflies all undergo incomplete metamorphosis.



Complete metamorphosis means a life cycle that has 4 distinct stages:
an egg, a larva, a pupa, and the adult.
Butterflies, moths, flies, fleas, beetles, wasps, bees, ants, and caddisflies all undergo complete metamorphosis.

Where do insects lay their eggs?
Different insects lay their eggs in different places. Butterflies lay their eggs on the leaves of the plants the caterpillars will eat. Dragonflies lay their eggs in the water. Mosquitoes make rafts of eggs that float on the water. Woodboring beetles lay their eggs under the bark. Parasitic wasps lay their eggs inside the larvae or eggs of other insects.

How long are insects in the egg stage?
That depends on the insect. The average is about a week, but some fly eggs hatch in hours. A few insects overwinter in the egg stage so they are in the eggs for months.

How many eggs does an insect lay?
Some very large insects lay only a few eggs, but house flies lay hundreds of eggs. A female mosquito may lay as many as 400 eggs. A queen ant or termite may lay thousands of eggs during its long life time.

Why do insects lay so many eggs?
Lots of things can happen to insect eggs to stop them from hatching. If it is too hot, or too cold , or too wet, or too dry they will not hatch. They might get eaten or stepped on, so not many hatch. The ones that hatch do not all survive to be adults. So laying a lot of eggs means that a few will survive and grow up.

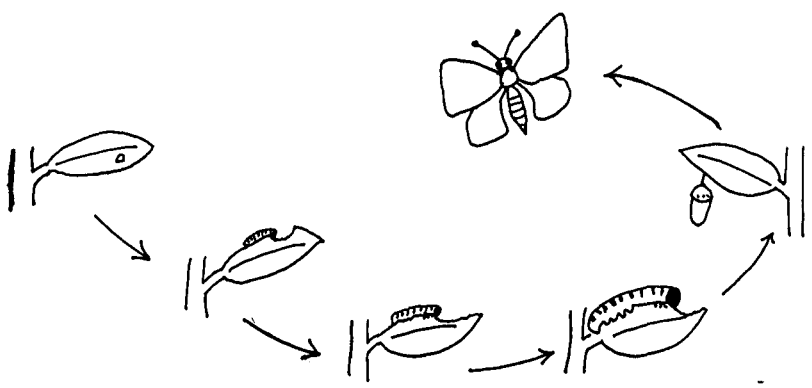
What would happen if all of the eggs hatched and survived to be adults?
Imagine that a single pair of house flies mated in the spring, laid eggs, and all the eggs hatched and grew to adults, and they all hatched and survived and so on, through the whole summer. By the end of the summer there would be 190,000,000,000,000,000,000 house flies flying around. If they all landed they would cover the earth about 14 m (47 feet) deep!

MORE ABOUT GROWING UP

Do most bugs hatch from eggs or are some live born?
Almost all insects hatch from eggs. A very few are born as larvae or nymphs. The tsetse fly of Africa is born as a larvae that is almost ready to pupate. Aphids that we can find on plants in our gardens have live babies, too.

Why do insects shed their skin?
Insects have a hard "skin" or shell called an exoskeleton (see page 7). Insects have to shed their skin to grow, since the exoskeleton does not grow. When an insect sheds its skin, it has a new larger and softer skin underneath. The insect fills the new skin with air to make it bigger, when it dries it is hard and the insect has room to grow.

What do caterpillars do?
Caterpillars eat and grow. Caterpillars like other larvae and nymphs are the growing stage of the insect. Once an insect is an adult it does not shed its skin any more, so it cannot grow.



How do caterpillars change into butterflies?
Caterpillars change into butterflies while they are in the resting stage called the pupa. While in the pupa the cells rearrange and some new parts, like wings, are formed. Scientists are not really sure how all the changes take place.

How do caterpillars make their cocoons?
Caterpillars make silk with a gland by their mouth. They wrap this silk around and around themselves to make a covering called the cocoon. Some kinds of caterpillars make the job easier by using leaves as well as silk.

What are cocoons made of?
Cocoons are made of silk that the caterpillar produces. Some cocoons are made of leaves or twigs that are held together with silk.

How long are caterpillars in their cocoon?
Caterpillars that make cocoons turn into moths. Most of these cocoons are the overwintering stage, so they may be cocoons for 7 or 8 months.

How long are caterpillars in the chrysalis stage?
Caterpillars that make a chrysalis turn into butterflies. They usually develop and emerge into the butterfly in about two weeks.

How can you tell girl and boy insect apart?
Scientists call girls females, and boys males. For some insects the males and females look very different; the male Hercules beetle has horns, the male moth has large feathery antennas, but you have to look very closely to see the difference with most insects. You can only tell the difference with some insects if you look inside.

Can lady bugs be men?
Yes, lady bugs, like all insects can be males or females. The name is a bit confusing.

Can you tell how old an insect is?
If an insect is an immature we can guess at its age by its size and development, but once it is an adult it does not change in appearance as it gets older.

Do insects die?
Yes just like all living things, insects die.

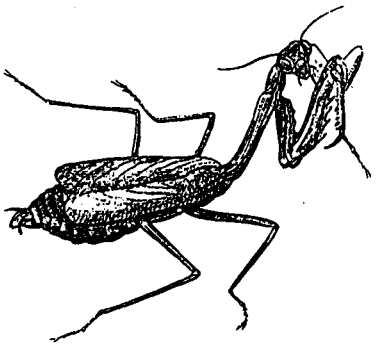
INSECTS HAVE SIX LEGS

How many legs do insects have?
All insects have 6 legs.

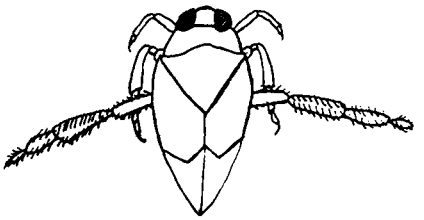
Are all insects legs alike?
Insect legs are not all alike. Different kinds of insects have legs that are modified for the way that they live.

Walking and running: Insects that walk or run have long legs like this ant.

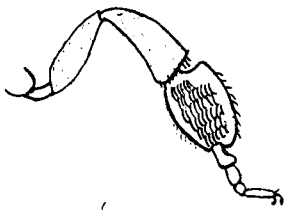
Jumping: Insects that jump have large strong hind legs like this grasshopper.



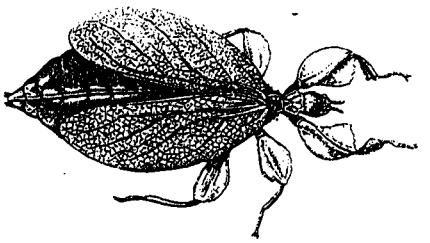
Grasping: Some insects that are hunters have large spiny front legs for catching and holding their food, like this praying mantis.



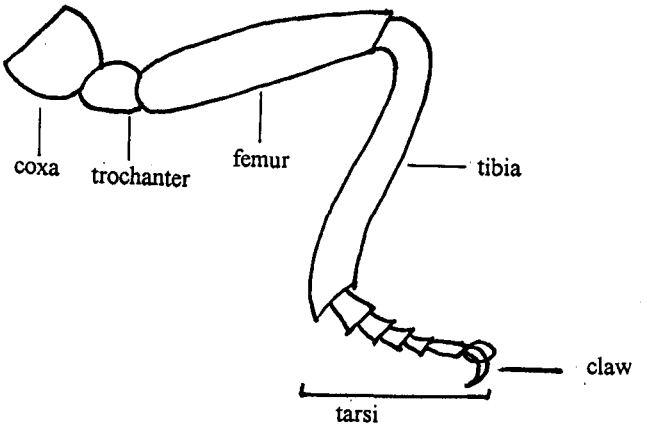
Swimming: Insects that swim have large flat paddle-like back legs like this backswimmer.



Gathering: Honey bees have legs with hairy baskets for collecting pollen.



Camouflage: This leaf insect can hide in the trees because it has legs and wings that look like leaves.



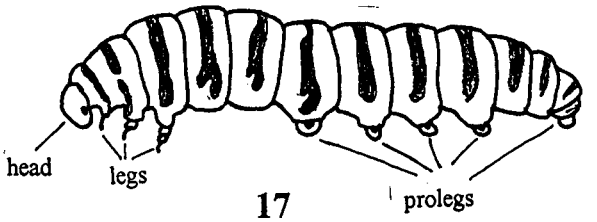
Do insects have feet?
At the end of the leg are a few segments that touch the ground when they walk or stand, like our foot. These segments are called the tarsi.

Do some insects have claws?
Yes, some insects have claws on their tarsi. Insects that need to grasp their prey may have large claws on their front legs.

Do all insects have spines on their legs?
No, only some insects have spines on their legs. The spines are used to protect them from their enemies.

How do insects climb up a wall, window, or ceiling?
The little claws on the insect tarsi help them hang onto the surface of walls and ceilings. To hang onto windows some insects have hairs on their feet and others even secrete a sticky fluid.

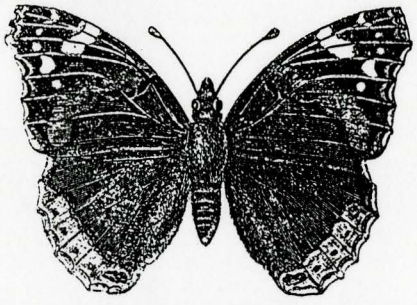
Why do caterpillars have so many legs?
If you look closely you will see that a caterpillar only has six legs like all insects. The six real legs are just behind the head. It also has as many as 10 prolegs that look like short fat legs. These prolegs are used to hold on the edge of the leaf.



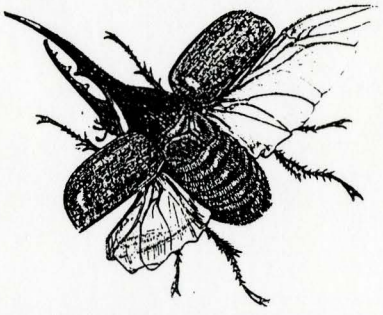
INSECTS HAVE WINGS

Do all insects have wings?
Almost all insects have wings in the adult form. Most insects have two or four wings. Insects were the first animals to fly. Only insects, birds, and bats can fly.

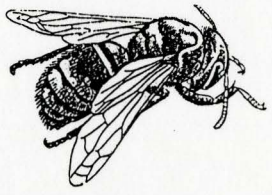
Are all insect wings alike?
No they are very different. We use insect wings to tell what group insects belong in. The colours and veins on some insect wings tell us what family they belong to.



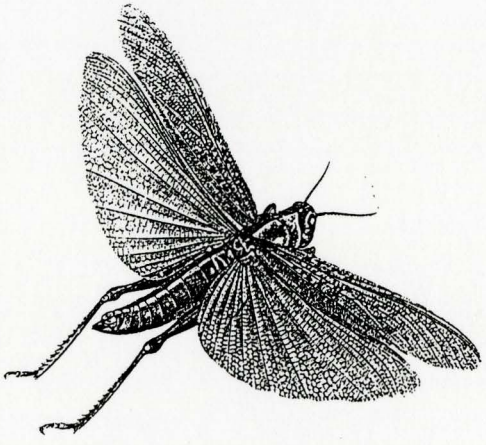
Butterflies have 4 wings.
Their wings are covered in rows of colourful shingle-like scales.
(See more about butterfly wings on page 29.)



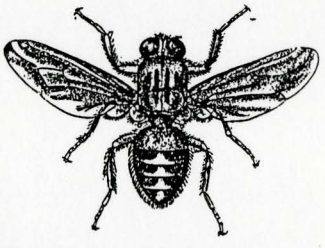
Beetles have 4 wings.
The front wings form a hard cover for the membranous hind wings.



Wasps have 4 wings.
Each pair of wings is held together by a row of hooks.



Grasshoppers have 4 wings.
The thin hind wings are folded under the tough front wings when at rest.

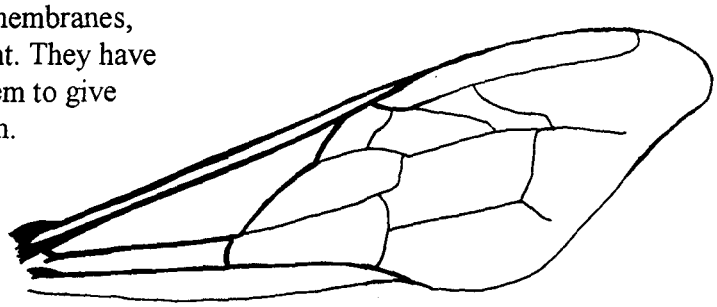


Flies have only 2 wings.
The second pair of wings are reduced to tiny halteres.

Do all insects fly?
Since most insects have wings, most can fly. Some are better flyers than others.

Why do insects fly?
Insects fly to escape from enemies, move to a new food source, and to find a mate.

What are insect wings made of?
Wings are made of thin membranes, this makes them very light. They have veins running through them to give them support and strength.



honeybee wing

Why don't caterpillars have wings?
Caterpillars do not have wings because they are not the adult stage. When the caterpillar turns into a butterfly (the adult stage) it has wings.

Why do some ants have wings?
When it is the time of year to mate the ants that are emerging from the pupae stage will have wings. These ants fly from the colony, mate, shed their wings and start an new colony. They need to fly to find a mate and to start a colony that is not too close to the original colony.

Do ladybugs have wings under their shell?
Yes, ladybugs and other beetles have wings folded neatly under their shell. The thin wings are protected by the hard wing covers (elytra) that are part of the shell.

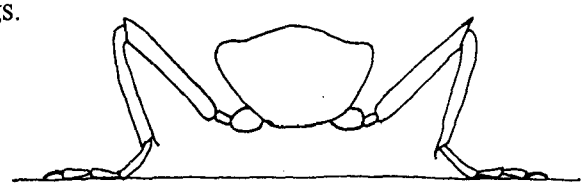
How does a bee buzz?
The buzzing of a bee is the sound of its wings moving very fast. Flies and mosquitoes buzz this way, too. The faster the wings flap the higher the pitch of the buzzing sound. Honeybee wings beat at 225 beats per second, houseflies at 200, and mosquitoes at 600.

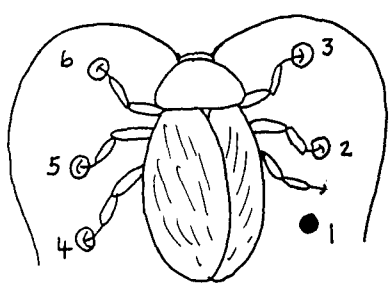
LOCOMOTION

How do insects move around?
Insects get around by walking, running, jumping, flying or swimming.

How do insects walk?
It must be hard not to trip when you have six legs but I have never seen an insect trip.

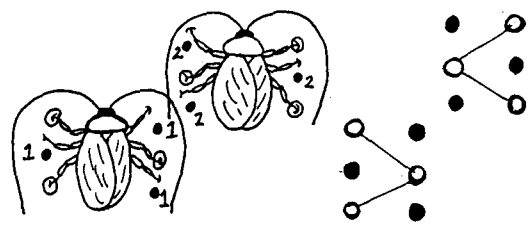
The body is held off the ground by the legs. The leg on one side of the body is never raised unless the leg on the other side is on the ground.



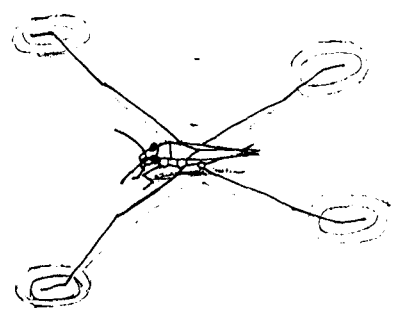


All insects move their legs in a definite sequence, so that no leg is raised off the ground until the leg behind it is firmly on the ground. When an insect walks slowly it only has one leg off the ground at a time; all the right legs then all the left legs.

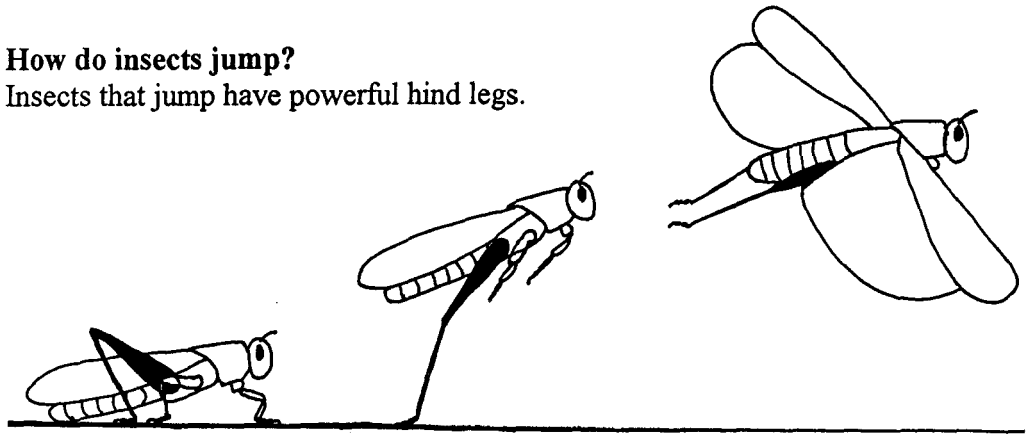
When an insect runs it has three legs on the ground at once. Because the legs form a triangle the insect does not fall over.



How do bugs walk on water?
A leaf can float because its small weight is spread over a large area. Insects that walk on water also spread their small weight over a large surface by spreading out their long legs. Because water molecules are attracted to each other water has an elastic film on the surface that will support some weight, this is called surface tension. Water striders have no claws on their feet so they will not break through the surface tension. They also have hairy tufts on their feet that spread the weight around like snowshoes.



How do insects jump?
Insects that jump have powerful hind legs.



Before an insect jumps it raises the front part of its body with its front legs.

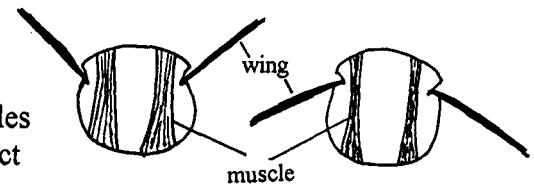
The folded hind legs are then extended by the powerful muscles and the body is pushed into the air.

Some insect then extend their wings so they can glide down.

Do all insects jump?
No, insects need strong hind legs to jump. If an insects has big hindlegs, like a grasshopper or flea, it is probably a good jumper.

How far can insects jump?
A flea can jump 20cm which is 100 times its own length. A cricket can jump 20 times its length. Grasshoppers can cover more ground in a jump but they use their wings to help them.

How do insect wings work?
Muscles in the insects thorax move the wings up and down; this flapping motion gives the wings lift. The muscles can also tilt the wings to help the insect maneuver.
(See more about wings on page 18.)



How far can insects fly?
Most insects do not fly far from where they live, but some do travel from one place to another looking for food or a mate. Dragonflies often fly from one pond to another. The champion distance flyer is the Monarch Butterfly that flies 3000 km to overwinter in Mexico.

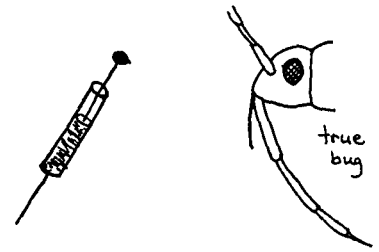
How fast can insects fly?
Dragonflies are the fastest insect flyers; they reach speeds of 25-50 km/hr. Bumblebees and honeybee fly at 7-11 km/hr, medium size butterflies at 7-14 km/hr, houseflies at 7 km/hr, and mosquitoes at less than 2 km/hr.

MANY KINDS OF MOUTHS

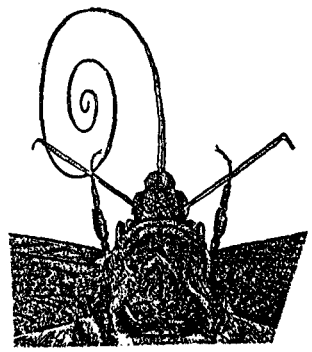
Do insects have mouths?
Yes, insect have mouths where food enters the body, but insects have many different kinds of mouthparts.

Are all mouths alike?
Each kind of insect has mouthparts that are modified for the way it feeds and the kind of food it eats.

Chewing: Ants, beetles, and grasshoppers all have chewing mouthparts. They have jaws that can cut like pliers. Chewing mouthparts are found on plant eaters and hunters.



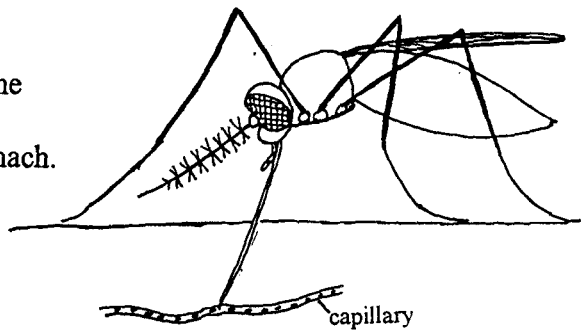
Piercing: Mosquitoes and the true bugs have mouthparts that can pierce and suck up fluids like a syringe. Some insects suck juices out of plants with their piercing mouthparts.



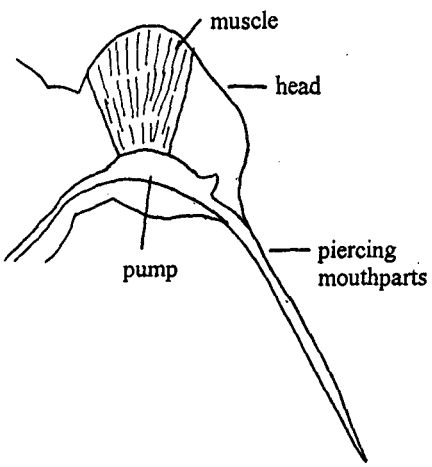
Sucking: Butterflies and moths have long tubes for mouthparts. They use them like a straw to suck up the nectar. When they are not feeding the tube is coiled neatly under their head.

Sponging: Some flies have mouthparts with a large tip. This tip can soak up liquids like a sponge soaks up water.

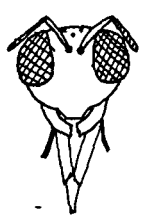
How do mosquitoes bite?
Mosquito mouthparts are like a fine needle. The mosquito pushes it into the flesh until it hits a capillary. The mosquito then injects some saliva which stops the blood from clotting and also stops the bite from hurting. The mosquito then sucks the blood through the needle like mouthparts into its stomach.



How do mosquitoes bite through people's clothing?
Mosquito mouthparts are very fine so they can pass through cloth just like a needle.



How do mosquitoes suck blood?
Mosquitoes and other insect suck up their food through piercing and sucking mouthparts. They have a little muscular pump in their head to help draw the fluid up the tube.

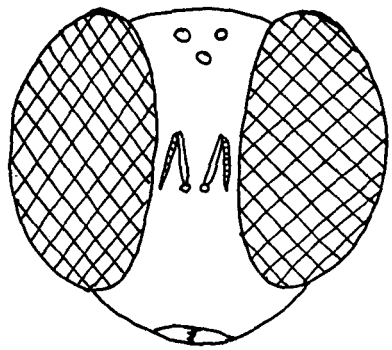


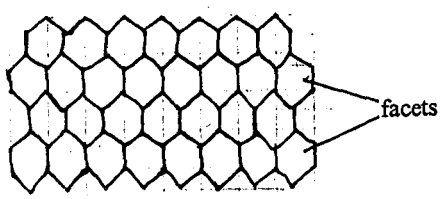
Do insects have teeth?
No, insects do not have teeth inside their mouth like we do, but some do have strong chewing mouthparts.

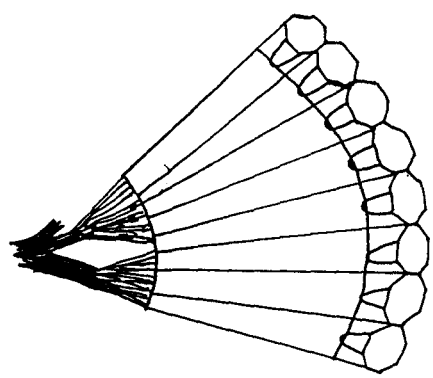
How do bees drink and eat?
Bees have separate mouthparts for drinking and eating. They have chewing mouthparts for eating pollen, and sucking mouthparts for drinking up the nectar from flowers.

THE COMPOUND EYE

What do insect eyes look like?
Insects eyes are not like ours, they have a hard covering on the outside, and they do not move around. Insects eyes are usually pretty big, and if you look closely you can see that they are made up of many little parts.





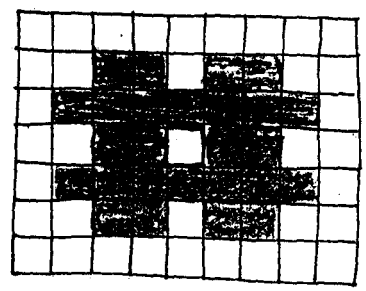


Do insects have eyes in their eyes?
Insects have compound eyes. Compound eyes are made up of many small eyes or facets. You can see the many facets in the eye of the insect.

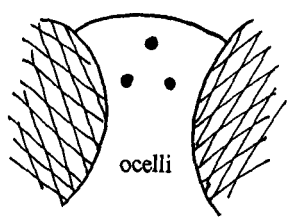
How many little eyes are there in a compound eye?
That depends on the kind of insect, it can be as many as a few thousand. The more little eyes in the compound eye the better the insect can see. Insects that are good hunters usually have big eyes.

Why do insects have such big eyes?
Big rounded eyes help insects to see in almost every direction at once.

How do compound eyes work?
Each facet sends a message to the brain so the picture made by the compound eye looks like a mosaic, or many little pictures put together. It is hard for an insect to see something that is still, but it can see motion.

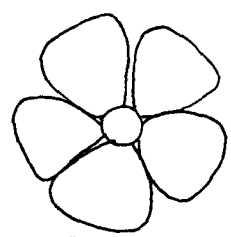


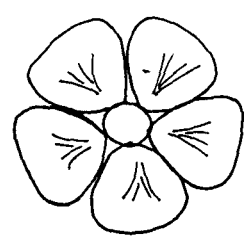
Do insects have simple eyes, too?
Some insects have simple eyes (ocelli) that are just sensitive to light.



How do bees find flowers?
Insects can see colours. Bees are attracted to the colours of the flowers. Bees do not see all colours the same as we do; but we can see colours the ways bees do by looking through special filters. When we look through these "bee eyes" we can see that some flowers have patterns that direct the bee to the nectar.

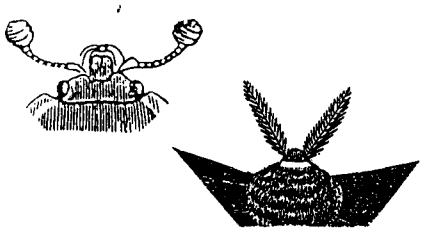
Can bugs be blind?
A few insects that live in caves are blind. Since they have lived in caves for many generations their eyes do not work any more.



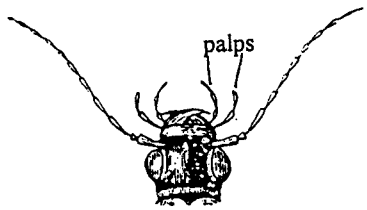


SOUNDS AND SENSES

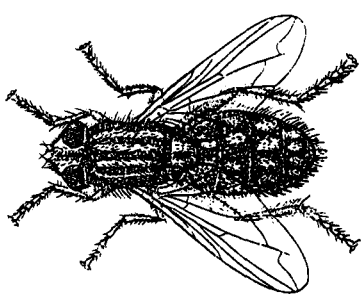
Do insects have senses?
Insects have all five senses. We have already talked about sight on page 24. Since their vision is poorly developed insects live in a world of smells, tastes, feelings, and sounds.



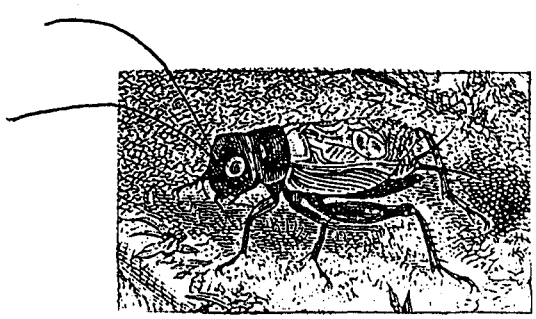
Smelling: Insects detect smells with their antennae. Male moths have bushy antennae to smell the female's scent. Insects also use scents to make trails and warn others of danger.



Tasting: Insects taste with little palps that are part of their mouth. Since they can taste before they eat they can avoid eating poisons. Flies have taste sensors on their feet.



Feelings: Insects can feel with the sensitive hairs that cover their body. Insects are sensitive to pressure, movement, temperature, and humidity.



Hearing: Many insects can only sense vibrations, but some insects have well developed ears called tympanal organs. Cricket's tympanal organs are located on their legs.

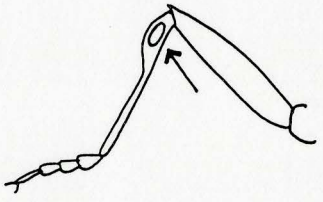
Why do insects need antennae?
Insects need their antennae to smell with. Antennae can also detect vibrations. Many male insects are attracted to the female by the female scent. It is called a pheromone.

Why don't insects have noses?
Insects do not need noses because they can smell with their antennae. People do not need antennae because we can smell with our noses.

How do bugs communicate?
Bugs can communicate with sounds like the cricket or grasshopper, or with light like the firefly, but some insects communicate with smells called pheromones. Female moths use pheromones to attract males for mating. Ants leave a trail of pheromones when they return to the colony after getting food so other worker ants can find the food. Bees, wasps and ants release alarm pheromones to warn the others of danger. Honeybees do dances in the hive to tell the other bees where to find the good flowers.

Do insects make sounds?
Many insects can produce sounds. Some insects click, buzz, or hiss while others like crickets, grasshoppers, and cicadas produce songs. Insects produce sounds to scare away enemies, attract a mate, or communicate with each other.

How do insects make their noise?
Insects do not have vocal chords so they cannot speak, but they can make sounds in other ways. Some insects like crickets and grasshoppers make sounds by rubbing two parts of their body together. This is called stridulation. Crickets rub the file of one wing against the ridge of another wing. Grasshoppers rub the ridge on their wing with the pegs on their legs. Cicadas have a piece of skin on their thorax that vibrates like a drum. The death watch beetle knocks its head against the wood it lives in to attract a mate.



Do insects have ears?
Insects do not have big outer ears like people but they do have listening organs called tympani. Crickets and grasshoppers have their tympani on their front legs, cicadas have theirs on their abdomen. Some insect do not have hearing organs but they can fell the vibrations of sound.

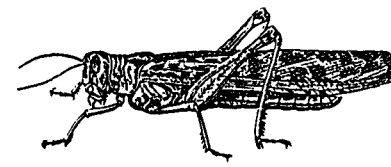
How and why do fireflies make their light?
Fireflies are really beetles. They make their light in their abdomen by mixing two chemicals together. This light is special because the firefly does not get hot like a light bulb when it makes its light; this is called cool light. Fireflies make their light to attract a mate.

THE COLOUR OF BUGS

Are all insects the same colour?
No, insects are a lot of different colours.

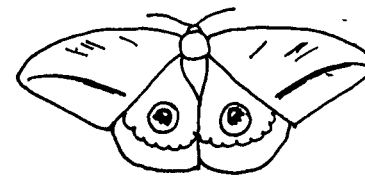
Why do insects have all those different colours?
Different kinds of insects have different colours so they can recognize their own kind.

How many different colours are insects?
Some people think insects are all brown, black or maybe green, but insects are almost every colour in the world. Some beetles, butterflies, and moths are very colourful.

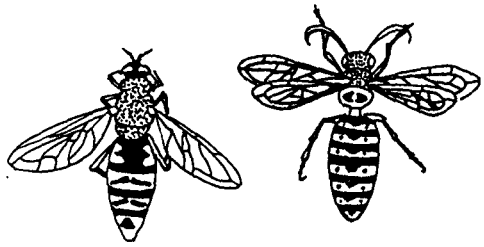


Why do insects have spots and stripes?
The spots and stripes on insects sometimes help them hide from their enemies. Spots may help them blend in with the backgrounds or make them look like another animal. The stripes on insects also help insects look like their background. If a bunch of striped insects are together it is hard to see where one insect stops and another starts; this makes them look like one big animal.

Why do some insects have eyespots?
The large eyespots on the wings of some insects are meant to fool the enemies into thinking they are facing a bigger animal. Smaller eye spots are intended to distract the enemies away from the head. If a bird attacks the spot on the wing instead of the head the butterfly will likely escape.

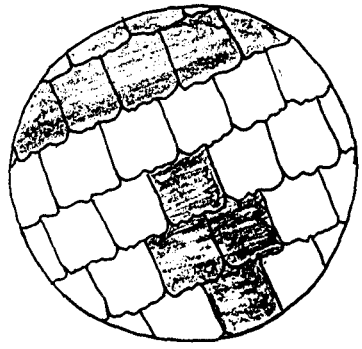


Why are some bugs shiny?
Some bugs are shiny because their exoskeleton has ridges and lines made to reflect a lot of light.



Why are bees black and yellow?
Bees and wasps are yellow and black to warn their enemies that they can sting. Many other insects that are black and yellow fool their enemies into leaving them alone.

Why are ladybugs black and red?
Ladybugs taste bad. Their red and black colour warns their enemies that they taste bad.



What makes the colour on butterfly wings?
Butterflies and moths have membranous wings covered in colourful scales. The scales are what give the butterflies and moths there colours and patterns. If you look closely at a butterfly wing you can see the rows of scales. Under a microscope the scales look like rows of shingles on a roof.

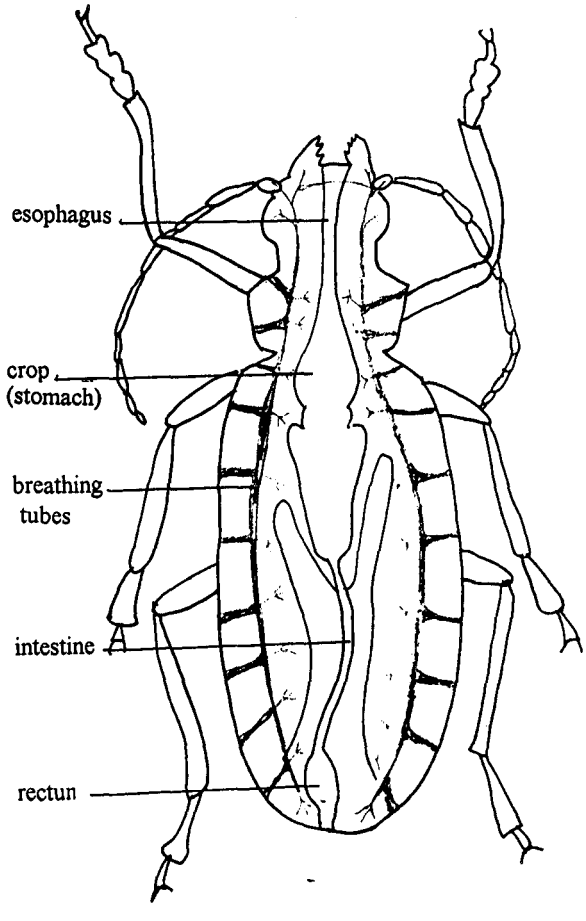
Do the spots on a lady bug really tell their age?
No, different kinds of ladybugs have different numbers of spots. The number of spots on a lady bug never changes.

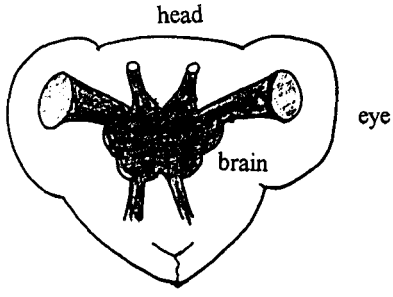
INSIDE AN INSECT

Why does "goo" come out of a squished insect?
The "goo" that comes out of a squished insect is its insides; its guts and blood, and the food it was digesting.

Can you dissect a bug?
Yes, but you need very small tools! Scientist dissect insects to understand more about them, or to find out if they are male or female.

Do bugs have the same organs as we do?
Bugs have the same systems as we do; nervous, digestive, respiratory, and reproductive. Some of their organs are similar but some are very different. Their nerves, intestines, and muscles are similar to ours.

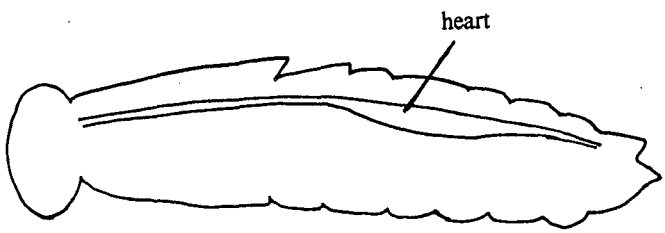




Do insects have brains?
Yes, insect have small brains in their heads.

Do insects have blood?
Yes, but we usually call it heamolymph. It takes oxygen to all parts of the body just like our blood.

What colour is insect blood?
Insect blood is a different colour than ours; it is yellow. All insects have yellow blood.



Do insects have hearts to pump their blood?
An insect has only one large blood vessel that runs down the length of its body, the back half of this vessel is the heart. It pumps the blood through the vessel and out into the body cavity. They do not have veins like ours.

Are insects cold blooded or warm blooded?
Insects are cold blooded, they do not make their own body heat. Butterflies and dragonflies often rest in sunny places until the sun warms them up enough to fly.

Do caterpillars have green guts or green blood?
Caterpillar blood is yellow. The guts look green because they are full of the green leaves they eat.

Do insects go to the toilet?
Insect do not have toilets but they do go "poo". All animals produce waste products when they eat. Insect waste is called frass.

Can insects tinkle?
No, insects do not "pee". Insect bodies are designed to save water; urinating is a big waste of body water.

FOOD

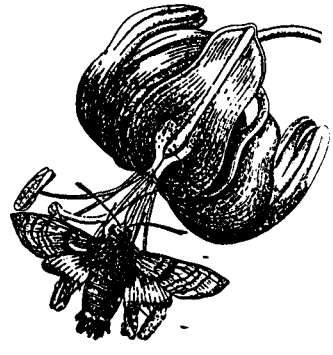
What do insects eat?
Different insects eat different things. Some eat animals, other insects and dead animals; others eat parts of plants like leaves, wood, seeds, and nectar.




What is the most common insect food?
There are more insects that eat plants and plant products than there are ones that eat meat.

How do insects eat?
Just like us! Insects take food into their body through their mouth, and into the digestive system.
(See about mouthparts on page 22)

Do all insects eat?
All insects eat in their young stages, but a few insects that do not live very long as adults do not eat as adults. They live on fat stored by the young stages.



What do insects drink?
Insects drink water, or juice from fruits. They may get the water from dew drops or from puddles.

How do insects get nectar out of the flower?
Insects like bees and butterflies that eat nectar have sucking mouthparts called a proboscis. They put their proboscis into the nectary and suck out the nectar.
(See more about mouthparts on page 22.)

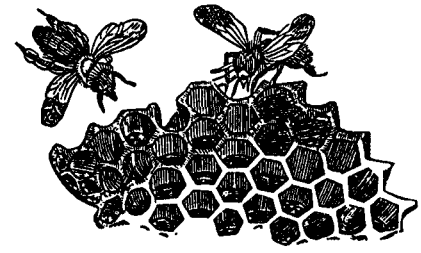
Do some bugs eat other bugs?
Yes, many bugs eat other bugs. Praying mantis eat crickets, ladybugs eat aphids, many other beetles eat other insects, some wasps eat other insects. Some insect lay their eggs in other insects and then the young that hatch eat the other insects.

Why do flies go into the garbage?
Some kinds of flies go into garbage to find food for themselves and to find rotting food to lay their eggs on. The larvae will feed on the rotting food when they hatch.

Why do ants eat leaves?
Leafcutter ants cut leafs and take them back to their nest but they do not eat them. They are farmers; they grow fungus on the leaves and eat the fungus.

Do insects eat dead animals?
Yes, flies lay their eggs on dead animals so their larvae can feed on the decaying flesh. The burying beetles actually bury dead animals before they lay their eggs on them.

Why do termites eat wood?
Termites can use dead wood as food and there is lots of wood around in dead trees and in wooden buildings. Most insects cannot digest wood but termites have a microbe in their gut that helps them digest the wood.



Why do bees like sweet food?
Bees like sweet food because they need high energy food.

Why do bees make honey?
Bees make honey to store food in the hive. They store food to feed their young and to survive during bad weather.

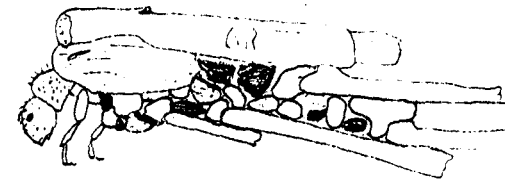
How do bees make honey?
Bees collect the sweet nectar from flowers and bring it back to the hive in their honey stomach. Once they are back to the hive they regurgitate the nectar into the honeycomb. Chemicals in the saliva help to change the sugars, and the water evaporates off the nectar making it into thick honey.

HOMES AND HABITATS

Where do insects live?
Insects live almost everywhere in the world: on land, in the soil, and in freshwater. Some insects even live in brackish water, and sea water striders can be found miles away from land on the surface of the ocean, but no insects live in the salty ocean water.

Do insect build homes?
Some insects simply live on the plants that they feed on, but other insects build homes for themselves.

Burrows: Earwigs burrow into the ground to make nests for themselves and their eggs.

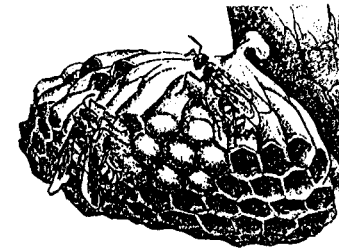


Galls: Some wasp and fly larvae live inside a plant gall. The gall starts to form when the insect eggs are laid in the plant stem.

Cases: A caddisfly larva fastens stones and twigs together with silk to make a home that it carries along wherever it goes.

Some insects live and work together. They are called social insects. They build homes for the whole community.

Hives: Bees build hives inside hollow trees or other cavities. The wax honey combs are used to store food and rear young.



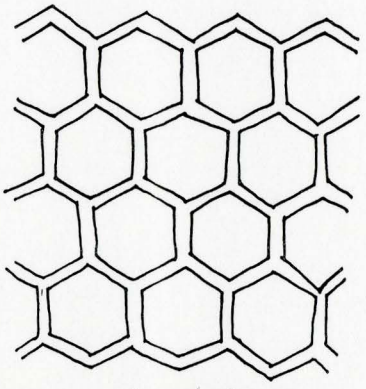
Colonies: Ants and termites build underground colonies with many different chambers or rooms. Different rooms have different purposes like the nursery.

Nests: Wasps live together and rear their young in a paper nest that the workers build.

Why do ants and termites live underground?
Living underground gives ants and termites protection from lots of enemies, and it gives them room to make large homes. Termites have very thin exoskeletons and they would dry out very quickly in the sun. Living in the cool moist underground protects them from drying out. Temperatures does not change as much underground as it does at the surface.

How do ants build their tunnels?
Ants build their tunnels by digging. Every bit of dirt that they dig out has to be brought to the surface. That is why you see mound of dirt around the entrance of an ant colony.

Do all bugs live in the ground?
No, some live above ground or in the water. Insects' hard exoskeletons protect them from drying out like a worm.



honeycomb

How do bees build their hive?
Bees do not dig or make holes to build their hives in, they usually make their hives in a hole that is already there, like a hollow log. They make the honeycombs in the hive with wax that they secrete from a gland. Bees are not the only animals that make wax; we make wax in our ears.

Do some bugs live in the water?
There are lots of insects that live underwater. We call them aquatic insects. Some insects live their whole life cycle underwater, but some like mosquitoes and dragonflies, have adults that live on the land.

How long does it take insects to build their homes?
Insects that build homes for just themselves like cases or burrows can usually build them in a few hours, but social insects that build hives or nests may take weeks. A wasp starts its nest in the spring with just a few cells, but keeps adding to it all summer as the population grows.

LIVING TOGETHER

Do all insects live in groups?
No, only the social insects live together in groups .
All ants, and termites, and some bees and wasps are social insects.

Why do some insects live in colonies?
When insects live in groups they can share the work. Each insect can specialize in doing a certain job, like being a guard, taking care of the young, or going out to collect food. Living in groups provides extra protection; a hundred ants are scarier than just one ant.

Do parents take care of baby insects?
Some insect parents take care of their young. In social insects the queen takes care of her first batch of young, after that the older sisters and brothers take care of the young. Some insects just guard the eggs, others guard the young, but some insects just lay the eggs and leave the young to take care of themselves.

Do all insects have a queen or leader?
No, only social insects have Queens. The Queen is the female who starts the colony and then provides the eggs for the whole colony.

When a queen dies who takes its place?
In some colonies, if the queen dies the colony will die out because their will be no more eggs. In some colonies when the queen dies the next young that develop will have males and females that can mate and one mated female will take over as the new queen.

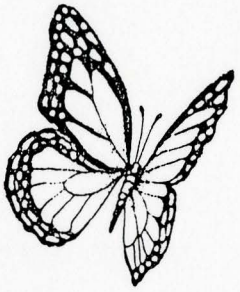
Do insects have families?
Most insects do not live in families, but a colony or hive could be called a family. The queen is the mother so that makes all the members of the colony brothers and sisters.
Families are also a science grouping. All ladybugs are in the same family of beetles.

Do bugs travel together?
Some bugs travel together like a swarm of bees, or a swarm of locust. Monarch butterflies travel in a group when they are migrating south for the winter. Most of the time when we see a group of insects together they are not travelling together they have just all emerged at the same time or they have been attracted to the same thing.

WINTER

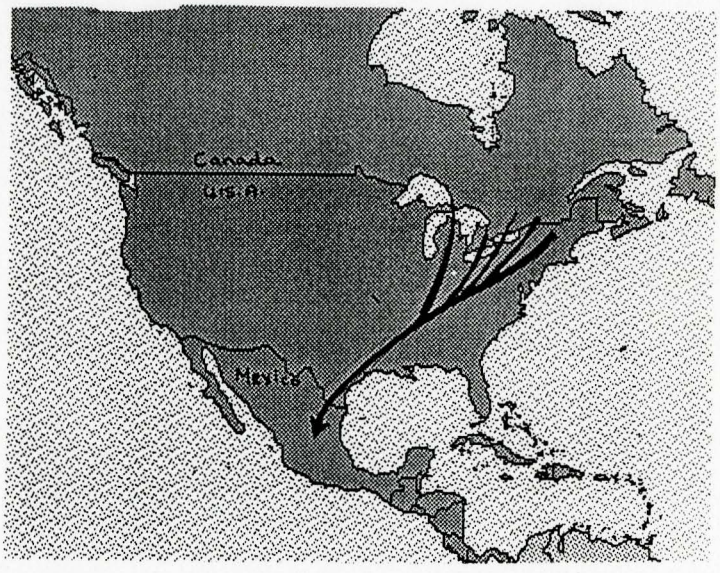
Where do insects go for the winter?
That depends on the kind of insect. Some hibernate, some migrate, and some die.

Do bugs freeze in the winter?
Yes, some insects freeze in the winter, but their eggs, larvae, or pupa survive. Other insects move up from the south as the weather warms up, they all freeze in the winter but new ones move up next summer.



Do bugs hibernate in the winter?
Yes, some insects like beetles hibernate for the winter. The nymphalid butterflies also hibernate. Sometimes it is the immature stages like the larvae that overwinter.

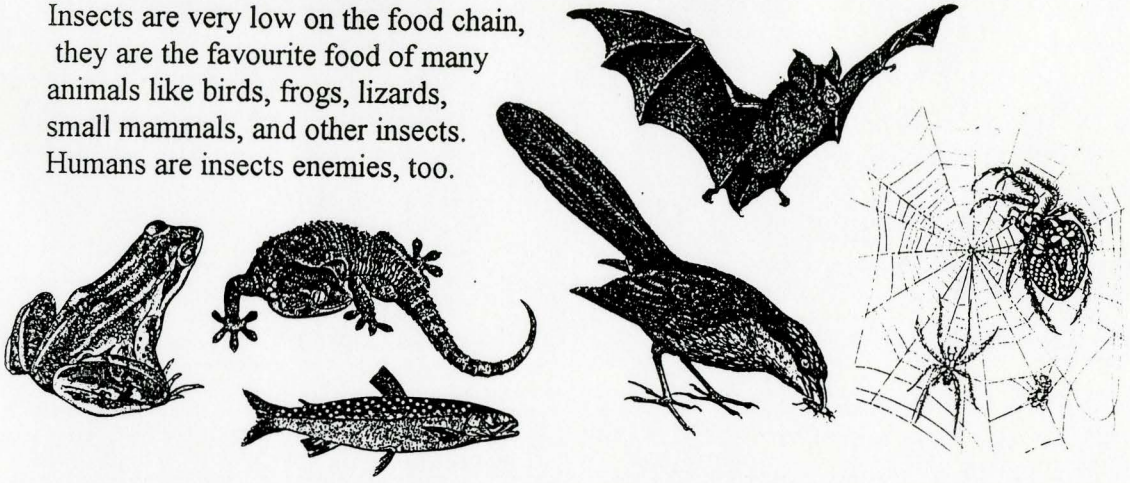
Do some bugs migrate?
Yes, many butterflies do. The monarch butterfly migrates almost 3000 km to Mexico.



Do some bugs come out in the winter?
Sometimes on a warm sunny winter insects come out by mistake because they think it is spring. Snow fleas, which are a kind of springtail, come out and eat the mould on the snow.

ENEMIES and DEFENCE

What enemies do insects have?
Insects are very low on the food chain, they are the favourite food of many animals like birds, frogs, lizards, small mammals, and other insects. Humans are insects enemies, too.



How do insects defend themselves?
Insects have many ways of defending themselves.

Stinging and Biting: Some insects can inflict a painful bite to scare their enemies. Other insects like bees, wasps, and ants, can use their stinger to inject their enemies with poison.
(See more about stinging and biting on p. 40)

Chemicals: Many insects contain chemicals that taste bad to their enemies. Any animals trying to eat these insects will spit them out because they taste bitter.

Warning colours: Many insects that taste bad or sting have warning colours. The red and black colour of some beetles warns its enemies that it tastes bad. The black and yellow of bees and wasps warn that they can sting.

Mimicry: Many insects fool their enemies by looking like dangerous insects. A harmless fly may look like a stinging bee. Some have eyespots so they look like bigger animals.

Camouflage: Many insects hide from their enemies by looking like their surroundings. Some insects look like dead leaves.

Spines: Some insects are covered in spines or spikes that make them hard or even painful to hold.

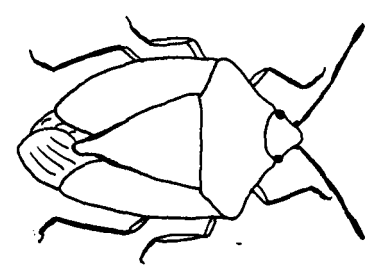
Do insects get diseases?
Yes, insects get diseases, but not the same ones as people. Many of them die from bacteria and fungus infections.

Do insects have special body parts to kill predators?
Yes, some have very powerful jaws and others have stingers.
(See more about biting and stinging on p. 40)

Are caterpillars poisonous?
Not many, but some caterpillars have poisonous hairs on them, other have hairs that make their enemies itch.

Are some insects poisonous for birds to eat?
Yes, some insects like monarch caterpillars have poison in them that would make bird sick if they ate them.

How do stink bugs stink?
Stink bugs produce a liquid that has a terrible smell to it. When they are touched or disturbed they release some of this chemical to warn their enemies that they taste bad.



Why are some insects camouflaged?
Camouflaging is a way of hiding; an insect is safe from its enemies if it can hide.

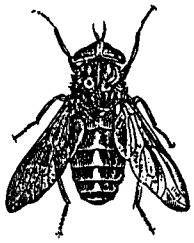
Do insects colours and patterns defend them?
Yes, insects colours and patterns may make them hard to see, or they may be a warnings that they sting or taste bad.
(See more about colour on page 28)

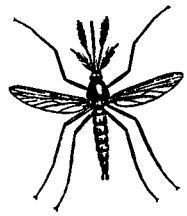
STINGING AND BITING

Do all insects bite?
No, not all insect have mouthparts made for biting. (See more about mouthparts on page 22).

Do caterpillars bite?
Caterpillars have mouthparts made for biting and chewing, but they are only strong enough to bite and chew leaves not people.

What bugs bite people?
A few different flies bite; mosquitoes, blackflies, deer flies, horse flies, and some midges. Fleas bite us and our pets. Some beetles, tropical bugs and grasshoppers can bite but will only do that if we are holding them.





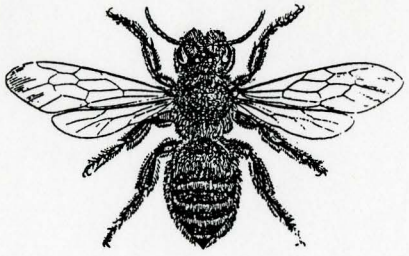
Does it hurt when an insect bites or stings you?
Most insects that bite and sting also inject some anesthetic (that's a chemical that takes feelings away), so you do not know they are feeding on you. Usually a bite, like a mosquito bite hurts more a few minutes after the mosquito is gone.

Why do mosquitoes suck blood?
Only the female mosquito sucks blood. She needs the proteins in the blood to make her eggs mature (ready for laying).

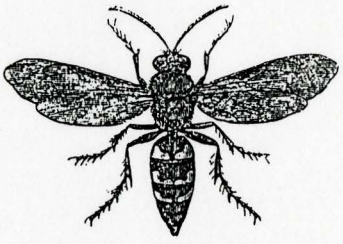
What do male mosquitoes eat?
Male mosquitoes (and females when they are not maturing eggs) eat nectar and fruit juice.

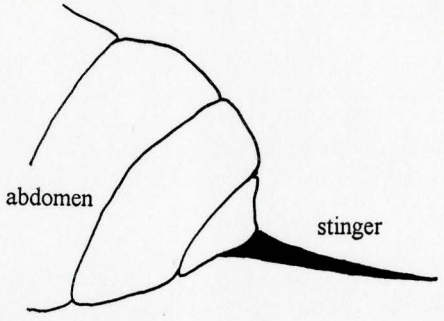
How much blood do mosquitoes suck?
Mosquitoes are not very big they can only hold about 4 mg of blood. That is a very small drop.

Do all insects sting?
No, only the insects in the group Hymenoptera (bees, wasps and ants) can sting. Only the females can sting.



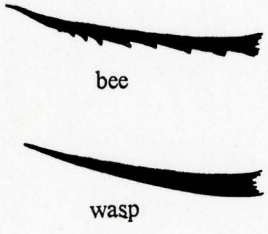
Why do bees and wasps sting?
Bees and wasps sting to defend themselves and the hive. Stinging scares the enemies away.





Where is the stinger on the bee?
A bee's stinger is on the back end of its abdomen.
Only the female worker bees have stingers. Stingers are modified ovipositor (egg layers).

Do bees die after they sting people?
Yes. Bee stingers are not smooth; they have barbs like a fish hook so they stick in when the bee pulls away. The stinger and the poison sac stay in the victim, and the bee dies from the wound.



Is there such a thing as a killer bee?
Killer bees are the name given to the African honeybee. They rarely kill but they are called killer bees because they are quicker to sting than a normal bee. Once one bee stings it attracts many more bees that will also sting. African honeybees were brought to South American by mistake. There are no killer bees in Canada.

INSECTS AND PEOPLE

How do insects help us?
Insects help us in many ways.

Pollination:
They pollinate the plants so they grow good fruit and seeds.

Insect and weed control:
Some good insects eat the insects and weeds that are pests.

Eating Natures Garbage:
Insects eat the dead leaves and fruits and also the dead animals.

Products:
Insects make things that we use like wax, honey and silk.

Food:
Insects are eaten by many animals that we eat.

Do people really eat bugs?
Yes, insects are very high in proteins so they are good food. In some countries large beetle grubs and grasshoppers are fancy food. This sounds gross if you are not used to it, but remember that we eat other arthropods; shrimp, lobsters and crabs.

Why do people kill bugs?
People kill insects that are pests. Farmers kill insects that eat their crops, or bother their livestock. People kill insects that get into their homes and food. Some insects are killed because they spread disease.

Why do bugs come into our houses?
Insects come into the house because we have food that they eat. They may eat our stored foods, our house plants, our clothes or feed on our pets.

How do bugs get into our houses?
Some bugs come in through holes and cracks in the walls, others use open windows and doors. Many other pests may come in with the food we bring in or they may hitchhike a ride our pets.

Do bugs carry diseases?
Yes, insects can spread disease just by spreading the germs around. This is only a problem if places are not clean and there are lots of germs around. Some insect spread disease by carrying the germs in their bodies and spreading it to people by biting them. Some diseases that are carried by insects are Malaria, Yellow Fever, and Sleeping Sickness; none of these are problems in Canada.

Why are bugs attracted to humans?
Some insects are attracted to humans because they find good food sources by humans. Some insects eat our food, the plants we plant, the animal we produce or the garbage we make.

Can insects kill people?
Some of the diseases that insect spread can kill people. If a person is very allergic to an insect bite or sting they may die from the allergic reaction.

Why are people afraid of insects?
So many people have a fear of insects that we have a special word for it: entomophobia. Most people who are afraid of insects do not understand them. If they knew that most insects do not bite, sting, or carry disease then they would not be as scared.

If a mosquito bites someone with AIDS, and then bites you, will you get AIDS?
No, when a mosquito bites you it injects its own saliva not the blood from another person. A mosquito can only pass on a disease if the bacteria or virus lives in its system.

Do earwigs really get into people's ears?
No, earwigs do not make a habit of going into people's ears. Earwigs like dark, warm, moist places. If they went into an ear it would only be by mistake.

What would the earth be like without insects?
The earth would be a very different place without insects. Many fruits and seeds would not develop without insects to pollinate their flowers, so many plants would die off. Some animals would starve because they had no insects to eat, and larger animals would starve because their were no small animals to eat. And there would be no insects to clean up the carcasses! Many of the grains, fruits, and animals we eat would not be around without insects.

ABOUT THE AUTHOR

How old were you when you first became interested in insects?
I first became interested in insects as a very young girl. I started my butterfly collection when I was seven years old. I took them for show and tell in grade two! When I was nine, I was collecting and studying all kinds of insects.

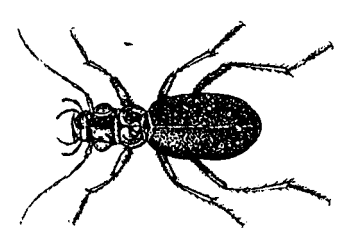
Why do you find insects so fascinating?
The idea that insects are so tiny but they still have all the functions and systems that large animals have is very fascinating to me. It also fascinates me that insects are such an important part of the ecosystem.

Where did you learn about insects?
I learned a lot about insects from books and from TV shows, and best of all from watching and studying the real things. I was lucky that my parents let me keep live insects in the house as long as the cages were tightly closed! When I finished school I went to University to study science including insects. I am still learning new things about science and insects by reading and studying.

What is the largest insect and the smallest insect that you have ever examined?
I was lucky enough to see some of the largest bugs in the world when I was on a field expedition in Trinidad. I saw one of the Owlet Moths and I also collected the large Hercules Beetle and the fancy Harlequin Beetle. They sounded like helicopters when they were flying by! I have also been lucky enough to work with people who study some of the smallest insects in the world. I needed a very good microscope to study the tiny wasps called microhymenoptera.

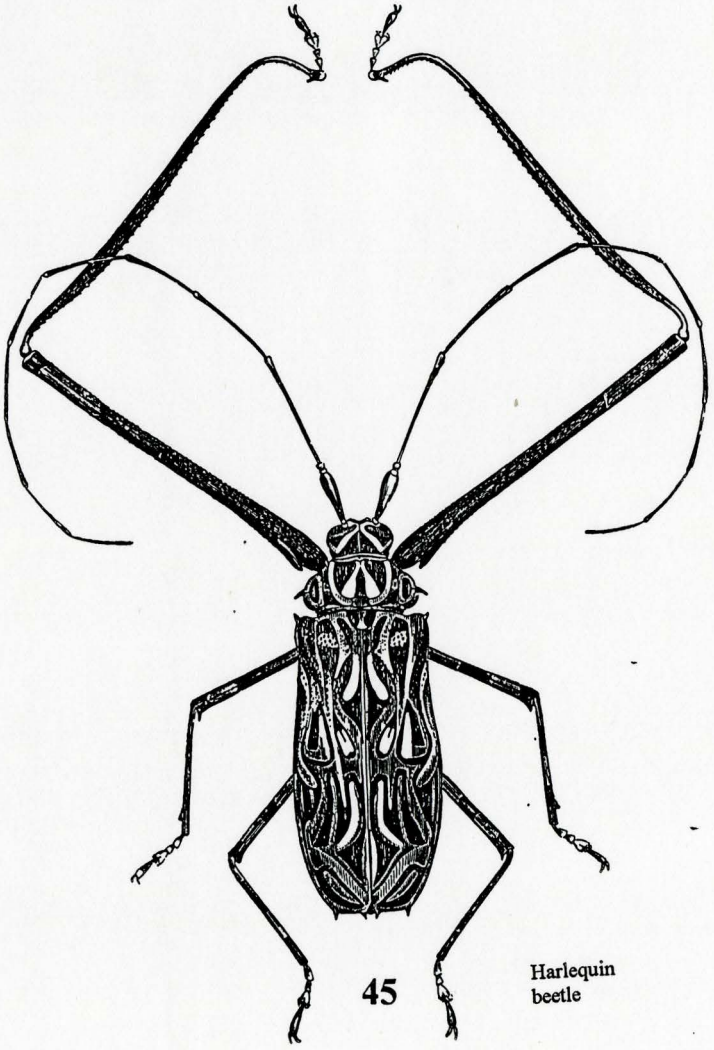
Which is your favourite insect?
My favourite insects are the butterflies, they are so beautiful. I also think that the beetles are very attractive. My favourite beetle is the tiger beetle because it is very colourful, fast and it is a great hunter.

Have you ever eaten a chocolate covered beetle?
Yes, it tasted good, and it was crunchy!!!



Have you ever seen a tarantula?
Tarantulas are not insects but I will answer this question because so many people want to know the answer. I have not only seen a tarantula I have held one. I used to take care of 17 tarantulas when I was working at a Royal Ontario Museum, and I caught live tarantulas while in Trinidad.

As an entomologist what do you find most fascinating about your job?
The most interesting part of being an entomologist for me is sharing my fascination of insects with other people. I think people can learn a lot from insects.



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Harlequin beetle

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PART III: THE EVALUATION

III a.) Introduction

The focus of my project was on producing the resource book but an evaluation was necessary to determine if the book met certain criteria. Since the focus was not on the evaluation it was less rigorous that it might have been. A more rigorous evaluation study might have included more testing of knowledge gained and changes in attitudes about insects and their significance. This could have been achieved by pretesting and post testing groups exposed to the book. Control groups that studied insects without using the book would also have been tested. More observations of students using the book during their study of insects may have been included. Comparisons to other resource books could have also been considered.

Another factor that was not considered was the cultural background of the students. Many cultures view insects in a much different way than we do in western culture. They may see insects as food, pests, or even pets. Considering the diverse cultural backgrounds represented in our urban schools it would have been of interest to consider the variation in the use of and reaction to the book by students of different cultural backgrounds.

The main purpose of my evaluation was to "attempt to summarize achievements and to set out the major claims that might be made for (this) curriculum's effectiveness" (Kemmis and Stake, 1988). In effect the main focus of the evaluation was summative.

Recognizing that the evaluation presented an opportunity to solicit suggestions for improving the book I included a formative question in each questionnaire. Observations of how the teachers and students used the book could also lead to changes in the book and would be considered in the formative evaluation.

A questionnaire was prepared for the teachers because I wanted to find out if teachers thought of the book as a valuable resource that was easy for them and their students to use. I considered teachers a major stakeholder in this evaluation because if this book was ever to be published and purchased by schools teachers would be the ones making the purchase. Teachers could also assess if the book was appropriate for their grade; whether the language appropriate, whether they felt that the students would make use of this book. I did not want to rely solely on the teachers' evaluation because as Miller and Seller (1990, p.167) point out, transformation evaluation should include "student interaction with the teachers in critiquing the curriculum." Therefore, I prepared a separate questionnaire for students and considered them also a major stakeholder.

The criteria I used when preparing the evaluation were as follows:

Did the book a.) provide information about insects

b.) address the students' concerns and questions about insects

c.) have an easy to use format

d.) use language appropriate to the target grades (1-6)

e.) provide move than one method to find information.

III b.) The Students' Questionnaire

The student questionnaire included twelve questions each with its own purpose (appendix D). Preceding the questions students were asked to fill in some personal information, but they were not asked to include their names. The personal information was gathered so their responses could be categorized by gender and grade.

The questions for the student questionnaire, the rationale behind them and the information they were intended to gather follow.

Question #1 was "What was the most interesting thing about this book?" This question was designed to evaluate whether students retained information that they read in the book. It would also indicate whether there were any trends in the areas of interest.

Question #2 " What was the least interesting thing about this book?" was intended to find weaknesses in the book by revealing what parts were of little or no interest to the students.

Question #3 "How did you look things up?"

__look for pictures

__look for word or topic

__look in front of book (contents)

__look in back of book (index)"

was intended to explore which methods students used to look up information. The data was expected to reveal which methods were most valuable and if multiple methods were used.

Question #4 "Did you find what you were looking for? __yes __no __sometimes" was to ascertain if the students concerns were actually addressed.

Question #5 "Did you like the book?" was followed by a Likert scale of frowning to smiling faces. In their answers the students could indicate the enjoyment factor of this book.

Question #6 "What did you like about the book?

__the pictures

__the answers

__the questions and the answers

__the list in the back (index)"

was to find out which parts of the book they enjoyed the most.

Question #7 "Was there anything you would change about this book?" was to give the student an opportunity to make suggestions to improve the book and reveal what they thought the weaknesses were. Responses to this question were used as data for the formative evaluation.

Question #8 was "What would you tell your friends and family about this book?" I chose this open ended question in hopes of eliciting more complete answers than a simple request for comments would have yielded. By asking what they would tell their friends and family I hoped to give the students a perspective on what is meant by comments.

III c.) The Teachers' Questionnaire

The questionnaire that was developed for teachers (appendix E) is separated into three sections, the first being a request for personal information including grade, years of teaching, gender, and level of education. The second section was to be answered by only those teachers who used the book with their students and was on the front of the form. The third section that was found on the back of the form was to be answered by both teachers who used the book with their students and those who were just reviewing the book. The questions for the teachers' questionnaire, the rationale behind them and the information they were intended to gather follow.

Question #1 was "Did you use the book during your class studies of insects?

__yes Please answer both sides of this form

__no, just reviewed the book. Please go to other side of form."

This question was to find out how the teacher used the book and to give the teacher directions as to which questions to answer. I separated the questions onto opposite sides of the form so that respondents who were to skip questions could easily find the division.

After question #1 and before questions #2 through #6 there was a heading in bold saying "While studying insects in the class:" This was to indicate and reinforce that these were the questions that were to be answered by teachers who used the book during their study of insects.

Question #2 "You referred to it:__occasionally __fairly often

__often __frequently"

was a straight forward question to determine how often they used the book.

Question #3 "Did your students use the book?" was followed by the instructions that if the response was "no" they should proceed to other side of form because questions #4 to #6 referred to how the teachers perceived the students response to the book. Teachers who responded yes, proceeded to question four. Question #4 ascertained how the students used the book and #5 asked what method they used. Question #6 simply asked what the students seemed to like or dislike.

Question #7 started the questions aimed at those who reviewed the book without using it with the class. These questions were also to be answered by the teacher who did use the book with their class. This question was used to determine in what way the teacher did or would use the book. The question was "You used it or would use it:

__as an overall reference

__to look up general topics

__to look up specific questions of your own

__to look up specific students questions

__other _____."

Question #8 and #9 were similar to questions #4 and #5 but they were asked in terms of the teacher. Question #8 asked what method they used to look things up and #9 asked what aspects of the book they liked.

Question #10 asked "Was there anything you did not like about the book?" giving the teachers an opportunity to point out weaknesses in the book, or to make suggestions for improvement. This data was to be used in the formative evaluation.

Question #11 was specific to the index and its usefulness. "Did you find the index useful?" was followed by a space for comments. As was stated earlier I thought the index was very important and was eager to see if it was satisfactory or could be improved upon.

Question #12 was "Was the language appropriate for your grade level?" Having gathered the teachers grade level in the personal information I could match these responses with the grade level, and determine which grades the language was appropriate to and adjust the language if necessary.

Question #13 gave the teachers an opportunity to assign an overall rating to the book. The categories were fair, good, very good and excellent. Space was left for comments to encourage teachers to state reasons for their rating.

Question #14 was phrased much like the final question on the student questionnaire. The open ended question "What would you tell other teachers about this book?" was hoped to elicit comments about what they thought of the book in respect to its educational value. It also gave the teachers an opportunity to praise or criticize any aspect of the book.

III d.) The Pilot Study

Once the student and teacher questionnaires were prepared I arranged to visit a school to pilot the questionnaires and determine if and what changes needed to be made. Although I would be sending the books and questionnaires out to schools I thought it was wise to actually visit a school and observe the students and teachers filling in the questionnaires. Actual observations would help determine which parts of the questionnaires were easy to follow and which needed changes. The purpose of this pilot was not to evaluate the book but to evaluate the effectiveness of the questionnaires. The pilot was twofold; I needed to test both the student evaluation forms and the teacher evaluation forms.

The pilot was arranged to be done at an elementary school in Guelph. I had been to this school on more than one occasion and had developed a rapport with the resource teacher. She had on another occasion arranged for her students to participate in the study for one of my courses. Since she was familiar with me and how I worked with the students she had no hesitations in letting her students participate. After obtaining permission from the principal, the resource teacher sent consent forms out to parents with all students. Participants were only chosen from the students that returned the consent form. Participants were chosen by drawing names from a cup. This provided a degree of randomness in selecting the students and avoided biases that may have been created by having the classroom teachers select the students. Teachers may have had a tendency to select their brightest students. One teacher, in fact, complained that I was not getting her

best students by doing a draw. I wanted to be sure that the average students, not just the brightest, could use the questionnaire. Two groups of three from each class were used in the pilot. A total of 36 students, six students from each grade, grade one to six took part in the pilot. Each group took approximately 20 minutes to complete. The pilot took most of the school day.

After students were selected, groups of three at a time were escorted to the library. Space was provided in a secluded corner of the library, where no other activities were taking place. This proved to be a familiar spot in which the students were comfortable. It provided little distraction. The students were comfortable with me as most had seen me during various visits to their school. The students and I were seated at a round table.

Once we were all settled at the table I explained to them the purpose of my visit. I explained that I had written a book about insects and briefly explained how I had gathered questions from students. Then I provided them each with a copy of the book and allowed them about 5 minutes to look the book over. Students were allowed to discuss the books. Once they seemed satisfied that they had looked the book over, I asked them to think of a question about insects. After each assured me they had a question I asked them to try to find the answer in the book. This proved to be an interesting time for me as I was able to make many observations that could test the findings of the questionnaire. It was also rewarding to see the students enjoying the experience. About five minutes were allowed for the students to look up answers. Individual students then shared their questions and answers with the other students and discussed how they had found the answers. Once that

was completed I handed out the questionnaires and asked the students to fill them out. I instructed them not to ask me questions but just to fill them out as if I was not there. It was important for me to see whether the students could fill in the questionnaire without assistance.

While the students were participating in the study their teachers were asked to pilot the teacher questionnaire. The procedure for the teachers was that I left copies of the book in the staff room and the teachers were encouraged by the resource teacher to look at it during recess, lunch and their prep times. During the afternoon recess the teachers who had had a chance to evaluate the book were given copies of the questionnaire to complete.

III e.) Observations and Results of the Pilot Study

Judging from their smile and laughter and their eagerness to participate, the students seemed to enjoy being part of the pilot and took their role in my "research" very seriously. Most students had no problems working with the book and filling out the questionnaire. The exception to this was the grade one and two students. Although the grade ones could read some of the book they had a lot of difficulty reading the questions and were not able to answer most. We did complete the questionnaires but they were looking to me for answers. Their biggest concern was pleasing me by giving the answers they thought I might want. For example a boy who had hardly looked at the book for a minute before abandoning it wanted to circle the happy face on the Likert scale when it

was explained that that would tell me he liked my book. Some students just wanted to check off all the boxes. Since I had intended that this book would be mostly a reference for teachers in the lower grades I was not surprised that the students had difficulty with the book. The grade two students were much better readers but still lacked comprehension of the questions. Most asked, of at least one question, "what does this mean?" My observations also indicated that they did not understand the questionnaire. Some students who had found answers to their questions did not indicate so in their questionnaire.

It was apparent that the questionnaire was not appropriate for the grade one and two students. I felt that if I were to send it to the classes the teachers would probably help the students fill in the questionnaire. This could bias the results as the teachers would likely, but not intentionally, during their explanations encourage the students to select the answers that they expected the students should select.

For grades three to six students there was little difficulty in reading the book or reading and comprehending the questions. They filled it out with ease and resisted asking me for explanations or "hints" as a few of them called them. Some students were distressed with the happy faces on the Likert scale. "No", "not sure", and "OK" were designated by a single face with a frown, straight lips, and a smile respectively. The categories "quite a lot" and "a lot" were represented with two and three smiling faces. Some students commented that they were smiling all the time so that was one smile, and one boy thought that the two and three smile meant he and his friends would like it. Some of the grade four students thought it meant that all three people in the group liked the

book. More than one student commented that they liked the book but they thought the smiling faces were ugly.

The problem with the smiling faces led to a minor change in the final student questionnaire. The smiling face scale was still used to reinforce the verbal scale, but a single face was used for each indicator. The faces were also modified to have a changing face that progressed from a frown through a smile to an ecstatic grin. These faces were computer generated (see appendix F).

The only question that posed a major concern was question #2 "What was the least interesting thing about the book." All grades responded differently to this question but all approached it with difficulty. I had intended to present the opportunity for students to criticize any part of the books content or format, even the colour of the cover if they wished. The grade one and two students simply did not understand the question. The grade one students became more confused as I tried to explain that the "least" was the opposite of the most and they soon resorted to telling me what they liked the most. One group of grade two students informed me that what they did not like was not there, or most of them answered the question with one word, "nothing." Grade three and four students consistently asked if they had to answer the question. I responded by explaining if they did not like the question or did not understand it they could leave it blank. They all left it blank. Both groups of grade five students independently came up with the idea that I wanted to know which bug they liked least. The grade six students were frank in telling me they did not like the question because they had only looked up the good things. This

question was very similar to question #7 ("Would you change anything?") which was answered easily by the students. In light of the confusion question #2 presented and the fact that the students were later given an opportunity to indicate the books weaknesses in question #7, I decided to drop the question entirely from the questionnaire. The amended questionnaire is seen in appendix F.

Seven teachers filled in the pilot teacher's questionnaire. I did not observe them having difficulty with any of the questions. An inspection of their answers confirmed that they understood the intent of the questions. After the teachers filled in the questionnaire and offered more comments and praise about the book, I reminded them that I was piloting the questionnaire and asked them to specifically comment on the questionnaire and its effectiveness. They all agreed that it was self-explanatory, and formatted in a easy to follow manner. Most important to the teachers was the fact that it was quick to fill out; it gathered the information without asking them for lengthy comments and gave them opportunities to add comments where they wanted. After the pilot I decided to proceed with the teacher questionnaire without any changes. The final questionnaire without the pilot instructions is found in appendix G.

II f.) The Evaluation Study

Once I was satisfied with the questionnaires I sent packages to the schools for evaluation. Each package contained a book, several teacher questionnaires, a class set of student questionnaires and a letter of explanation (appendix H). Participant schools were

first selected from the respondents to the request for questions that had indicated that they would like to participate in the evaluation. Packages where sent out to 20 schools in mid-May. In the first week of June, recognizing that the teachers have many distractions at this time of year I sent out another letter gently reminding the teachers to return the questionnaires. I also sent 5 packages and the reminder letter to schools that had indicated they were interested in the book during a "Science is Alive" visit. By the end of the school year I received only five responses, one that contained only the teacher's response. Fortunately some of the packages contained more than one teacher response.

Unfortunately school was out for the summer but this was not a large enough response nor did it represent enough grades for me to draw any conclusions. I felt strongly that I would need more responses even though that did mean postponing the conclusion of my project and degree. In the fall I telephoned the teachers who had not responded and managed to get many promises that resulted in a few more teacher responses and one more group of student responses. Most teachers said they had run out of time and they would try to get to it next spring when they did their insect unit. I gladly let them keep their copy of the book but told them I would be finished my data collection by that time.

With the help of a science coordinator in Niagara South I distributed ten more copies of the book to teachers that he felt would be interested in the book. This resulted in one more teacher response. This teacher was from grade two and so I did not expect to receive student responses from her class.

By October I had received 19 teacher responses. The range of grades they taught was from kindergarten to grade eight. Sixteen of the teachers were in my target audience. I was satisfied that I had a representative response. At this point I still had only five groups of student responses. A total of 47 students representing grade three, four and six had participated in the study. I was not satisfied with this data base. There were not enough students and grade five was missing from the study.

To remedy this problem I took a new approach. I decided I would visit a school and conduct the survey in a similar fashion to that of the pilot study. This would require little commitment or time on the teachers' part. It would also allow me to collect data from all grades. This method would also add an observation element to my evaluation. Since the transformation orientation encourages mixing methods of evaluation including informal forms of evaluation this was in keeping with the philosophy of the project. To set this up I contacted a principal in the Niagara area where I am now living. This principal was aware of my project and once I explained my need for more student responses, he was very eager to help me out. I had worked in many of the area schools when he was a science coordinator and I had given lectures for his additional qualification, teacher training courses.

In early November I visited elementary school in the Niagara area, to work with the students. The set up was similar to the pilot evaluation. I was given the use of an unoccupied portable classroom, and the students visited me in groups of ten to twelve. I worked with six groups for about a half hour each. Students were not told why they were

visiting me. I had a similar concern to that of the pilot of the teachers selecting only the good students. Since all classes were composed of split grades I elected to include all students from one grade of each class in the evaluation session. This was intended to eliminate the chance of the teacher being biased in the selection of students.

Once the students settled into the circle of desks I explained why I had invited them to be part of the evaluation. I provided them each with a copy of the book and explained how the book had been written. After that I gave them five minutes to look over the book and become familiar with it, they were allowed to talk to their fellow students. Once this time was complete, I asked them to think of a question and try to find the answer in the book. This section was completed and repeated one more time. Students were given an opportunity to look up at least two questions. Since the students of all groups requested to share the answers with the rest of their evaluation group I complied. Once the discussion was over I distributed the questionnaires and asked the students to answer without the help of their classmates. I did not help the students with their responses because I did not want to influence their answers. Once the questionnaires were completed I collect them and thanked the students before they returned to their class.

The visit to the school resulted in 63 more student responses giving me a total of 110 students responses from grade 3 to 8. I was now satisfied that I had adequate data to draw some conclusions.

III g.) Observations From the Evaluation

On two occasions, the pilot of the questionnaire and the visit to the school, I was able to observe students working with the book. This provided me with additional qualitative data about how the students interacted with the book. In general students appeared to enjoy the book. There was a general atmosphere of excitement as they looked through the book for their questions. Some of this excitement could have been attributed to the fact that they were involved in a special activity that took them away from the daily routine. The fact that students wanted to share their findings with other students, and that the conversation was interspersed with comments such as "This is cool" and "Wow, look at this" indicated that the students were excited about the book. Overall my observations concurred with my findings from the questionnaires that most of the students liked the book.

One of my criteria for evaluation was to determine if the language was appropriate for the target audience. My observations were that most students were comfortable with the language. The grade one and two students, although they had difficulty with the questionnaire, seemed to enjoy looking at the pictures in the book and were able to read some of the text. They could read the questions but could not always read and understand the answers. I was not surprised by this since I did not expect them to be able to read any of it, and I had suggested in the preface to the book that it would best be used as a teacher resource for these grades. Students in grade three and higher had no problem with the language. Although the language was simple enough for the grade three students the older

students did not seem to think it was below them. Some commented that there could be more words and fewer pictures but many of them had used the pictures as a means to find information in the book.

As mentioned earlier in this project an important outcome included in the area of Inquiry, Reasoning, and Reporting (p.32) of the Common Curriculum (Ontario Ministry of Education and Training, 1993) requires that students will "be motivated to ask questions, and know how to look for answers and talk about their findings." I had hoped that the question and answer format of the book would encourage students to ask questions and be able to employ several methods to find the answers. While observing the students I was pleased to see that they were indeed being encouraged to ask questions. The fact that they were able to find the answers to their first question led them to ask more questions and look for the answers. The students from all grades used many methods to find answers. I observed all available tools, (pictures, words and topics, contents, and the index) were used by at least some students from each of the grades. Even the grade two students observed in the pilot were familiar with the use of the index. Students also exhibited good problem solving skills when looking up information. For example one group of grade four students was looking for information on how insects "talk." Their first approach was to look in the index, but they were not able to find "talk" in the index. Their next step was to look in the contents, still to no avail. Then they discussed how they thought insects talked. The comment that insects did not talk like us but made sounds led them to the key word "sound." While some of the students looked in the table of contents, others looked in the

index for "sounds." Both ended up at page 27 of the book where they found four relevant questions and answers. The problem of where to find information about insect sounds had been solved using teamwork.

Another interesting observation was that most students used more than one method to look up information. Many students I observed using more than one method only indicated on the questionnaire that they had used one. This leads me to believe that more students actually used multiple methods than is indicated by the questionnaire.

III h.) Students' Responses to Questionnaire and Discussion

As previously noted 110 students and 19 teachers filled in evaluation questionnaires. Twelve samples of students' responses ranging from grades three to six are included in appendix I. Four samples of teachers' responses are included in appendix J. The answers to all the questionnaires were collated using the data base program Access. Appendix K shows all 110 students responses. Appendix L shows the responses of the 19 teacher questionnaires. Responses to the questionnaire were from students in grades three to eight. I had not seen grade seven and eight as part of my target audience but since they seemed to value the book as a resource they could use I included their results. Of the 110 questionnaires 86 were in my target audience of grades three to six. Students' ages ranged from 8 to 13 years old.

The questionnaires' request for personal information included an indication of gender. I had requested this information to observe any differences in interest or use of the

book between genders. Of the 110 students 57 were girls and 53 were boys. No obvious trends were detected in any area of the study, but some minor differences were observed. The responses to the questionnaire by girls and boys are summarized in appendix M. There was little difference in how they rated the book with 40 girls (75%) and 39 boys (68%) indicating that they liked the book a lot or quite a lot. Almost equal numbers of girls (38, 70%) and boys (39, 67%) would change nothing about the book. When asked which aspects of the book they liked there was little difference in the boys and girls responses. However, when asked which methods they used to look up information there were some differences. More boys (21, 39%) than girls (15, 26%) used pictures. Boys also used the index more frequently; 32 boys (56%) as compared to 25 girls (47%). The girls tended to make more use of the topic headings, and table of contents to look up information. Of the girls, 22 (42%) as compared to 14 (25%) boys used the topic headings, and 28(53%) girls and 16 (28%) boys used the table of contents. These findings may indicate that the boys had more specific questions that they wished to have answered whereas the girls were more interested in general topics or areas of concern. Further studies would have to be done to justify acceptance of this interpretation.

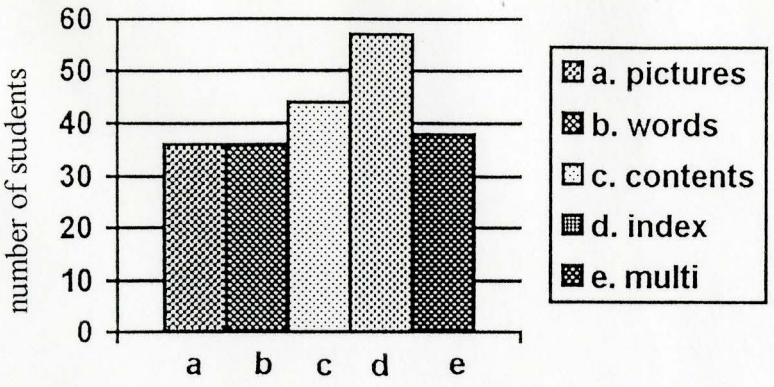
The responses to question #1 "What was the most interesting thing about this book?" varied in each grade. In grades three to six the students were evenly split indicating a specific insect or fact that they thought was interesting and comments about the format of the books. The majority of grade seven and eight students commented on an aspect of the format, not a specific part of the content. The answers referring to both

content and format were so varied that no trends were obvious. The answers referring to specific insects or topics, and the conversations they had generated during the observations were indicators that the students were retaining some of the information that they had looked up.

Question #3 was designed to explore the methods used by the students. (Question #2 had been dropped after the pilot.) There was a fairly even spread over the different methods available. Of the 110 students 36 (33%) used pictures, 36 (33%) used words or topics, 44 (40%) used the table of contents, and 57 (52%) used the index to look up information (see figure 1a). My conviction that an index was important was reinforced by the fact that over half of the students used the index. During the observations I had noted that many students used more than one method to look things up. This was reinforced by 38 (35%) of the students indicating that they used more than one method. In designing the book I had provided more than one method in anticipation of this need.

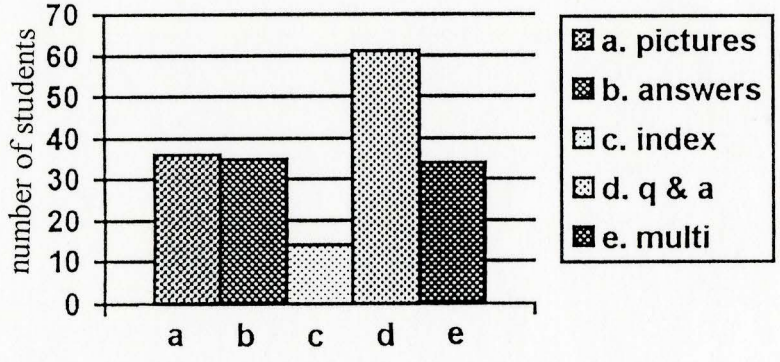
The method employed in gathering questions for this book was intended to produce a book that addressed the students concerns. Question #4 "Did you find what you were looking for?" was intended to determine if the students concerns were met. Of 110 students, 106 (96%) indicated that they had found the answer to their questions; only 4 (3.5%) indicated that they had not found the answer to their questions. (Students who had indicated "sometimes" were included in the yes column when entered in the data base.) These findings suggested not only that soliciting questions from students was a good

Figure 1: Students' responses to evaluation questions. Sample size was 110 students.



a.) Methods used by students to find information in the book.

b.) Students overall rating of resource book.



c.) Aspects of book that students liked.

method of determining the concerns of students, but it also indicated that the sample size had been large enough to cover most concerns.

The students were given an opportunity to rate the book on a Likert scale of happy faces in question #5. Only two students indicated that they did not like the book, 11 (10%) were not sure, 18 (16%) thought it was O.K., 29 (26%) liked it quite a lot, and 50 (45%) liked it a lot (see figure 1b). The two students that indicated that they did not like the books also indicated in question #7 that they would change everything. A closer look at these students' complete data assured me that their comments did not reflect deficiencies in the book but in their attitudes. These students, one girl and one boy, were both in grade four, and both reflected a negative attitude in their comments. The boy asked "Do you think I am crazy?' and the girl wrote "I don't tell (my family) anything." The majority of responses warrant the judgment that the students gave the book an overwhelming stamp of approval. This judgment could be challenged because the study did not take into consideration that the students may have just wanted to please me as the author of the book. They might have been reluctant to make a negative judgment on any book. The qualitative observations did reinforce the judgment that the students liked the book.

It was encouraging to know the students enjoyed the book but it was more interesting to find out in Question #6 specifically what the students liked about the book. Thirty four students indicated that they liked more than one aspect of the book. Although only 36 (33%) students had indicated that they used the pictures as a tool to find information 51 (46%) responded that they liked the pictures. The fact that 35 (32%) liked

the answers indicated that the language was appropriate and the information was relevant to the students. Only 14 (13%) indicated that they liked the index but 57 (52%) had actually used it as a tool. I had aimed to create a book that was user friendly and the fact that 61 (55%) students liked the question and answer format reinforced my conviction that this book was user friendly (see figure 1c).

When asked in question #7 if they would change anything about the book 77 (70%) students said they would change nothing. Other students gave the question considerable thought and made some suggestions to improve the book. Thirteen students (12%) suggested adding colour, an idea that would indeed make the book more attractive. Four students wanted more pictures and one suggested using photographs. Other suggestions included numbering the questions and changing the title. A few suggested adding more information about specific insects, a suggestion that is addressed in the discussion of the teachers' evaluation.

Question #8 "What would you tell your friends and family about this book?" was an open ended question intended to elicit more complete answers than if they had simply been asked to make comments. The comments were generally favourable with the exception of the two mentioned in the discussion of question #5. Many commented that they liked it or that it was "cool." Some commented positively on its value as a resource with such comments as "it had good facts" and "it had lots of information". Others commented on what they had learned from the book. Since my intent is to have the book published my favourite comments were "buy it" and " they should have this book around

the house." The comments closely matched the observations I had made and the ratings the students had given the book on the Likert scale. Over all I feel justified in saying the students found the book enjoyable, informative, and user friendly.

III i.) Teachers' Responses to the Questionnaire and Discussion

Four male and 15 female teachers responded to the teachers' questionnaire. There were too few males to make any gender comparisons of the responses. Teacher statistics as discussed here are seen summarized in appendix N. Teachers had between three and 34 years of teaching experience; 6 with 3 years, 6 with 10-19 years, 4 with 20-29 years, and 3 with 30-34 years. The wide range of experience was seen as an asset. It meant that the teachers came from a wide range of training backgrounds.

All 19 teachers had a Bachelor of Arts degree, and one also had a Bachelor of Science degree. This confirmed my initial concern that the majority of primary and junior teachers have little or no science background. Four teachers also indicated that they held a Masters of education degree. I hoped that this would better enable then to review the book with a critical eye.

The grades that these teachers were teaching at the time of the survey ranged from kindergarten to grade eight; kindergarten (2), grade one (4), grade two (4), grade three (2), grade four (2), grade five (2), grade six (1), grade seven (1), and grade eight (1). Nine of these teachers were teaching students in my initial target audience, but all data was included.

Twelve of the teachers just reviewed the book while seven used it as part of their insect study. Only four of these seven actually had the students use the book so I decided not to analyze the data collected on how the teachers felt the students responded to and used the book.

In response to the question on how the teachers themselves used or would use the book 15 responded that they would use it as a general reference and 14 said they would use it to look up specific questions. This showed that although the teachers saw the value of this book as a general reference on insect they also valued it for the specific questions it answered. Six respondents also said they would use it to look up a general topic and 11 indicated more than one use for the book (see figure 2a).

To find information in the book most teachers (15) indicated that they had or would use the index or a mixture of methods (14). This reinforced my conviction that the index was important. They also found topic heading (11), and the table of contents (7) useful research tools (see figure 2b). Much like the student survey these finding indicated that all methods were important and all would be used.

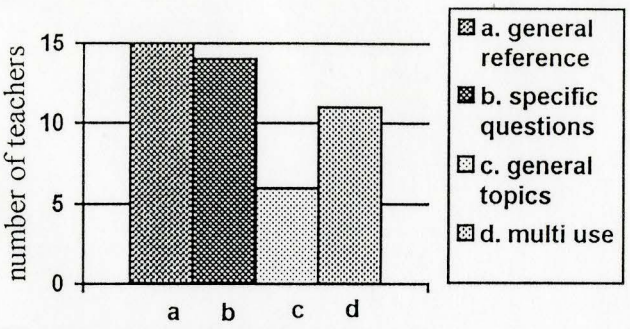
When asked which aspects of the book they liked, 15 indicated more than one aspect with 10 of those indicating all aspects. The majority (17 out of 19) liked the question and answer format, twelve liked the pictures, 14 the answers, 10 the content, and 11 the index (see figure 2c). As in the student survey all aspects of the book seemed to be appreciated.

Eleven teachers, like the majority of students, indicated that they would not change any part of the book. Also like the students, five teachers suggested adding colour to the pictures. I had considered doing this but with the number of books I needed to print the cost was prohibitive. I would suggest that when this book is published it should be done with colour pictures. Suggestions of enlarging the pictures and making the page headings larger would also be publication considerations. One teacher suggested adding sections about specific insects. This was never the intent of the book; it was designed as a general reference that reflected the concerns of the students. The addition of an annotated reference list could lead the students and teachers to more specific information.

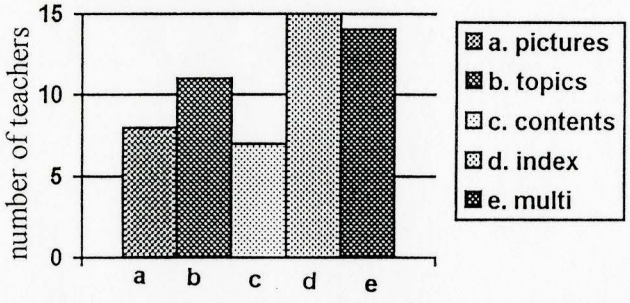
All but one teacher rated the index from somewhat to very useful. The one teacher who indicated that the index was not useful also indicated that he had not used the index. The fact that 18 teachers found the index useful was another indication that the teachers appreciated the value of an index and felt that the one in the book was well executed.

Only one grade two teacher found that the language was not appropriate. The other kindergarten, grade one and grade two teachers found some or most of the language appropriate for their students. Since I had intended the book as a teacher reference for the lower grades this was not surprising. All teachers from grade three and higher found most or all of the language appropriate. These findings were similar to the observation of the students.

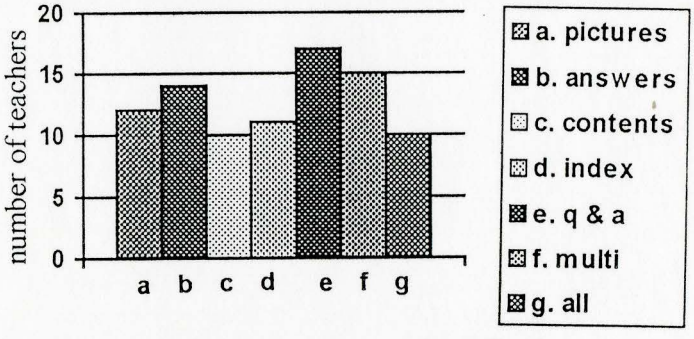
Figure 2: Teacher responses to evaluation questions. Sample size was 19 teachers.



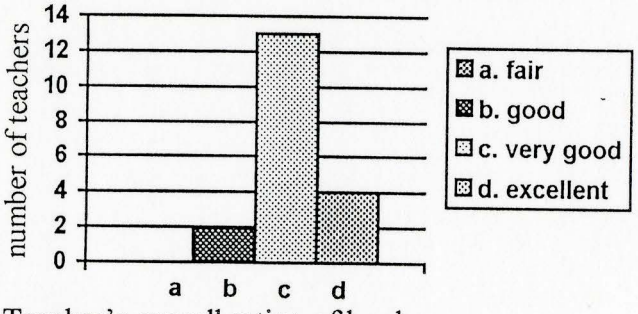
a.) How teachers used the book.



b.) Methods used by teachers to find information in the book.



c.) Aspects of the book that the teachers liked.



d.) Teacher's overall rating of book.

When asked to rate the book overall none of the teachers gave the book a negative rating. Two rated it as good, 13 as very good, and four as excellent (see figure 2d). The teachers responses were less critical than the students. Students likes and dislikes were based on personal feeling not on whether the book filled criteria important to learning. There ratings could have reflected the students feelings about insect or science as well as their feelings about the book. The teachers as "educational connoisseurs" (Eisner, 1991) could better understand all aspects of the reference book. With their training and teaching experience they were better able to know the criteria that a good reference book needs to meet and determine whether this book filled those requirements.

The final question of the teachers' questionnaire was similar to the open ended questions posed to the students. The teachers were asked what they would tell other teachers about this book. In response most teachers commented on the positive value of this book as a resource or reference. This is what I had hoped to create, a book they would value in as an important resource when studying insects. Two comments were particularly satisfying. One was that it "answers common questions in understandable language," in other words it was as relevant and the information as accessible to students as I had hoped. The other was that the book was "a good resource especially for teachers with no science"; this was exactly the niche I hoped to fill. The evaluation also confirmed that by getting in touch with the students as the transformation orientation requires I had successfully produced a book that addressed the concerns and interests of the students, and met with the approval of teachers.

CONCLUSION

Soliciting questions from students as a method of selecting subject matter for an educational resource proved to be effective. The book met with all the criteria I had set out for its preparation. It provides information about insects and answers questions and concerns of the students in an easy to use format using language that is appropriate to the target grades. Using this approach I was able to produce a document titled "You Asked about Insects" that the evaluation indicated the students liked and found easy to use. Teachers also found the book an important resource that they would use themselves and have their students use. The evaluation not only confirmed that criteria had been met, it also had a formative element. Students and teachers were presented with the opportunity to offer suggestions for improving the book. Their suggestions led to some important modifications that with be adopted when the book is published. The published book will include colour pictures to make it more attractive and appealing to the students. Topic headings will be larger and bolder so they are easier to locate for those who wish to look up information by browsing. Although sections on specific insects will not be added to the book, an annotated reference list will be included to direct readers to more detailed information on specific groups of insects.

Although the evaluation yielded some interesting information I would modify this study if it were repeated. Even though it would be more time consuming classes would be

given time to use the book while studying insects rather than just reviewing the book for evaluation purposes. Pretesting and post testing of the evaluation groups and control groups would also be done to determine knowledge gained and attitude changes. A comparison of this book to resource books prepared in a more conventional manner (without consulting students) would also be of interest. Closer attention to the demographics of the evaluators could also reveal cultural and socio-economic differences in the reaction to the resource book.

Listening to the students concerns and putting myself "in their shoes" (Miller and Seller, 1988) was an enlightening experience that led to a much different resource than I would have produced without their guidance. I was able to avoid the information that I would have tended to include in a resource that the students may have found of little or no relevance to them. My only fear with this approach was not realized. I had feared that using students' questions would unduly restrict the wide range of topics I wished to cover. The students' questions were wide ranging enough that this fear was never really a concern. I still have a desire to share some of the more specific and what I consider to be the more amazing facts about insects but perhaps these could be addressed in a second book that would appeal to students who wish to explore the world of insects beyond their initial concerns, and beyond what the curriculum documents treat as basic. It would be titled "What You Didn't Ask About Insects, But I Thought You Should Know!"

APPENDIX A: Introductory Letter and Forms for Question Gathering

Margaret Pickles
19 Halesmanor Court
Guelph, Ontario
N1G 4E2

Phone: (519) 837-8573
Fax: (519) 763-6086

Dear Primary and Junior Teachers,

I am presently enroled in the Master of Science (Teaching) program at McMaster University. In addition to the course work all students are required to complete a curriculum related project. Since my background is in Entomology I have chosen to compile a reference about insects suitable for primary and junior students and teachers. I believe it is important to address the concerns of the students in these types of references if they are to be valuable to the students or to the teachers who are trying to address the students' queries.

In order to access the concerns and questions students have about insects and other bugs I am asking for your assistance. I would like you to solicit questions about insects from your primary and junior students and send them to me at the above address. If you are interested in being a part of this project please read the added suggestions and fill in and enclose the survey form with the children's questions. The questions I receive will be compiled into categories and the most common questions will be answered in the reference. The material will also be indexed for convenience.

I am hoping to finish gathering questions by the end of February. If you can find the time to address this before then I would greatly appreciate it. The more students who are given the opportunity to ask questions the more representative the reference will be. Thank you for your participation in this matter.

Yours sincerely,

Margaret Pickles, B.Sc.

"Questions About Insects" Survey

Please fill out one survey form for each class that is submitting questions.

School: _____

_____

_____

Teacher's Name: _____

Grade Level: _____

Number of students: _____

Which method did you use to collect the questions?
Class discussion _____
Individual efforts _____
Others (please explain) _____

_____

_____

Have your student studied insects before?
No _____ Yes _____ If yes, when? _____

Are you studying insects now? Yes _____ No _____

Are you planning on studying insects in the spring semester?
Yes _____ No _____

If yes, would your class be interested in evaluating the resource?
Yes _____ No _____

Teacher's Background (optional)

Bachelor's degree specialty _____

Number of years teaching _____

Have you taken any science qualification courses?

Which one(s)? _____

What resources do you presently use when teaching about insects?

_____

_____

Thank you for your participation.

"Questions About Insects" Suggestions

Setting the Scene

Tell the students to imagine that they are going to have a visitor to the class. This visitor is an entomologist, a bug specialist. Tell them that since this visitor can only stay for a short while each student can only ask one or two questions of the bug specialist. Ask them what their question would be.

Collecting the Questions

There are a couple of ways that questions could be collected.
For younger students you may make this a class activity where the students relate their questions and you write them down. You would then send a list of questions from the class.

For older children you might have the individual students write down their questions, and then you can collect them and send them to me.

Please try to avoid influencing the students when they are deciding which questions to ask. I am interested in the students concerns. With your experience of working with children you may be able to think of questions that prior students have asked you but have not been address by your present group. I would welcome this input as very valuable, but please list these questions separately and indicate that they are from your prior experiences.

Sending the Questions

Please send the lists or packages of question to me at

Margaret Pickles
19 Halesmanor Court or fax them to (519) 763-6086
Guelph, Ontario
N1G 4E2
Please send by the end of February.

Please include a survey form with each response. If you are mailing responses from several classes in one package please include a survey form for each class. Thank you.

Evaluation of Resource

Once completed a draft of the resource document will be distributed to a few schools for them to use as a reference during their study of insects. The document will be used and evaluated by teachers and their classes. This should yield many comments and criticisms that will help to modify and improve the resource. If you will be studying insects in the spring term and would be interested in evaluating the resource please indicate so on the survey form. I will choose a representative cross section of grade levels to complete the evaluation.

Thank you for your participation. I look forward to your responses.

APPENDIX B: Summary of Classes that Responded to Request for Questions

NUMBER OF SCHOOLS THAT RESPONDED

20 OF 100 SCHOOLS ANSWERED THE REQUEST FOR QUESTIONS

NUMBER OF CLASSES THAT RESPONDED

44 CLASSES ANSWERED THE REQUEST FOR QUESTIONS

NUMBER OF STUDENTS THAT RESPONDED

1150 STUDENTS ANSWERED THE REQUEST FOR QUESTIONS

GRADES THAT RESPONDED

Kindergarten = 4 classes

GR. 1 = 7 classes

GR. 2 = 8 classes

GR. 3 = 11 classes

Gr. 4 = 6 classes

GR. 5 = 6 classes

Gr. 6 = 2 classes

Appendix C: List of Students' Insect Questions

Number in parentheses after questions indicates number of times question was repeated.

ARTHROPODS: INSECTS AND THEIR RELATIVES

Do insects have cousins?

Why aren't spiders insects? (3)

Are bugs the relatives of the dinosaurs?

Did bugs live with the dinosaurs?

Are bugs insects?

How can we identify them?

Are there any rare bugs?

What do all insects have in common?

How did bugs get created? (8)

What does the word insect mean? (5)

Why are they called insects? (3)

How did they get their names? (3)

12 (29)

SIZES AND NUMBERS

Why are bugs interesting?

When were insects first discovered? (3)

Why are insects called insect? How did they get that name? What does insect mean? (9)

Why are insects small? (6)

Do you think bugs will grow bigger some day?

Why are some bugs slimy?

Why do they call stink bugs stink bugs?

Why do bugs have names?

What was the first bug on earth? (14) when? (2)

Did bugs live in dinosaur times? (5)

Are there still bugs living from the dinosaur times?

Which is the most intelligent bug?

What are the fastest bugs? (3)

What is the world's smallest insect? (25)

What is the biggest bug in the world? (44)

How big can insects get?

When was the largest insect spotted?

What is the strongest insect in the world? (7)

What is the largest fly?

Are there nocturnal bugs? (3)

How many kinds of bugs in the world? (49)

Is the most popular insect a fly? a mosquito?

What kind of insect do we have the most of in Waterloo county?

How many different kinds of bugs would you find in Canada?

What would be the usual number of bugs in a family?

Which bug lives longest? (14)

What is the most interesting bug?

Do insects sleep? (4)

Which is the strongest bug?

Do all insects work?

Which is most common? (2)

How can ants carry things a lot bigger than themselves?

How can you tell bugs apart?

35 (209)

PARTS OF AN INSECT (STRUCTURE)

What makes and insect an insect? (2)

Why are insects so small?

Why do insects have 6 legs and spiders have 8?

Why do ants have three parts in their body? (2)

What are insects made of?

What does an insect feel like? (8)

Why are bees furry?

Do insects have bones?

Are some bugs fat?

Do all insects have their skeleton on the outside of their body? (2)

Do all insects have hairs?

Why are they slimy?

12 (23)

ORDERS (KINDS OF INSECTS)

What types of bugs are there?

Is a fly an insects?

Is a butterfly a bug?

Why do they call dragonflies dragonflies?

How big is a praying mantis?

Why are ants so small but so strong?

How does a firefly glow?

How many insects glow?

How many kinds of tiger beetles are there?

How many butterflies are there?

How many kinds of mosquitoes are there?

Why do leaf ants have giant queens?

How do fireflies light up? (3)

13 (15)

METAMORPHOSIS

How do insects grow? (6)

Where do they lay their eggs?

How long are insects in the egg stage? (4)

Why do bugs shed their skin?

Why do preying mantids grow back lost body parts?

How do caterpillars change into butterflies? (6)

Why do caterpillars change into butterflies?

How do caterpillars make their cocoon? (10)

What does a caterpillar do in the cocoon?

When a caterpillar comes out of it's cocoon where does it go? Does it dissolve?

How long do they live? (12)

Are dragonflies the longest living insects?

How can you tell how old a butterfly or insect is?

Are most bugs hatched from eggs or are some live born?

How long do ants live?

Do bugs die? (5)

Why do cicadas take so long to come out of the ground?

How long are caterpillars in their cocoon?

Why do dragonflies stay under water in the winter?

When do butterflies learn to fly?

What are cocoons made of?

21 (58)

REPRODUCTION

Why do some insects eat their mate?

How do ants make baby ants?

How do bugs lay their eggs?

Where do they lay their eggs?

How do grasshoppers get born?

How do cockroaches mate?

How can you tell boy bugs apart from girl bugs? (3)

Why do bugs lay eggs? (2)

Do all bugs have babies?

How many babies do they have at one time?

How many eggs do they lay? (3)

How can you tell if an insect is pregnant?

Can different insects mate together?

How are flies born?

Do dung beetles really live in dung?

How do bugs mate? (5)

Do bugs lay eggs? (3)

What do bug eggs look like?

Can lady bugs be men?

Why do insects lay so many eggs?

19 (30)

INSECTS HAVE SIX LEGS

How many legs do they have? (6)

Do all insects have six legs? (18)

How long are insect legs?

Why do insects have six legs? (12)

Do some insects have little claws? (2)

Why do caterpillars have so many legs?

Why do caterpillars have legs? (4)

How do grasshoppers jump so high?

How do grasshoppers jump so far?

How high does a grasshopper jump?

How and why do grasshoppers hop? (5)

Why can't some bugs swim?

Do some bugs swim? (2)

How long can a bug stay under water?

Can an ant jump?

How do they walk? (14)

Do all insects jump? How? (7)

Do all insects swim?

Can bugs go in the water?

Can some insects climb trees?

Why do some walk and some don't?

How many kinds of insects walk?

Do bugs have feet?

How do ants walk up a wall?

Do all insects have spines on their legs?

How do they climb up a wall? window? trees? (3)

How so they stick to the ceiling?

How do they walk on water?

27 (91)

INSECTS HAVE WINGS

How many insects fly? (19)

How many insects don't fly?

Which insects fly/ which don't?

Why do ladybugs have wings under their shell? (2)

Why do some insects fly? (15) And some don't? (2)

Why do some bugs fly?

Why do some ants have wings?

Why can't you see ladybug's wings?

What are wings made of?

How thin are fly wings?

How do wings of insects work?

How do flies fly with the wings they have?

How fast do flies fly? insects fly? (3)

Why do butterflies die when you take the dust off their wings?

Why do flies fly?

Where do ladybugs fly to?

Why do flies buzz like bees?

How do bees buzz? (4)

How does a bumble bee fly?

How do bugs fly? (4)

Why do queen ants have wings?

How far can they fly?

Why do dragonflies have 4 wings?

24 (66)

MANY KINDS OF MOUTHS

How do mosquitoes bite through your pants?

Do bugs loose their teeth?

Do insects have teeth? (3)

How do bugs eat? (3)

How do mosquitoes bite?

How do bees drink and eat?

How do mosquitoes suck blood? (3)

7 (13)

SOUNDS AND SENSES

Do bugs have senses?

How do bugs communicate? talk? (9)

Why do cockroaches hiss?

Why do bees buzz?

How do crickets make noise?

How do grasshoppers make their noise? (4)

Why do insects need antennae? (4)

Do they smell and taste with their antennas?

How and why do fireflies make their light? (2)

Why do moths like the light?

Why do insects fly around lights? (2)

Do all insects have sight or do some have no sight?

What do their eyes look like?

How many little eyes do flies have? (4)

How many eyes do flies have?

Why do bugs have different eyes?

How do they see? (3)

Which insect has the most eyes? (4)

Can bugs be blind? (3)

Do they have eyes in their eyes?

Why don't insects have noses?

Can bugs smell?

How do compound eyes work?

Why do insects have such big eyes?

25 (51)

INSIDE A BUG

Why does "goo" come out of a smashed bug?

If you kill a bug will it make a mess?

Can you dissect a bug?

Do insects have blood in them? (3)

Do insects have different coloured blood? (2)

Do bugs pump blood?

How fast does a bug's heart beat?

How big is an insects heart?

Are bugs warm blooded or cold blooded?

Do all bugs and insects have brains? (2)

How big is a bug's brain?

Which is the biggest brain?

What is the size of a bugs brain? (3)

How many brain cells does a preying mantid have?

How do bugs dispose of waste?

Can bugs tinkle?

Do insects go to the washroom?

Do bugs have the same organs as we do?

Why do caterpillars have green guts? blood? (3)

Why can't you see insect's heart?

Do bugs have hearts?

21 (29)

THE COLOUR OF BUGS

Are all insects the same colour?

What are all their colours?

Why do insects have all those different colours? (4)

How many different colours are insects? (4)

Why do butterflies have different coloured wings?

Why do lady bugs have spots? (9)

Do lady bugs get a spot after their birthday?

Do the spots on a lady bug really tell their age? (3)

Why are bees black and yellow? (4)

Why do bees have stripes?

Why are lady bugs black and red?

Why are beer bugs black and white and black and yellow?

Why are bugs attractive?

How do lady bugs get their spots? (2)

How do butterflies get their colours? (3)

What is the most colourful insect? (4)

Why are they spotted?

How do some insects change colours?

18 (43)

STINGING AND BITING: DEFENCE

How do insects defend themselves?

Why do mosquitoes suck blood? (23)

How much blood do they suck?

Why do moths eat through clothes?

Do all insects bite?

How many bugs bite people? (2)

What kind of bugs bite people?

Why do bees sting? (20)

How do bees sting?

Why do bees die after they sting people? (7)

Does it hurt when bugs bite or sting you?

What happens if you get bitten by a tarantula?

Which bugs eat other insects?

Why do some bugs eat other bugs?

What bugs are you afraid of? Why?

Which bug is the fiercest?

Do caterpillars bite?

Do some bugs fight?

Why do ants hurt?

Why do fleas bother dogs?

How many kinds of spiders, found naturally, in Canada are considered poisonous?

Are there poisonous bugs? (5)

How many bugs are poisonous? Which ones?

Which bug is the deadliest (most dangerous) kind? (in the world) (8) (in Canada) (2)

Are red ants dangerous?

Are caterpillars poisonous?

Are there such a thing as killer bees?

Do they have special body parts to kill predators?

Why is it called a stink bug?

How do stink bugs stink?

Do all insects have a form of protection? self-defence?

Are they all poisonous for birds to eat?

Why do caterpillars have hair?

What is the most dangerous insect? (3)

Why are insects camouflaged?

How do insects make their poison? (2)

Why does a walkingstick look like a stick?

Where is the stinger on a bee?

39 (102)

LIVING TOGETHER

Do all insects live in groups?

Why do some insects live in colonies?

Why do bees live in hives?

Do bugs travel together? (3)

When a queen ant dies, who takes its place?

Do bug families separate? Do they have families?

Do all insects have a queen or leader?

8 (10)

FOOD

How do bugs eat?

What is the most common insect food?

What do insects eat? (20)

Why do bees like flowers?

Do bugs eat other bugs? (2)

Why do termites eat wood?

Why do bees make honey? (4)

How do bees make honey? (7)

How much honey does a bee store in a day?

How do bees bring pollen back to the hive?

How do bees find flowers?

Why do bees like sweet food?

What types of food do ants eat?

Why do termites eat wood?

What do bugs drink?

What do ladybugs eat? (2)

What do caterpillars eat?

What do butterflies eat?

What do fireflies eat?

Why do ants eat leaves? (3)

Do insects eat dead animals?

Why do grasshoppers eat plants? (2)

Are most insects vegetarians?

Do they eat plants?

What do flies eat? (2)

What do male mosquitoes eat?

Do bugs share their prey?

Why do flies like horses so much?

Why are fleas on cats and dogs?

Do bugs go to the bathroom? (4)

Do they drink water and dew drops?

How do they get pollen out of flowers? (2)

Why do flies go in the garbage?

31 (72)

ENEMIES

What enemies do grasshoppers, ants, preying mantids, bees, crickets have? (6)

Do bugs get diseases?

Do humming birds harm insects?

Do bugs have animal enemies?

What insects are eaten by fish?

5 (10)

HOMES

What is the most common bug habitat? (10)

Where do bugs live? (4)

How do ants build tunnels? (4)

Can ants live in mud?

Why do ants like to live under the ground? (2)

How do bees build their hive? (3)

How do insects make their homes?

How long does it take insects to build their homes?

How long does it take for an ant to build a nest?

Why do beetles hate water?

Do all bugs like water?

How many insects live underground?

Do all bugs live in the ground?

What are bees hives made from?

Where do lady bugs live?

15 (33)

WINTER

How many Insects stay in Ontario for the winter?

In what season do bugs come out the most?

Where do insects go in the winter? (11)

Do bugs hibernate in the winter? (5)

Where do flies go in the winter? (2)

Do bugs freeze in the winter?

How do bugs live in the winter?

Do some bugs surface in the winter?

Do all insects hibernate?

Do some bugs migrate?

10 (25)

INSECTS AND HUMANS

Why do so many bugs like to come into our house in the summer?

Why do June bugs come into the house?

Why do earwigs get in the house? (2)

How do ants get in your house? (2)

Why are bugs attracted to humans?

Are head lice insects? Why do they bother people? How do you get id of them?

How do they help us?

Do flies help humans in any way?

Why do people kill bugs? (2)

If a mosquito bites someone with aids, and than bites you will you get aids? (4)

Do bugs carry diseases? (3)

Do insects kill people? (2)

What is the most deadly insect?

Could any kind of bug have rabies?

Do earwigs really go in people's ears?

What would our area be like without insects?

Do people really eat bugs? (2)

Why do mosquitoes suck blood from humans? (2)

Why are bugs a nuisance?

Why are most people allergic to mosquito saliva?

Why are bugs helpful? (3)

Why are people afraid of bugs?

Can flies kill people?

Why are people mean to insects? Can you play with insects?

Can you eat bugs and not get sick?

27 (40)

Entomologist

As an entomologist what do you find most interesting about your job?

Why do you find bugs so fascinating? (2)

Why do you like bugs?

Where did you learn about bugs?

Which is your favourite bug? (10)

In your job do you have to dissect bugs?

How did you become interested in the study of bugs?

Where does and entomologist do their work?

What is the largest bug and the smallest bug you have ever examined?

How old were you when you first became really interested in studying bugs? How long have you studied bugs?

An entomologist studies bug, an exterminator gets rid of bugs, do you help each other?

Are there groups of people in the world who want to protect bugs? (sort of like Save the Whales)

How big is your bug collection?

Have you seen a real live tarantula?

Where is your favourite spot to catch bugs?

Do you keep live bugs were you work?

Do you have any bugs from other countries?

Do you like spiders?

Do you have a black widow?

Have you ever eaten a chocolate covered beetle?

How do you study bugs?

Do entomologist dig up bugs from the Dinosaur age?

How many insects do you study in a day?

How many bugs do you collect in a day?

When did you get interested in bugs?

Can you name all the insects in the world?

27 (37)

TOTALS

Questions: 396 (986) 61 discarded Total: 1047 questions

Schools: 20/ 100 schools answered. Classes: 44 classes total Students:1151 students

-as few as 12 questions per class, to approx. 90 per class -majority were one per student.

APPENDIX D: Pilot Students' Evaluation Questionnaire

Student's Evaluation Form for "Questions and Answers About Insects"

Your grade: _____ Your age:_____ You are _____a girl____ a boy

1. What was the most interesting thing about this book?

2.What was the least interesting thing about this book?

3. How did you look things up?
   ____ look for pictures
   ____ look for word or topics
   ____ look in the front of book (contents)
   ____ look in the back of book (index)

4. Did you find what you were looking for? __yes __no __sometimes

5. Did you like the book?

6. What did you like about the book?
   ____ the pictures
   ____ the answers
   ____ the questions and answers
   ____ the list in the back (index)

7. Was there anything you would change about the book?

8. What would you tell your friends and family about this book?

APPENDIX E: Pilot Teachers' Evaluation Questionnaire

Please review this form for comprehension and value as an evaluation form for the book, ie) if you had used this book during your insect unit would this form adequately address all areas that need evaluating? Any suggestions or comments would be appreciated.

Teacher's Evaluation Of "You Asked About Insects"

Grade:_____ # of years teaching:_____ Gender:___female___male

Education:____ BA ____ BSc ____ BEd Other:_____

1. Did you use the book during your class studies of insects?
   ___yes Please answer both sides of this form.
   ___no, just reviewed the book. Please go to other side of form.

While studying insects in the class:

2. You referred to it: ___ occasionally __ fairly often
   ___ often ___ frequently

3. Did your students use the book? ____ yes ____ no

   If no, please go to other side of form.

4. Students used it:
   ____ as an overall reference
   ____ to look up general topics
   ____ to look up specific questions
   ____ other:_____

5. What methods did your students use to look things up?
   ____ browse for picture cues
   ____ browse for general topic
   ____ table of contents
   ____ index
   ____ other _____

6. In your opinion what did the students like or dislike about the book?

More questions on the back of this sheet!!!

7. You used it or would use it:
   ____ as an overall reference
   ____ to look up general topics
   ____ to look up specific questions of your own
   ____ to look up specific student questions
   ____ other _____

8. What methods did you (or would you) use to look things up?
   ____ browse for picture cues
   ____ browse for general topic
   ____ table of contents
   ____ index
   ____ other _____

9. What did you like about the book?
   ____ the pictures
   ____ the answers
   ____ the question and answer format
   ____ the index
   ____ other _____

10. Would you change anything about the book?

11. Did you find the index useful?
    ___ no ____somewhat ___quite useful ___useful ___very useful

    Comments:

12. Was the language appropriate for your grade level?
    ___no ___some ___half ___most ___ all of it

    Comments:

13. How would you rate this book overall?
    ___ fair ___ good ___ very good ____ excellent

    Comments:

14. What would you tell other teachers about this book?

Thank you for participating in the evaluation of "You asked about Insects".

APPENDIX F: Students' Evaluation Questionnaire

Student's Evaluation Form for "Questions and Answers About Insects"

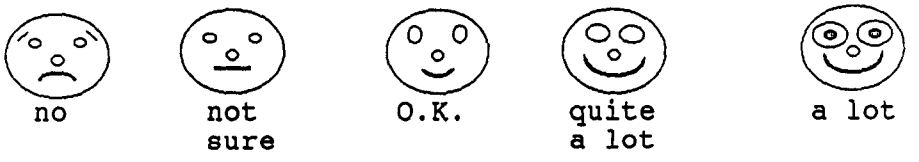
Your grade: _____ Your age:_____ You are _____a girl____ a boy

1. What was the most interesting thing about this book?

3. How did you look things up?
   ____ look for pictures
   ____ look for word or topics
   ____ look in the front of book (contents)
   ____ look in the back of book (index)

4. Did you find what you were looking for? __yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
   ____ the pictures
   ____ the answers
   ____ the questions and answers
   ____ the list in the back (index)

7. Was there anything you would change about the book?

8. What would you tell your friends and family about this book?

APPENDIX G: Teachers' Evaluation Questionnaire

Teacher's Evaluation Of "You Asked About Insects"

Grade:_____ # of years teaching:_____ Gender:___female___male

Education:____ BA ____ BSc ____ BEd Other:_____

1. Did you use the book during your class studies of insects?
___yes Please answer both sides of this form.
___no, just reviewed the book. Please go to other side of form.

While studying insects in the class:

2. You referred to it: ___ occasionally __ fairly often
___ often ___ frequently

3. Did your students use the book? ____ yes ____ no

If no, please go to other side of form.

4. Students used it:
____ as an overall reference
____ to look up general topics
____ to look up specific questions
____ other:_____

5. What methods did your students use to look things up?
____ browse for picture cues
____ browse for general topic
____ table of contents
____ index
____ other _____

6. In your opinion what did the students like or dislike about the book?

More questions on the back of this sheet!!!

7. You used it or would use it:
   ____ as an overall reference
   ____ to look up general topics
   ____ to look up specific questions of your own
   ____ to look up specific student questions
   ____ other _____

8. What methods did you (or would you) use to look things up?
   ____ browse for picture cues
   ____ browse for general topic
   ____ table of contents
   ____ index
   ____ other _____

9. What did you like about the book?
   ____ the pictures
   ____ the answers
   ____ the question and answer format
   ____ the index
   ____ other _____

10. Would you change anything about the book?

11. Did you find the index useful?
    ___ no ____somewhat ___quite useful ___useful ___very useful

    Comments:

12. Was the language appropriate for your grade level?
    ___no ___some ___half ___most ___ all of it

    Comments:

13. How would you rate this book overall?
    ___ fair ___ good ___ very good ____ excellent

    Comments:

14. What would you tell other teachers about this book?

Thank you for participating in the evaluation of "You asked about Insects".

APPENDIX H: Request Letter for Participation in Evaluation

Margaret Pickles
19 Halesmanor Court,
Guelph, Ontario
N1G 4E2

Ph: (519) 837-8573
Fax: (519) 763-6086
e-mail: mpickles@uoguelph.ca

May 17, 1996

Dear Teacher,

Thank you for participating in the evaluation of "You Asked About Insects". Enclosed you will find a copy of the book and evaluation forms for the students and teachers. If you need more evaluation forms please feel free to photocopy them.

Please use the book during your insect study unit, fill in the evaluation forms, and return them in the envelope provided. The student evaluation forms are intended for grade three and up. For grade one and two the teacher may wish to use the student evaluation form as a guide to elicit the student opinions of the book as a class effort.

If other teachers in your school would like to review the book and fill in an evaluation form I would welcome their opinions.

Please return the evaluations as soon as you have finished your insect units. You may keep the book for future reference. If you have any questions please feel free to contact me. I hope you enjoy your insect study.

Yours sincerely,

Margaret Pickles

APPENDIX I: Sample of Students' Responses to Evaluation Questionnaires

Student's Evaluation Form for "Questions and Answers About Insects"

Your grade: 3 Your age: 8 You are ____a girl ✓ a boy

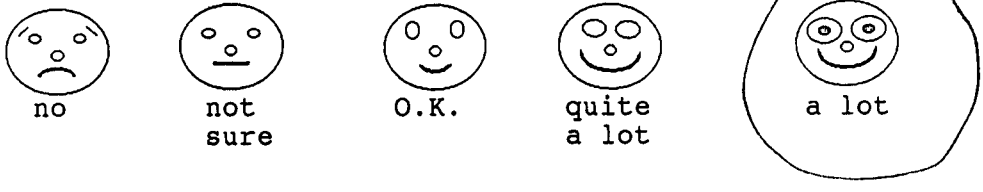
1. What was the most interesting thing about this book?

I thinck the most interesting thing is The-Est insects

3. How did you look things up?
   - ✓ look for pictures
   - ___ look for word or topics
   - ✓ look in the front of book (contents)
   - ✓ look in the back of book (index)

4. Did you find what you were looking for? ✓yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
   - ✓ the pictures
   - ___ the answers
   - ✓ the questions and answers
   - ✓ the list in the back (index)

7. Was there anything you would change about the book?

NO!

8. What would you tell your friends and family about this book?

I thinch it is Very interesting and good.

Student's Evaluation Form for "Questions and Answers About Insects"

Your grade: 3 Your age: 8 You are ____a girl ✓ a boy

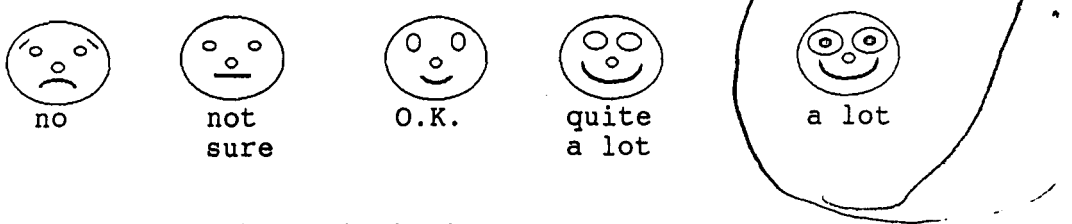
1. What was the most interesting thing about this book?

the index

3. How did you look things up?
   ____ look for pictures
   ____ look for word or topics
   ✓ look in the front of book (contents)
   ✓ look in the back of book (index)

4. Did you find what you were looking for? __yes __no ✓sometimes

5. Did you like the book? Circle one answer.



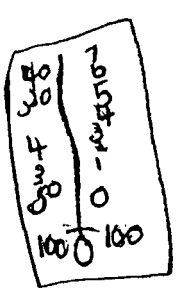
6. What did you like about the book?
   ____ the pictures
   ____ the answers
   ✓ the questions and answers
   ✓ the list in the back (index)

7. Was there anything you would change about the book?

No

8. What would you tell your friends and family about this book?

its good, instring
it's even COOL



Student's Evaluation Form for "Questions and Answers About Insects"

Your grade: 4 Your age: 9 You are ✓ a girl ___ a boy

1. What was the most interesting thing about this book?

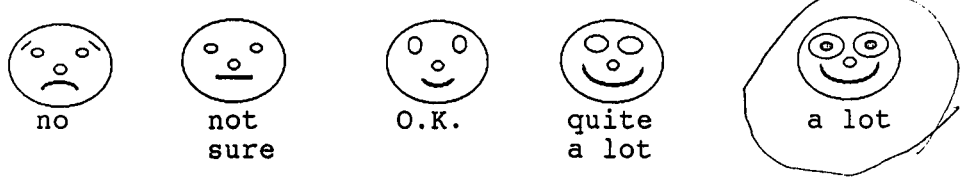
The bugs

3. How did you look things up?

___ look for pictures
___ look for word or topics
✓ look in the front of book (contents)
✓ look in the back of book (index)

4. Did you find what you were looking for? ✓ yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?

✓ the pictures
___ the answers
___ the questions and answers
✓ the list in the back (index)

7. Was there anything you would change about the book?

NO

8. What would you tell your friends and family about this book?

TO buy, the book because it is good

Student's Evaluation Form for "Questions and Answers About Insects"

Your grade: 4 Your age: 9 You are ____a girl ✓ a boy

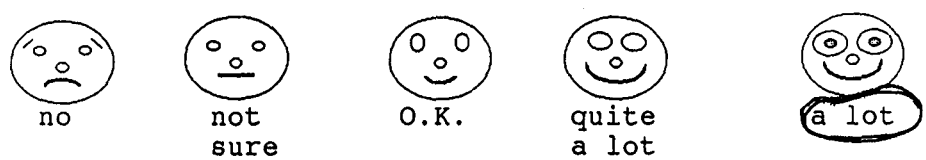
1. What was the most interesting thing about this book?

Homes and Habitats

3. How did you look things up?
   - ✓ look for pictures
   - ____ look for word or topics
   - ____ look in the front of book (contents)
   - ____ look in the back of book (index)

4. Did you find what you were looking for? ✓ yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
   - ____ the pictures
   - ____ the answers
   - ✓ the questions and answers
   - ____ the list in the back (index)

7. Was there anything you would change about the book?

Not really

8. What would you tell your friends and family about this book?

I would tell them to read it.

Student's Evaluation Form for "Questions and Answers About Insects"

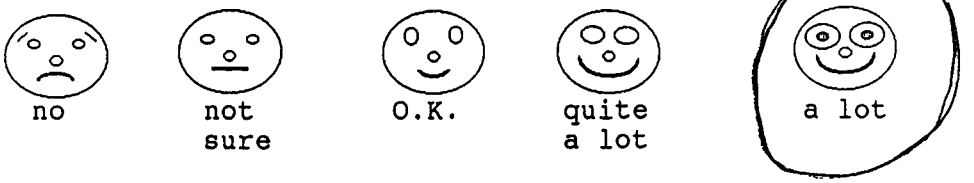
Your grade: 5 Your age: 10 You are ____a girl ✓ a boy

1. What was the most interesting thing about this book?
The page about the wasps and the bees, and there stingers.

3. How did you look things up?
yes look for pictures
NO look for word or topics
NO look in the front of book (contents)
Maybe look in the back of book (index)

4. Did you find what you were looking for? ✓yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
✓ the pictures
✓ the answers
✓ the questions and answers
✓ the list in the back (index)

7. Was there anything you would change about the book?
Nope.

8. What would you tell your friends and family about this book?
It was really neat with a lot of information.

Student's Evaluation Form for "Questions and Answers About Insects"

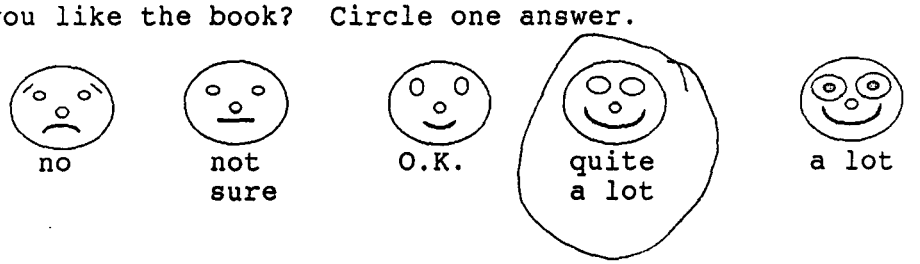
Your grade: 5 Your age: 10 You are ____a girl ✓a boy

1. What was the most interesting thing about this book?
how a mosquitoe bites

3. How did you look things up?
____ look for pictures
____ look for word or topics
____ look in the front of book (contents)
✓ look in the back of book (index)

4. Did you find what you were looking for? ✓yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
____ the pictures
✓ the answers
____ the questions and answers
____ the list in the back (index)

7. Was there anything you would change about the book?
maybe there could be colour

8. What would you tell your friends and family about this book?
it was cool because of all the insects.

Student's Evaluation Form for "Questions and Answers About Insects"

Your grade: 6 Your age: 11 ½ You are ✓ a girl ___ a boy

1. What was the most interesting thing about this book?

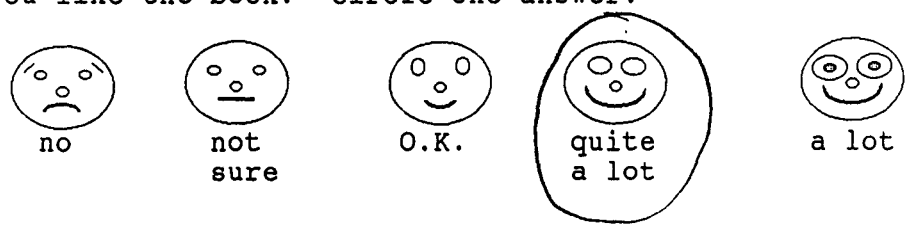
I think the most interesting thing about the book is everything.

3. How did you look things up?

___ look for pictures
___ look for word or topics
___ look in the front of book (contents)
✓ look in the back of book (index)

4. Did you find what you were looking for? ✓ yes __ no __ sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?

___ the pictures
___ the answers
✓ the questions and answers
___ the list in the back (index)

7. Was there anything you would change about the book?

No, there is nothing I would like to change about the book.

8. What would you tell your friends and family about this book?

I would tell them the insect book had alot of good, interesting questions and neat answers and awesome pictures.

Student's Evaluation Form for "Questions and Answers About Insects"

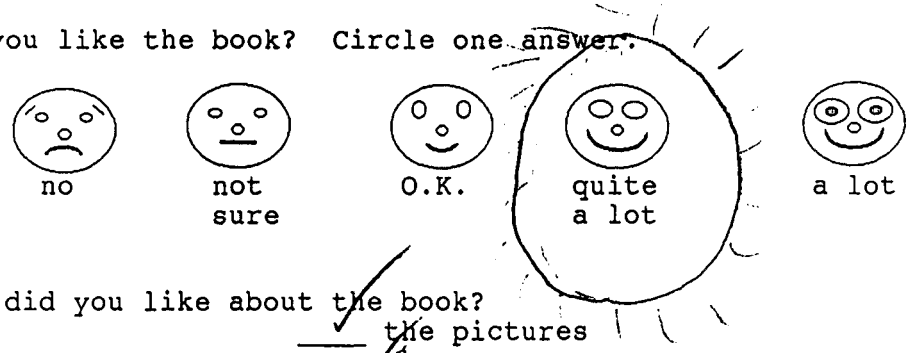
Your grade: 6 Your age: 11 You are ____a girl ✓ a boy

1. What was the most interesting thing about this book? I thought the most interesting part is the part about the posing insects.

3. How did you look things up?
   ____ look for pictures
   ____ look for word or topics
   ____ look in the front of book (contents)
   ____ look in the back of book (index)

4. Did you find what you were looking for? __yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
   ✓ the pictures
   ✓ the answers
   ____ the questions and answers
   ____ the list in the back (index)

7. Was there anything you would change about the book?

No!

8. What would you tell your friends and family about this book?

I would tell them that it was interesting and I learned a lot of things!! :-)

Student's Evaluation Form for "Questions and Answers About Insects"

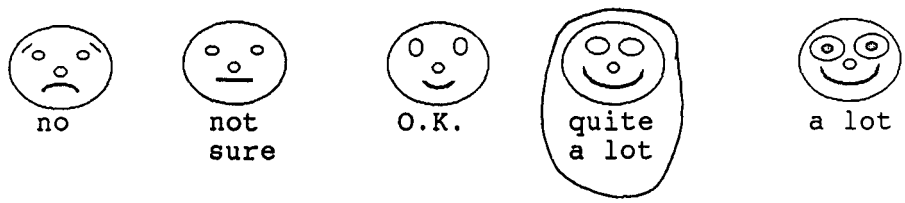
Your grade: 7 Your age: 12 You are ____a girl ✓ a boy

1. What was the most interesting thing about this book?
I found most interesting that there was a question and answer after it.

3. How did you look things up?
____ look for pictures
____ look for word or topics
____ look in the front of book (contents)
✓ look in the back of book (index)

4. Did you find what you were looking for? ✓yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
____ the pictures
✓ the answers
✓ the questions and answers
✓ the list in the back (index)

7. Was there anything you would change about the book?
I would make the pictures more clearer.

8. What would you tell your friends and family about this book?
I would say that this is a good insect book for people of all ages.

Student's Evaluation Form for "Questions and Answers About Insects"

Your grade: 7 Your age: 12 You are ✓ a girl ___ a boy

1. What was the most interesting thing about this book?

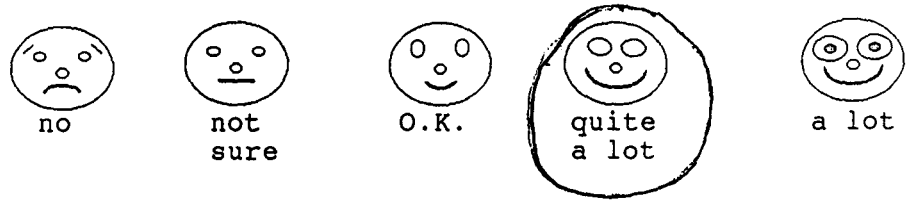
I think the pictures were good and the book was well laidout

3. How did you look things up?

___ look for pictures
___ look for word or topics
✓ look in the front of book (contents)
___ look in the back of book (index)

4. Did you find what you were looking for? ✓ yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?

✓ the pictures
___ the answers
✓ the questions and answers
___ the list in the back (index)

7. Was there anything you would change about the book?

no, I think it was a well writen book

8. What would you tell your friends and family about this book?

The book had good info that anyone could understand

Student's Evaluation Form for "Questions and Answers About Insects"

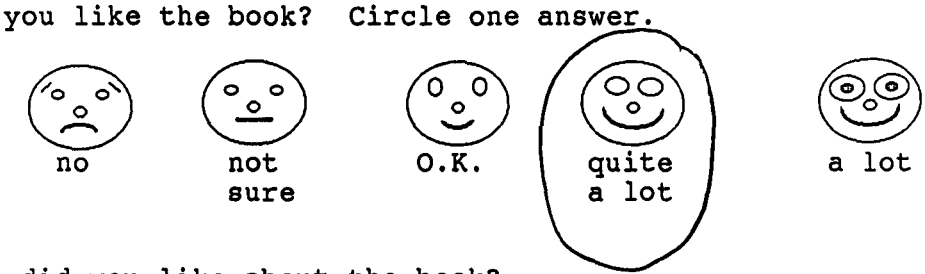
Your grade: 8 Your age: 13 You are ____(a girl)____ a boy

1. What was the most interesting thing about this book?
that it isn't a bunch of confusing info but it is actually questions that we wonder about.

3. How did you look things up?
____ look for pictures
____ look for word or topics
✓ look in the front of book (contents)
____ look in the back of book (index)

4. Did you find what you were looking for? ✓yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
____ the pictures
____ the answers
✓ the questions and answers
____ the list in the back (index)

7. Was there anything you would change about the book?
I would make different questions for different ages.

8. What would you tell your friends and family about this book?
that it is quite interesting and is good to have around the house.

Student's Evaluation Form for "Questions and Answers About Insects"

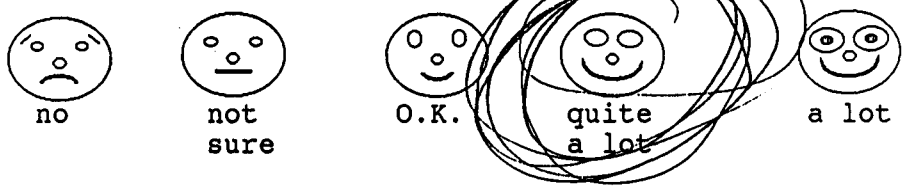
Your grade: 6 Your age: 13 You are ____a girl ✓ a boy

1. What was the most interesting thing about this book?
That you can learn about insects

3. How did you look things up?
____ look for pictures
____ look for word or topics
✓ look in the front of book (contents)
✓ look in the back of book (index)

4. Did you find what you were looking for? ✓yes __no __sometimes

5. Did you like the book? Circle one answer.



6. What did you like about the book?
✓ the pictures
✓ the answers
✓ the questions and answers
✓ the list in the back (index)

7. Was there anything you would change about the book?
Colour

8. What would you tell your friends and family about this book?
Go buy it! It was exciting and interesting!

APPENDIX J: Sample of Teachers' Responses to Evaluation Questionnaire

Teacher's Evaluation Of "You Asked About Insects"

Grade: 1/2 # of years teaching: 28 Gender: X female ___male

Education: ____ BA ____ BSc ____ BEd Other: ✓

1. Did you use the book during your class studies of insects?
   ✓ yes Please answer both sides of this form.
   ___ no, just reviewed the book. Please go to other side of form.

While studying insects in the class:

2. You referred to it: ___ occasionally ___ fairly often
   ✓ often ___ frequently

3. Did your students use the book? ____ yes ✓ no

   If no, please go to other side of form.

4. Students used it:
   ____ as an overall reference
   ____ to look up general topics
   ____ to look up specific questions
   ✓ other: _____

5. What methods did your students use to look things up?
   ____ browse for picture cues
   ____ browse for general topic
   ✓ table of contents
   ____ index
   ____ other _____

6. In your opinion what did the students like or dislike about the book?

They liked the information and would have preferred coloured pictures. There was a wealth of information which they enjoyed,

More questions on the back of this sheet!!!

7. You used it or would use it:
   - ✓ as an overall reference
   - ____ to look up general topics
   - ____ to look up specific questions of your own
   - ____ to look up specific student questions
   - ____ other _____

8. What methods did you (or would you) use to look things up?
   - ____ browse for picture cues
   - ____ browse for general topic
   - ✓ table of contents
   - ✓ index
   - ____ other _____

9. What did you like about the book?
   - ✓ the pictures
   - ✓ the answers
   - ✓ the question and answer format
   - ✓ the index
   - ____ other _____

10. Would you change anything about the book?

Not really

11. Did you find the index useful?
___ no ____somewhat ___quite useful ___useful ✓ very useful

Comments: I really prefer using books of reference which have both a table of contents & an index.

12. Was the language appropriate for your grade level?
___no ✓ some ___half ___most ___ all of it

Comments: The grade ones couldn't read it.

13. How would you rate this book overall?
___ fair ___ good ✓ very good ____ excellent

Comments:

14. What would you tell other teachers about this book?

To use it as a very useful reference.

Teacher's Evaluation Of "You Asked About Insects"

Grade: 1 # of years teaching: 30 Gender: ✓ female ___ male

Education: ✓ BA ____ BSc ____ BEd Other: _____

1. Did you use the book during your class studies of insects?
   ✓ yes Please answer both sides of this form.
   ___ no, just reviewed the book. Please go to other side of form.

While studying insects in the class:

2. You referred to it: ___ occasionally ___ fairly often
   ✓ often ___ frequently

3. Did your students use the book? ____ yes ✓ no

   If no, please go to other side of form.

4. Students used it:
   ____ as an overall reference
   ____ to look up general topics
   ____ to look up specific questions
   ____ other: _____

5. What methods did your students use to look things up?
   ____ browse for picture cues
   ____ browse for general topic
   ____ table of contents
   ____ index
   ____ other _____

6. In your opinion what did the students like or dislike about the book?

More questions on the back of this sheet!!!

7. You used it or would use it:
   - ✓ as an overall reference
   - ___ to look up general topics
   - ✓ to look up specific questions of your own
   - ✓ to look up specific student questions
   - ___ other _____

8. What methods did you (or would you) use to look things up?
   - ___ browse for picture cues
   - ✓ browse for general topic
   - ✓ table of contents
   - ___ index
   - ___ other _____

9. What did you like about the book?
   - ✓ the pictures
   - ✓ the answers
   - ___ the question and answer format
   - ___ the index
   - ___ other *information was simple BUT scientific*

10. Would you change anything about the book?

11. Did you find the index useful?
    ___ no ___somewhat ___quite useful ✓useful ___very useful

    Comments:
    Next time I use this I would probably rely on this more -

12. Was the language appropriate for your grade level?
    ___no ___some ___half ✓most ___ all of it

    Comments:
    Because I have a number of children below grade level I simplified the language to suit

13. How would you rate this book overall?
    ___ fair ___ good ✓ very good ___ excellent

    Comments:
    See the #11 comment – I will use this better next time

14. What would you tell other teachers about this book?

A great resource - especially for teachers who have little or no science background. I had already started this unit when I received book so will make better use of this next year. Many thanks— I'm glad to have it - Good Luck!

Teacher's Evaluation Of "You Asked About Insects"

Grade: SCC # of years teaching: 26 Gender: ✓ female ___ male

Education: ✓ BA ____ BSc ____ BEd Other: Spec Ed. Specialist

1. Did you use the book during your class studies of insects?
   ___ yes Please answer both sides of this form.
   ✓ no, just reviewed the book. Please go to other side of form.

While studying insects in the class:

2. You referred to it: ___ occasionally ___ fairly often
   ___ often ___ frequently

3. Did your students use the book? ____ yes ____ no

   If no, please go to other side of form.

4. Students used it:
   ____ as an overall reference
   ____ to look up general topics
   ____ to look up specific questions
   ____ other:_____

5. What methods did your students use to look things up?
   ____ browse for picture cues
   ____ browse for general topic
   ____ table of contents
   ____ index
   ____ other _____

6. In your opinion what did the students like or dislike about the book?

More questions on the back of this sheet!!!

7. You used it or would use it:
   - ✓ as an overall reference
   - ✓ to look up general topics
   - ✓ to look up specific questions of your own
   - ✓ to look up specific student questions
   - ___ other _____

8. What methods did you (or would you) use to look things up?
   - ✓ browse for picture cues
   - ___ browse for general topic
   - ✓ table of contents
   - ✓ index
   - ___ other _____

9. What did you like about the book?
   - ✓ the pictures
   - ✓ the answers
   - ___ the question and answer format
   - ___ the index
   - ___ other - the extent & quality of information
     - easy access to information

10. Would you change anything about the book?
    Colour would be more eye appealing
    Binding may not be serviceable for long-term storage & student use.

11. Did you find the index useful?
    ___ no ___somewhat ✓quite useful ___useful ___very useful

    Comments:

12. Was the language appropriate for your grade level?
    ___no ___some ___half ✓most ___ all of it

    Comments:

13. How would you rate this book overall?
    ___ fair ___ good ___ very good ✓ excellent

    Comments: I learned information I had not been previously aware of.

14. What would you tell other teachers about this book?
    That it is an excellent, clear cut, no-nonsense resource for both students & teachers.

Teacher's Evaluation Of "You Asked About Insects"

Grade: ~~2~~/3/4 # of years teaching: 14 Gender: ~~male~~ female (Appropriate?)

Education: ✓ BA ___ BSc ✓ BEd Other: M.Ed.

1. Did you use the book during your class studies of insects?
   ___yes Please answer both sides of this form.
   ~~✓ no~~, just reviewed the book. Please go to other side of form.

While studying insects in the class:

2. You referred to it: ___ occasionally ___ fairly often
   ___ often ___ frequently

3. Did your students use the book? ____ yes ____ no

   If no, please go to other side of form.

4. Students used it:
   ____ as an overall reference
   ____ to look up general topics
   ____ to look up specific questions
   ____ other:_____

5. What methods did your students use to look things up?
   ____ browse for picture cues
   ____ browse for general topic
   ____ table of contents
   ____ index
   ____ other _____

6. In your opinion what did the students like or dislike about the book?

More questions on the back of this sheet!!!

7. You used it or would use it:
   - all ___ as an overall reference
   - all ___ to look up general topics
   - all ___ to look up specific questions of your own
   - all ___ to look up specific student questions
   - all ___ other as a "centre" for student research

8. What methods did you (or would you) use to look things up?
   - In multi grade class, all would be used. ___ browse for picture cues
   - ___ browse for general topic
   - ___ table of contents
   - ___ index
   - ___ other _____

9. What did you like about the book?
   - All! ___ the pictures — picture/print ratio, spacing
   - ___ the answers
   - ___ the question and answer format ✓ "bold" is helpful
   - ___ the index
   - ___ other organisation

10. Would you change anything about the book?

11. Did you find the index useful?
    ___ no ___somewhat ___quite useful ___useful ✓ very useful

    Comments:

12. Was the language appropriate for your grade level?
    ___no ___some ___half ___most ✓ all of it

    Comments:

13. How would you rate this book overall?
    ___ fair ___ good ___ very good ✓ excellent

    Comments:

14. What would you tell other teachers about this book?

"Fabulous!"

ID	gr	age	gender	interesting things	look up by	find?	liked	liked	would change	would tell fiends
1	3	9	girl	bees	T	Yes	5	q&a	nothing	This book is interesting.
2	3	9	girl	pictures, writing	T	Yes	5	q&a	more pictures	It is a good book.
3	3	8	girl	the bees	T	Yes	3	q&a	nothing	It is a good book to read
4	3	9	girl	the answers to the questions	T	Yes	5	q&a	nothing	It gave me lots of information
5	3	9	girl		P	Yes	5	q&a	nothing	It is a very nice book
6	3	8	girl		P,I	Yes	5	p, q&a	more colour	To buy the book.
7	3	9	girl	Lots about insects	T	Yes	5	a	nothing	It is very nice
8	3	8	girl		T	Yes	3	q&a	nothing	It is a good book.
9	3	9	boy		I	No	5	q&a	nothing	It is interesting.
10	3	8	boy		I	Yes	5	q&a	nothing	It is interesting.
11	3	8	boy	The bees.	T	Yes	5	q&a	nothing	It was really great to learn out of this book.
12	3	9	boy	neat facts	C	Yes	3	a	add colour	A lot of neat facts in it.
13	3	9	boy	pictures	I	No	5	p	nothing	Good information
14	3	9	boy	Has lots of information	C	Yes	4	q&a	add colour	It's an OK book.
15	3	9	boy	Pictures	C	Yes	4	p	add colour	nothing
16	3	9	girl	The index.	I	Yes	5	a, q&a	nothing	I found out a lot!
17	3	8	girl	The colour of the bugs.	P,T,C,I	Yes	5	q&a	nothing	That it was great. I love this book.
18	3	9	girl	Biggest bug.	T,C,I	Yes	5	p, a, q&a	nothing	It was really good.
19	3	8	girl	Biggest bugs.	P,T,C	Yes	5	p, a, q&a	nothing	It's really good.
20	3	8	boy	The -est insects.	P,C,I	Yes	5	p, q&a, I	nothing!	I think it is very interesting and good.
21	3	8	boy	It tells different things of bugs.	P,T	Yes	5	p, a, q&a	nothing	It is very, very interesting.
22	3	8	boy	The hecules beetle.	P,C	Yes	5	p, a, q&a, I	nothing	It is full of pictures.
23	3	8	boy	The scorpions	P,C	Yes	5	ps, a, q&a, I	nothing	It was the best.
24	3	8	boy	The index	C,I	Yes	5	I	nothing	It is good, interesting and even cool.
25	3	8	boy	the index	I	Yes	5	p, a, q&a, I	nothing	It's cool and interesting, and good.
26	4	9	girl	It has lots of information.	I	Yes	4	q&a	nothing	This insect book was excellent.
27	4	9	boy	the answers	I	Yes	5	a	nothing	That we saw the author of the book.
28	4	10	boy	About killer bees.	P,I	Yes	5	pI, q&a	nothing	It was cool.
29	4	9	girl	The honey bee wing.	P	Yes	5	q&a	nothing	This is what a caterpillar looks like (picture).
30	4	10	girl	everything	P,T,C,I	Yes	5	p	nothing	butterflies.
31	4	10	boy	butterflies	P,T,C,I	Yes	4	p, a, q&a, I	nothing	I would try to tell everything about this book.
32	4	10	boy	wasps.'	P	Yes	2	p	nothing	bugs.
33	4	10	boy	wasp nests	I	Yes	2	p	nothing	Nothing
34	4	10	girl	Enemies and differences.	P,I	Yes	3	q&a	nothing	Nothing
35	4	10	boy	The pictures	P	Yes	2	p	more pictures.	Nothing
36	4	10	boy		P	Yes	5	p	nothing	
37	4	9	boy		C	Yes	1		everything	Do you think I am crazy?
38	4	10	boy		C	Yes	2	p	nothing	It is about animals and the pictures are cool.
39	4	10	boy		P	Yes	5	p		I did not get to read it all.
40	4	10	girl		C	Yes	5	a	nothing	Good to look at, lots of facts, good q&a.

P=pictures, T=topics, C=contents, I=index, q&a=question and answer format

ID	gr	age	gender	interesting things	look up by	find i	liked	liked	would change	would tell fiends
41	4	10	girl		C	Yes	5	q&a	nothing	I would ask them questions to look up.
42	4	9	girl		C	Yes	5	q&a	nothing	It is really neat and gives a lot of information.
43	4	9	boy	Homes and habitats.	P	Yes	5	q&a	nothing	I would tell them to read it.
44	4	10	girl		P,T,C,I	Yes	2	p	everything	Nothing, I don't tell them anything.
45	4	9	boy	How bugs sting and bite.	C,I	Yes	5	p	the title	
46	4	9	girl	the bugs	C,I	Yes	5	p, i	nothing	To buy the book because it is good.
47	4	9	boy	Mosquitoes mouthparts.	I	Yes	3	p	add more information	It is a good book.
48	4	9	boy	Its answers and questions.	I	Yes	2	p	not sure	It was ok.
49	4	9	girl		I	Yes	5	q&a	nothing	I feel like buying the book. I learned a lot.
50	4	9	girl	the answers	I	Yes	5	p, q&a	nothing	It was a cool book. I would like to keep it.
51	4	9	girl	the answers	I	Yes	5	p, a, q&a	nothing	It was a really cool book. I would like to keep it
52	4	9	boy	The stingeing of an insect	I	Yes	3	q&a	nothing	I don't know.
53	4	9	boy	The answers and questions.	I	Yes	2		nothing	nothing
54	4	9	boy	Its answers and questions.	I	Yes	3	p	nothing	Buy the book.
55	4	9	girl	Pictures and information	T,C	Yes	3	p, a, q&a	nothing	It was good.
56	4	9	girl	The pictures and infromation.	C,I	Yes	5	p, as, q&a	nothing	The book is wonderful, it should be published.
57	5	11	boy	How many different insects.	P,T	Yes	5	p, a, q&a	add some colour	That it is very interesting and unique.
58	5	10	boy	the bee parts	T	Yes	5	q&a	nothing	this book tells almost everthing you want to know.
59	5	10	girl	That there are all kinds of different i	T	Yes	3	a	nothing	About the different kinds of insects.
60	5	10	girl	3/4 of living things are insects.	C	Yes	4	a	nothing	It was a good book.
61	5	10	boy	How a mosquito bites.	I	Yes	4	a	add colour	It was cool because of all the insects.
62	5	10	boy	wasp and bee stingers	P,I	Yes	5	p, a, q&a, i	nothing	It was really neat with a lot of information
63	5	10	boy	bees have 2 wings.	I	Yes	4	a	nothing	It was cool.
64	5	10	boy	the killer bees	T	Yes	4	p	nothing	I saw a book on insects.
65	5	10	boy	Lots of good facts.	P,I	Yes	4	p	nothing	That it was an interesting book.
66	5	10	girl	pictures	C	Yes	4	p	ntohing	That is is an interesting book.
67	5	10	girl	the hercules bug.	P,T,C	Yes	5	p, q&a	add colour	I would tell them about the hercules bug.
68	5	10	boy	the best jumpers.	P,T,C	Yes	1	p	answers, add numbers	About the pictures.
69	6	11	girl	everything	I	Yes	4	q&a	nothing	It has good, interesting q&a and awesome pictures.
70	6	11	girl	It tells a lot.	I	Yes	4		nothing	It was really cool.
71	6	11	boy	bees and wasps.	P	Yes	3	p	nothing	There are more insects than animals.
72	6	11	boy	The poison bug page.	P,C	Yes	5	p, a, q&a	nothing	It is the pictures, they're cool.
73	6	11	boy	The life cycles.	I	Yes	5	p	nothing	It is interesting.
74	6	11	girl	It had interesting questions.	C,I	Yes	4	q&a	nothing	It had really good facts.
75	6	11	boy	the poisin insects	T	Yes	4	p, q&a	nothing	It was interesting and I learned a lot of things.
76	6	11	girl	the answers	I	Yes	5	q&a	nothing	I liked the pictures.
77	6	11	boy	A spider is not an insect	P,C,I	Yes	3	p, a, q&a, I	add photographs	If you are looking for information, use this book.
78	6	12	boy	the questions	I	Yes	4	p, a, q&a, I	nothing	The questions were mailed in from children.
79	6	12	boy	the whole book	T,C,I	Yes	2	p	some of the questions	I would tell about the pictures.
80	6	11	girl	the questions	P,T,C,I	Yes	5	p, a, q&a, I	nothing	It was interesting and fun.

P=pictures, T=topics, C=contents, I=index, q&a=question and answer format

ID	gr	age	gender	interesting things	look up by	find i	liked	liked	would change	would tell fiends
81	6	11	girl		P,T,C,I	No	5	p, a, q&a, i	nothing	There was a lot of questions in that book.
82	6	11	boy	flies have only two wings.	P,T,I	Yes	4	p, a, q&a	nothing	It is a very good and educational book.
83	6	12	girl	bees and spiders	T	Yes	2	p	some of the questions	It was good information for research.
84	6	12	boy	somethings	P	No	2	p	nothing	The pictures
85	6	12	girl	the facts	C	Yes	4	p, a, q&a	nothing	It had good facts, pictures. It was very organized
86	6	11	boy	Insects have hairs.	P,T	Yes	4	p	nothing	It had good pictures and good facts.
87	7	12	boy	question with answers after it	I	Yes	4	a, q&a i	make pictures clearer	It is a good book for people of all ages.
88	7	12	boy	information	I	Yes	5	p, a, q&a, i	add colour, arthropods	Lots of information in this book.
89	7	12	girl	insects and people	C	Yes	3	q&a	pictures of other animals	It was interesting and full of facts.
90	7	12	girl	Insect blood.	I	Yes	3	p	more pictures, add colour	Use book if they need good information on insects.
91	7	12	girl	pictures	C,I	Yes	3	p, q&a	nothing	It is very interesting.
92	7	12	girl	the number of insects	C,I	Yes	3	a	add colour	I learned about these animals.
93	7	12	girl	good pictures, well laid out	C	Yes	4	p, q&a	nothing	It has good information that anyone can understand
94	7	12	girl	insects and pictures	I	Yes	4	p	nothing	good information
95	7	12	boy	pictures	I	Yes	4	q&a	more about spiders	It is a good book. It has lots of infromation.
96	7	12	boy	the pictures	T	Yes	2	p	nothing	It is good for young children not older children.
97	8	13	boy	that you can learn about insects.	I	Yes	4	p, a, q&a, i	add colour	Go buy it! It was exciting and interesting!
98	8	13	girl	Mosquitoes and AIDS.	P,T,C,I	Yes	4	p, a, q&a	add subtopics	I would tell my parents the author came to school.
99	8	13	girl	table of contents	C	Yes	5	p	nohting	It was cool
100	8	13	boy	The information and index	I	Yes	5	a	nothing	I is interesting and cool.
101	8	13	girl	the pictures	C	Yes	4	p	nothing	It's good.
102	8	13	girl	The answers and questions.	P,T,C	Yes	4	p, a, q&a	add colour, shorter answ.	To read it, fun to read.
103	8	13	girl	the pictures and questions.	C	Yes	3	q&a	add colour	It was great
104	8	13	girl	Q&A, Insects don't pee.	P,T,C	Yes	4	p, a, q&a	add colour	It ws very interesting and I enjoyed it a lot.
105	8	13	girl	It is Qs that we wonder about.	C	Yes	4	q&a	different level of question f	It is quite interesting. Good to have at home.
106	8	14	boy	# flies there would be	T,C,I	Yes	4	q&a	add colour, information	The interesting facts.
107	8	13	boy	Insects have brains.	I	Yes	3	q&a	nothing	That insects bleed.
108	3	9	girl	lady bugs don't change their spots	T	Yes	3	p	nothing	I liked everythign
109	3	9	girl	interesting	P,T	Yes	5	a	nothing	I liked it.
110	3	9	boy	It had lots of information.	T	Yes	5	q&a	more praying mantids	It was fun to read and interesting.

P=pictures, T=topics, C=contents, I=index, q&a=question and answer format

ID	gr	years	gen	education	used	refered to	students	teacher use	teachers' method	teacher liked
1	jk	13	f	other	No			all	contents, index	all
2	jk	3	f	b.a., b.ed.	No			reference, specific questions	all	q&a, index
3	1	34	f	b.a., b.ed., m.ed	No			reference, specific questions	contents, index	q&a
4	1	6	f	b.a., b.ed	No			general topics, specific questions	topics, index	answers, q&a
5	1	30	f	b.a.	Yes	often	no	reference, specific questions	topics, contents	pictures, answers
6	1	6	f	b.a., b.ed.	Yes	occasionally	no	reference	pictures, topics, contents	answers, q&a
7	2	28	f	other	Yes	often	yes	reference	contents, index	all
8	2	16	f	b.a.	No			reference	pictures, topics	answers
9	2	7	f	b.ed.	No			specific questions	contents, index	all
10	2	18	f	b.a.	Yes	fairly often		specific questions	index	q&a
11	3	15	f	other	Yes	occasionally	yes	reference, specific questions	index	all
12	3	6	f	b.a., b.ed., m.a.	Yes	occasionally	yes	reference	topics	q&a
13	4	14	f	b.a., b.ed., m.ed.	No			all	all	all
14	4	10	f	b.a., b.ed.	Yes	fairly often	yes	all	all	all
15	5	29	m	b.a.	No			reference	all	all
16	5	7	f	b.sc., b.a.	No			refernce, specific questions	index	all
17	6	29	m	b.a.	No			all	all	all
18	7	26	m	b.a.	No			specific questions	contents, index	pictures, q&a
19	8	31	m	b.a., m.ed.	No			all	all	all

change	index useful	language	rate	comments
no	very	half	very good	excellent resource
add colour	useful	some	very good	a good reference
no	useful	most	very good	a good resource; promote problem solving
add colour	very useful	some	excellent	excellent resource, has questions students ask
no	useful	most	very good	a good resource, esp. for T with no science
no	no	most	very good	an excellent teacher resource
no	very useful	some	very good	a very useful reference
no	somewhat	most	good	students would find it easy to use
no	quite useful	most	very good	It is a great resource book!
no	useful	no	very good	a good quick reference
add section on specific insects	somewhat	all of it	good	Good general information, but no specific insects
no	very useful	most	very good	Information is simple and direct
no	very useful	all of it	excellent	Fabulous!
add colour	useful	most	very good	Great addition to insect file. Will use often.
no			very good	
add colour	very useful	most	very good	Answers common questions in understadable language
enlarge pictures	very useful	allof it	excellent	Nice format. comprehensive, easy to use.
add colour	useful	most	excellent	Excellent tool for research.
make page headings bigger	somewhat	all of it	very good	Use it!

APPENDIX M: Summary of Gender Differences in Answers to Some of the Evaluation Questions

Sample size is 110 students.
Girls =53
Boys=57

Question #3 How did you look things up?	girls	boys
look for pictures	15 (28%)	21 (37%)
look for words	22 (42%)	14 (25%)
look in the front of the book	28 (53%)	16 (28%)
look in the back of the book	25 (47%)	32 (56%)
multiple methods	20 (38%)	18 (32%)
Question #4 Did you find what you were looking for?		
yes	52 (98%)	54 (95%)
no	1 (2%)	3 (5%)
Question #5 Did you like the book?		
no	0 (0%)	2 (4%)
not sure	2 (4%)	8 (14%)
O.K.	11 (21%)	9 (16%)
quite a lot	14 (26%)	15 (26%)
a lot	26 (49%)	24 (42%)
Question #6 What did you like about the book?		
the pictures	29 (55%)	33 (58%)
the answers	17 (32%)	18 (32%)
the questions and answers	35 (66%)	29 (51%)
the list in the back (index)	6 (19%)	7 (12%)
multiple aspects	19 (36%)	16 (28%)
Question #7 Was there anything you would change about the book?		
nothing	38 (72%)	39 (68%)
add colour	9 (17%)	5 (9%)
more pictures	1 (2%)	3 (5%)

APPENDIX N: Summary of Teachers' Statistics

Gender: 4 males 15 females

Years of Teaching Experience

Years of Experience	Number of Teachers
3 years	6
10-19 years	6
20-29 years	4
30-34 years	3

Education Level of Teachers

Education Level	Number of Teachers
B.A.	19
B.Sc.	1
M.Ed.	4

Grades Taught

Grade Level	Number of Teachers
K	2
1	4
2	4
3	2
4	2
5	2
6	1
7	1
8	1

BIBLIOGRAPHY

Eisner, E. W. (1991) The enlightened eye : Qualitative inquiry and the enhancement of educational practice. New York: Macmillan Publishing Company.

Funston, S. (1992). The Dinosaur Question and Answer Book. Toronto: Greey de Pencier Books.

Harter, J. (1979). Animals : 1419 Copyright-Free Illustrations of Mammals, Birds, Fish, Insects, etc. New York: Dover Publications, Inc.

Kemmis, S. and Stake, R. (1988). Evaulating Curriculum. Geelong, Australia: Deakin University Press.

Miller, J. and Seller, W. (1990). Curriculum perspectives and practice. Toronto: Copp Clark Pittman Ltd.

Ontario Ministry of Education and Training. (1993) The Common Curriculum grades 1-9; a version for parents and general public. Toronto: Queen's Printer for Ontario.

Rogers, C. (1969). Freedom to Learn. Columbus, Ohio: Charles Merrill.

Rogers, C. (1972). "The Facilitation of Significant Learning" in Silberman, M. L., Allender, J. S. and Yanoff, J. M. (1972). The Psychology of Open Teaching and Learning: An Inquiry Approach. Boston: Little, Brown & Company.