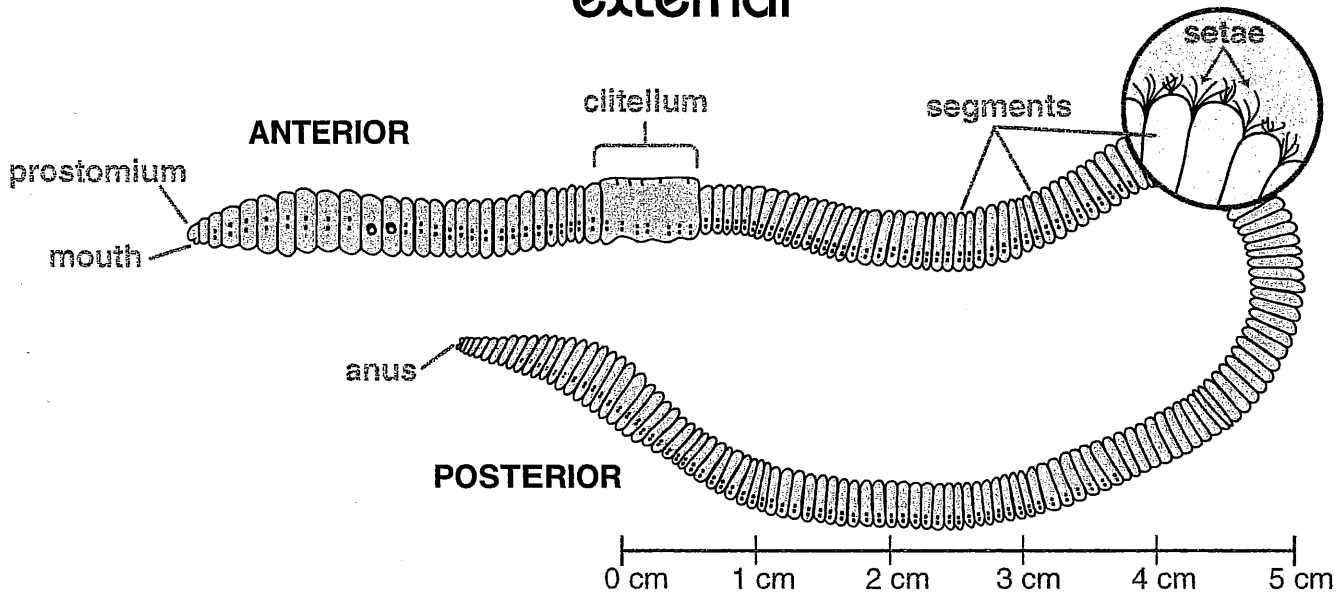


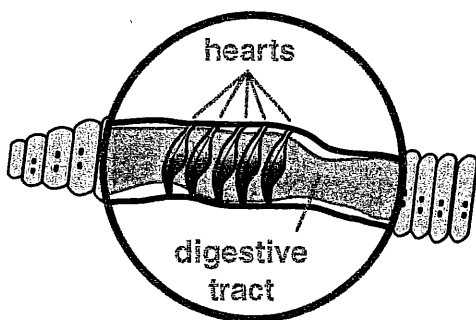
Earthworm Anatomy

external

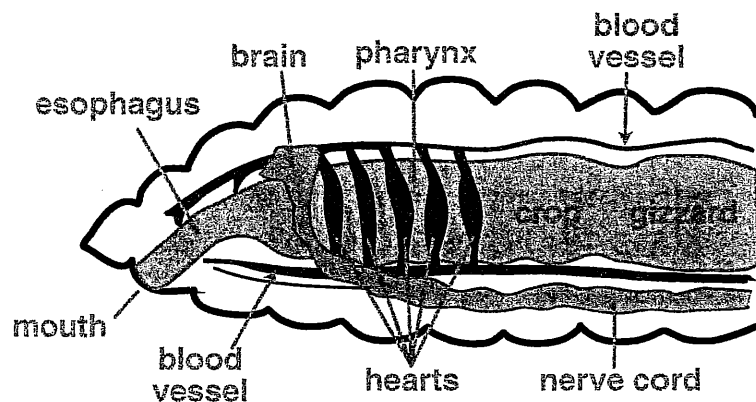


- Earthworms are invertebrates — they do not have backbones.
- Like humans, earthworms have bilateral symmetry.
- The prostomium, a flap that covers the mouth in some species, is a sensory device.
- Earthworms do not have lungs — they can breathe through their skin as long as it stays moist.
- Because earthworms do not have teeth, they use a gizzard to grind up large pieces of food.
- Earthworms are hermaphrodites — their bodies contain both male and female reproductive organs.

internal



earthworms have
FIVE hearts



RED WIGGLER FACTS

RED WIGGLER'S SCIENTIFIC NAME IS EISENIA FETIDA

THOUGH RED WIGGLERS ARE A SPECIES OF EARTHWORM, THEY ARE RARELY FOUND IN SOIL.

RED WIGGLERS ARE PHOTOSENSITIVE, THEREFORE, THEY ONLY WORK IN THE DARK.

RED WIGGLERS WILL EXCRETE A FOUL SMELLING LIQUID WHEN HANDLED ROUGHLY.

RED WIGGLERS WHEN HAPPY AND HEALTHY CAN EAT ABOUT HALF OF THEIR WEIGHT IN FOOD EACH DAY.

RED WIGGLERS HAVE GIZZARDS THAT NEED GRIT TO HELP GRIND UP THEIR FOOD. SOIL, SHREDDED LEAVES, COFFEE GRINDS ARE EXAMPLES OF THINGS THAT SUPPORT THE RED WIGGLERS DIGESTIVE PROCESS.

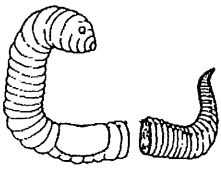
RED WIGGLERS ARE HERMAPHRODITIC (THEY HAVE BOTH MALE AND FEMALE SEX ORGANS) BUT TWO WORMS ARE NEEDED TO REPRODUCE. THE TWO WORMS JOIN TOGETHER AND EXCHANGE SPERM AND BOTH WORMS SECRETES COCOONS THAT CONTAIN EGGS.

RED WIGGLERS ARE READY TO MATE WHEN THEIR CLITELLUMS ARE ORANGE IN COLOR.

"RED WIGGLERS -- THE CADILLAC OF WORMS!" WAS AN ADVERTISEMENT THAT AIRED DURING A BROADCAST ON THE SITCOM WKRP IN CINCINNATI.

TEENAGE RED WIGGLERS EAT MORE THAN ADULT RED WIGGLERS.

RED WIGGLERS LOVE WATERMELON, PUREED PUMPKIN AND CORN MEAL. I'VE HEARD THAT CORN MEAL ENCOURAGES RED WIGGLERS TO REPRODUCE PROLIFERICALLY BUT I HAVE NOT WITNESSED THAT MYSELF.



Activity 6: Counting earthworms

Curriculum connections

Use of this learning and teaching activity may contribute to achievement of elements of the Standards. Indications of relevant Domains and Levels in the *Victorian Essential Learning Standards* are provided to assist teachers to make decisions about the appropriateness of the activity for their students.

Summary

Students count earthworms at different sites to see where earthworms prefer to live.

Student outcomes

This activity will enable students to:

- Investigate the soil type and habitat preferred by worms
- Undertake simple field surveys in teams
- Prepare simple reports to communicate findings of the surveys.

Background notes for teachers

Most earthworms hibernate deep in the soil during summer. They become active when the soil becomes wetter during autumn. They then move up to the topsoil where they find most of the organic matter - their food.

Note: The best time to do this activity is during late autumn and during winter/spring.

Materials

- Shovel
- Worksheet 'Counting earthworms'.

The activity

- Divide the class into small groups.
- Each group should choose at least three different sites to survey earthworms. They may choose a patch on an oval, a sandy area and a protected area in the garden.
- At each site, dig a hole about the size of a lunchbox with the shovel, and sort through the soil dug up.
- Separate out the worms carefully and count them. If you can't find any worms, choose another site.
- Repeat this two more times and then work out the average number of earthworms for that site.

$$\text{Average number of worms} = \frac{\text{total number of worms}}{3}$$

- Students should record their results in the 'Counting earthworms' student Worksheet and then prepare short presentations to the class to communicate their results.

Victorian Essential Learning Standards Domains and (Levels):

Science (2,3)

Duration: 2 hours

Setting: The classroom and outdoors.

Worksheet Counting earthworms

Name: _____

Choose three different sites to survey earthworms eg. the oval, a sandy area and a protected area in the garden.

For each site:

- Dig a hole about the size of a lunchbox at the first site and sort through the soil you dig up. Carefully separate out worms from the soil worms and count them. If you can't find any worms, choose another site.
- Dig holes at the other sites and count the earthworms present. Work out the average number of earthworms for that site.

$$\text{Average number of worms} = \frac{\text{total number of worms}}{3}$$

- Record your results in the table below.
- Replace soil and worms carefully.

Site location	Describe the site	Average number of earthworms found	Worm habitat rating (poor, moderate, good)
1.			
2.			
3.			

Where were the most earthworms found? Why do you think they were found here?



Worm Bin Maintenance

Feeding Your Worms

Gather food scraps to feed your worms once a week. Make sure to only feed worms half of their total weight, (for example 16 oz of red wigglers can eat 8 oz of scraps). This is why it is important to weigh your worms before putting them in your bin. As your grow your population, you will add more food each week.

Blend your scraps together. This will make it easier for your worms to digest their food. This can be done in a blender or food processor. It may take longer for larger chunks of food to be eaten. All food should be completely covered with dirt.

Spread the food over your worm bin. Spread a thin layer of food over your entire bin. If it is time to harvest your worm casting, only put food over half. Then, add a thin layer of bedding that contains soil, compost, or coconut coir so that it completely covers the food. This keeps mold from growing and fruit flies from showing up.

The following is a guide for what to put (and not put) in your bin:

Great for Worms	Avoid
vegetables	onions and garlic (will smell)
fruits (not too much fruit in comparison to veggies or you can get fruit flies)	too much citrus (worms cannot handle a lot of citrus)
biodegradable tea bags	meat and bones
eggshells	processed foods
coffee grounds	oils and sugars

Placing Your Bin

Place your bin in a relatively quiet location that does not have a lot of vibration (like next to a washer or dryer). Kitchen cupboards and garages work great for worm bins. Make sure to check that your worms do not get too cold or hot if they are in garage during the peak of summer and winter (temp should be between 59 and 86F). The bigger the worm bin, the less of an issue this will be.

Bin Upkeep

Keep the moisture in your bin like a damp sponge (when you squeeze a handful, a few drops come out). Use a spray bottle or watering can to maintain moisture, checking on your worms daily or every other day.

Once every two weeks, empty the cookie sheet or lid under your worm bin and use the liquid as a fertilizer outside on soil near plants, or water it down to use on indoor plants.

When the worm bin is full:

- Feed the worms on one side of the bin for a couple of weeks in order to draw the worms to that side.
- Once all the worms are on one side, harvest the castings on the other side and use it in your garden. Be sure to harvest compost at the end of the week, before you feed the worms again.
- If there are too many worms in the worm bin, share extras with friends or release some into your yard or garden.

Troubleshooting

Migrating Worms. Your bin could be too hot or too wet. Worms will start to climb the walls in either of these situations. Adjust accordingly, keeping moisture level like a damp sponge and temperature between 59 and 86F. This could mean moving your bin out of direct sunlight or covering with a cloth. Additionally, adding lots of bedding will help it regulate for heat better.

Worms Balling Together. This happens when temperatures get cold, especially when you have an outdoor worm bin. This will slow down productivity. If you don't want to have a slow season, move your bin into a warmer area. Adding bedding will help regulate temperature or adding nitrogen rich plant scraps.

Odor. If there is a bad smell coming from your worm bin, gently lift up the layers of food waste and bedding, enabling air to enter the system. Worm bins need oxygen. Then, dig around in your bin and investigate the source of odor. Remove any food scrap offenders (you may have put something in they do not like or simply too much food for the total weight of the worms). If the whole surface of the worm bin smells, add a generous layer of dry shredded paper or other dry bedding to the top of the bin, and gently work some of this bedding into the lower layers.



Activity 8: Worm investigations

Curriculum connections

Use of these learning and teaching activities may contribute to achievement of elements of the Standards. Indications of relevant Domains and Levels in the *Victorian Essential Learning Standards* are provided to assist teachers to make decisions about the appropriateness of these activities for their students.

Victorian Essential Learning Standards Domains and (Levels):

Interpersonal Development (2)
Science (2,3,4)

Duration: 2 hours

Setting: The classroom.

Summary

These simple worm investigations enable students to learn more about the wonderful world of worms!

Student outcomes

These activities will enable students to:

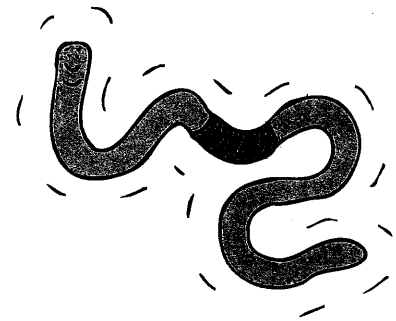
- Observe the characteristic of worms
- Investigate the ability of worms to smell, and observe their sensitivity to light and heat
- Discover how worms move
- Identify what worms prefer to eat.

Part A: Looking at worms

Divide the class into small working groups of two or three students.

Ask students to use a magnifying glass to observe and discover the following:

- Distinguishing features of worms
- The number of segments worms have and whether all worms have the same number of segments
- The location of the worms clitellum (collar or saddle)
- Differences in worm colour
- How worms move



Each group should decide how to organise the information collected by designing a recording sheet. This may be in the form of a learning log, pictures and labels, written descriptions, notes or sketches.

As a class, discuss observations, recording methods and plan further investigations.

Part B: Can worms smell?

As a class, discuss how you can answer the question 'Can worms smell?' Brainstorm the materials you will need for your investigation eg. worms, cotton buds, smell test liquids (vinegar, oil of cloves, lemon essence, pepper, chilli sauce, water etc).

Working in small groups, students should:

- Dip a cotton bud into one of the smell test liquids and place the cotton bud at a distance of about 2cm in front of the worm's head. (Note: the dampened cotton bud shouldn't touch the worm's body because a different question would then need to be investigated).
- Note the worm's reactions in the table below.
- Use the same procedure at the worm's tail end and record the worm's reaction.
- Continue the experiment with each of the test liquids.
- As a class, share findings and produce illustrations to communicate what was learned about earthworms and their sense of smell. Students may add captions to describe their illustrations eg. My worm knotted itself up when it didn't like the smell.

Note: Be patient – reactions can take a while to occur.

Use active worms to begin with. Ensure they are not exposed to strong light during the experiment.

Worms will 'play dead' when you pick them up, so be careful not to disturb them unnecessarily.

PRODUCT	Head - reaction			Tail - reaction		
	No reaction	Moved toward	Moved back	No reaction	Moved toward	Moved back
<i>For example</i> <i>Pepper</i>			✓			
Oil of cloves						
Disinfectant						
Nail polish remover						
Peppermint						
Vinegar						
Chilli sauce						
Water						

name _____

Student Lesson: Earthworms on the Job:

Body to food ratios

Who eats more food, an earthworm or you? Let's do some math to find out.

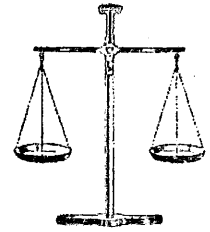
You will need:

A bowl

A scale

An empty gallon milk jug

Earthworms (you can substitute gummi worms for real worms)



1. Weigh the empty bowl. 1. _____
2. Count your worms and then place worms in the bowl and weigh them together. 2. _____
3. Subtract the weight of the bowl from the weight of the bowl and worms together: (Combined weight - bowl weight = weight of worms alone) 3. _____
4. Determine the average weight of your worms. (Weight of worms \div number of worms = average weight of each worm) 4. _____
5. Earthworms eat enough food each day to equal their weight. Do you think you can do that? Write in your weight, or the average weight of your classmates 5. _____
6. Determine how many gallons of milk you would have to drink to eat as much food as an earthworm A gallon of milk weighs about eight pounds. Divide your weight or the average weight of your classmates by 8 to determine the number of gallons of milk. (Student weight in pounds \div 8 pounds = the number of gallons) 6. _____
7. Look at an empty gallon jug. Can you drink one gallon of milk in a day? How many do you have to drink to equal what an earthworm can eat? Who eats more food, you or an earthworm? 7. _____

Although an earthworm is small and light, it eats more food than you do in proportion to its size. Its ratio of body weight to food intake is huge!

name _____

Student Lesson: Earthworms on the Job
Test Your Knowledge

1. List three body parts that humans have that earthworms do not:

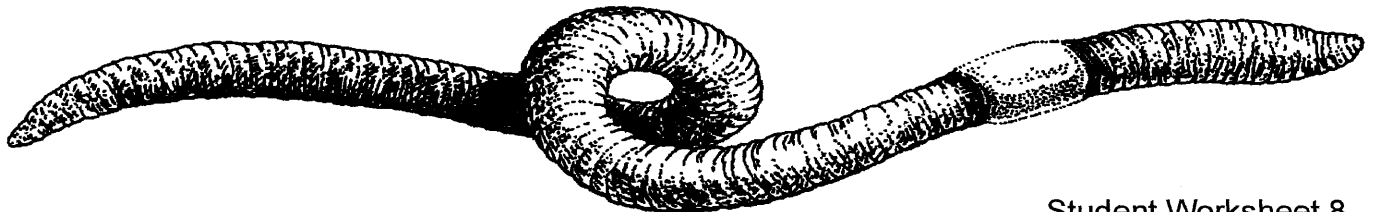
2. How do earthworms improve the soil?

3. What do we like that earthworms try to avoid? _____

4. Baby earthworms are called _____

5. Earthworms have _____ more hearts than humans do.

6. What is one new thing you learned about earthworms?



Student Lesson: Earthworms on the Job!

Vocabulary

Castings - earthworm droppings; a great fertilizer for soil

Clitellum - the smooth, non-segmented band around an earthworm. A cocoon is formed on the clitellum when it is needed for reproduction.

Dormant - describes an inactive period in the lives of some animals and plants when bodily functions slow down dramatically

Habitat - the environment in which an organism lives; it can be small or large depending on the size of the organism or how far it travels

Hatchlings - newly born or hatched animals; generally animals that develop inside an egg

Nutrients - vitamins, minerals, fats, proteins, and other elements that living organisms need to grow and survive

Organisms - living plants and animals; includes a range from one-celled living creatures to large animals

Setae - the tiny, bristly, hair-like structures on an earthworm's skin that it uses to move

Integrated Pest Management is a specialized form of environmental management wherein scientific research and real-world application work together to reduce pests such as insects, diseases or weeds.

- 1. Properly identify pests*
- 2. Learn the pest/host biology*
- 3. Sample the environment for pests*
- 4. Determine an action threshold*
- 5. Choose the best tactic*
- 6. Evaluate results*

