RESEARCH, RHYTHM + RHYME FOR HEALTHY COMMUNITIES

RESEARCH ACTIVITY 3:

WATER QUALITY

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GET RESEARCH READY!

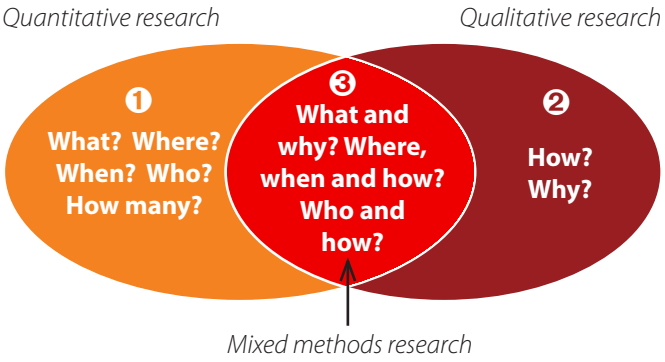
Welcome to Hip Hop Health. Did you know that Hip Hop artists and scientists do the same thing? They all observe the world around them. When artists and scientists see problems – they try to do something about it. But before a problem can be solved we have to find out more about it, or the solutions won't work. That's called research. In this project we'll be doing research to better understand the problems in water and health, so that we can help fix them.

But how do we do research? No problem – it is just like making music! Let us break it down: a research project is about finding an answer to a new question or a new solution to a problem. The research question is the project's basic beat, simple né?

Next the beat needs some rhythm. This means choosing what kind of information you need to answer your research question and how you are going to collect it. The information you collect is called raw data. Data is like a single sound in a song – put it all together and you get an answer! Having only one data point is just noise, but lots of data points means music!

There are three kinds of data you can collect. They are:

1. Numbers – called quantitative research.
2. Words, ideas or pictures – called qualitative research.
3. Both numbers and words – called mixed methods.



The method you choose depends on the questions you ask. When you put all your data together, they tell you a story about the topic you are researching.

The research cycle

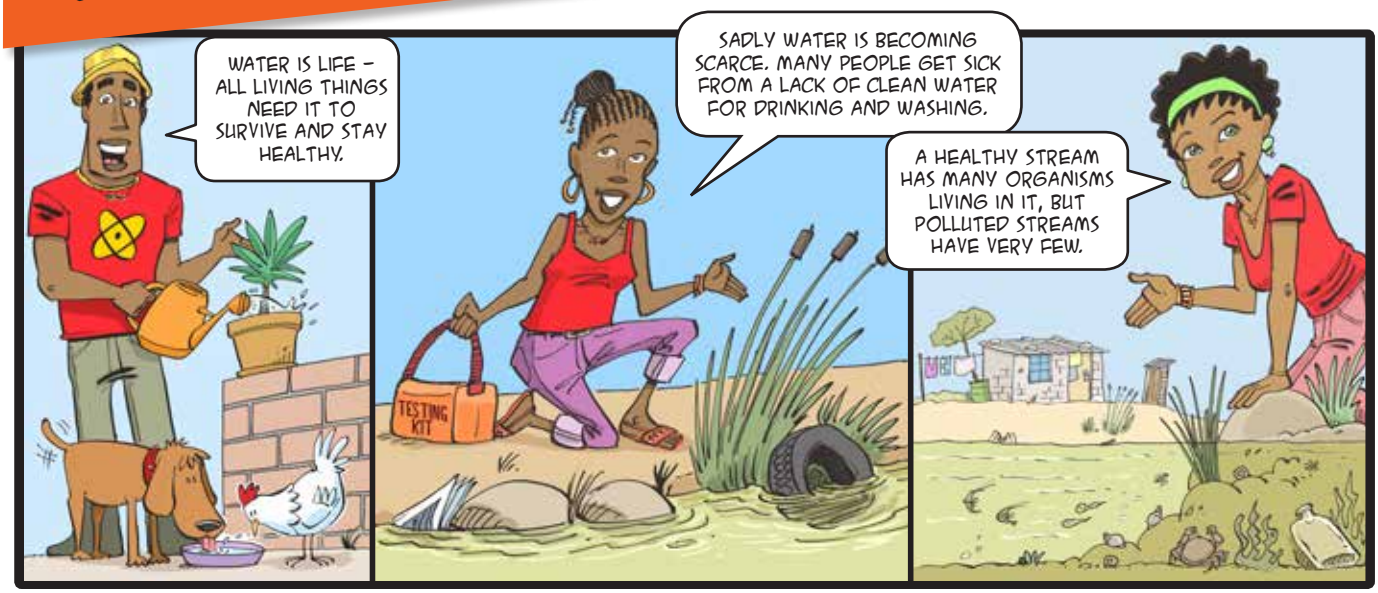
Research is done in steps, called the **research cycle**. Research usually leads to more research.

Keep it fair and safe

All research must be done in a way that does not harm people, animals or the environment. It must also be done in a way that means we can trust the results. This is called research **ethics** – here are a few principles:

- **Informed Consent:** when you talk to people, always ask permission first and explain exactly what the research is about. It is a person's right to say no!
- **Community Engagement:** involve or talk to the people affected by the research problem.
- **Privacy and confidentiality:** you must always protect the people you talk to by keeping their names and any personal information private.
- **Risk-benefit:** all research must do more good than bad.
- **Social Value:** research must also be useful to the community.
- **Research Justice:** all community members must have an equal chance to benefit from the research.

WATER QUALITY



STEP 1 Problem Statement

WHAT IS THE PROBLEM?

Many of South Africa's rivers are polluted with litter, dangerous chemicals from homes and businesses, and faecal matter (stool and urine) from storm water drains and waste water treatment works. The harmful micro-organisms and chemicals can make people sick and kill the organisms that help to keep our water healthy.

STEP 2 Knowledge Review

WHAT DO WE ALREADY KNOW ABOUT WATER QUALITY AND WATER POLLUTION?

All living things need **fresh water** to survive. Fresh water is water that has a very low concentration of dissolved chemicals and occurs naturally on Earth's surface or underground. There is very little rain in most parts of South Africa, so fresh water is scarce.

Water quality is defined by describing the chemical, physical, and biological content of water. Because all living things depend on fresh water to survive, we need to pay close attention to water quality by monitoring and testing. This means that we assess whether it is suitable for living organisms, including humans, and for other human purposes.

Water pollution occurs whenever we introduce substances into a water source that harm the plants, animals and human life which depend on that water resource. Water sources include rivers, streams and dams. Pollution affects the quality of the water as it kills many of the organisms that live in it, and which are an important part of the ecosystems that keep our planet clean and healthy.

A **healthy river** contains many different types of small animals called macro-invertebrates. These are animals that do not have backbones, such as flies and worms. Most of these small animals can't survive in polluted water. Some of them are able to live in a river that is slightly polluted, but others can't – this is called their **pollution sensitivity**. By looking for, identifying and counting how many of these small animals can be found in a river, we can measure how healthy that river is. The greater the variety of macro-invertebrates, the healthier the water is. miniSASS is a testing system that you can use to tell how healthy a river is at the place where you do the test.

What else do you know about water quality and pollution? Use the Internet, e.g. miniSASS website, or look up information in your local library and write it down here.	Reference (Where did you find the information?)
•	•
•	•
•	•

WHAT DO YOU WANT TO FIND OUT BY DOING THIS RESEARCH?

We want to find out how healthy our rivers are.

WHAT IS THE SPECIFIC RESEARCH QUESTION?

What is the health of our local river? *(Name the river you will test.)*

ACTIVITY

ASSESSING THE HEALTH OF A RIVER

YOU WILL NEED:

- ***NETS OR SIEVES*** FOR COLLECTING MACROORGANISMS IN THE RIVER. YOU CAN ALSO MAKE YOUR OWN NETS!
- ***LIFE JACKETS*** (IN CASE YOU FALL IN THE WATER). DO NOT COLLECT SAMPLES IN FAST FLOWING WATER.
- ***WHITE CONTAINER*** WITH FLAT BOTTOM AND DEEP SIDES. (E.G. ICE CREAM TUB) FOR PUTTING YOUR SAMPLES IN.
- ***GUMBOOTS*** TO PROTECT YOUR FEET WHILE COLLECTING SAMPLES IN THE RIVER.
- ***GLOVES*** TO PROTECT YOUR HEALTH WHEN SAMPLING IN SERIOUSLY POLLUTED RIVERS.
- ***MAGNIFYING GLASSES*** TO BE ABLE TO IDENTIFY THE SMALL MACROINVERTEBRATES.
- ***CAPS AND SUNSCREEN*** TO PROTECT YOU FROM THE HARMFUL SUN RAYS WHILE YOU ARE WORKING OUTSIDE.
- ***TIMERS*** TO MAKE SURE YOU KEEP WITHIN THE TIME YOU ARE ALLOWED TO SPEND SAMPLING.
- ***MINISASS SCORING SHEET*** AND ***PENS*** TO RECORD WHAT YOU FIND.
- ***ADULT SUPERVISION***.

WHAT RESEARCH METHOD WILL YOU USE TO COLLECT DATA? WHY DO YOU CHOOSE THIS METHOD?

You will be using a method called a miniSASS to identify and count the small animals living in your local river. miniSASS stands for mini Stream Assessment Scoring System. It is a **quantitative** method because the data you will collect is numerical.

Keep it fair and safe

There is a list of ethical and safety principles on page 2. Read through this list again and write down the ethical and safety issues you think are important for this project.

Ethical issues: *(For example, follow the method carefully so that your results are true and fair.)*

_____

_____

Safety issues: *(For example, all participants must wear gumboots when collecting samples.)*

_____

_____

Things to think about before you start

- There are two types of rivers: rocky and sandy. The bed of a rocky river is made up of rocks and stones, and the bed of a sandy river is made of sand (sand, small stones and mud).
- Rivers have different biological habitats, called **biotopes**. Different kinds of organisms live in each biotope. There are three biotopes: GSM type (gravel, sand or mud), rocky type, and vegetation type (plants).
- You will collect a sample from each biotope. A sample is a small collection of the organisms found at a site.
- Not all biotopes are always present at one site.
- The river you choose must have moving water and be not deeper than your knee level – a miniSASS cannot be done in stagnant (still) and deep water.

1. Decide which local river you will use to collect samples. Then decide on the exact places you will go to. These are called collection sites. If possible, look for a place where all three biotopes are close to each other.

2. Make sure that you have all the right equipment with you. Divide your team into three groups. Each group will collect a sample from one of the biotopes.

3. Collect your samples. Your aim is to collect as many different kinds of macro-invertebrates as you can in five minutes of collecting. This means that each group should spend almost two minutes collecting in their biotope.

4. Turn the contents of the three nets into the white container for collecting samples.

5. Use the **dichotomous key** and **identification guide** on pages 6 and 7 to work out which organisms you have collected. Remember to mark the groups you have identified by circling the sensitivity score on the table on page 8.

Macro-invertebrates are small, but you can see them with your naked eye. **Micro**-invertebrates are so small that you have to use a microscope to see them. Here are some hints to help you find animals in each biotope.

For all the biotopes:

- Hold the net so that the moving water flows through it.
- Disturb (move, tap or shake) the rocks, sand or plants with your feet and hands, just in front of your net, so that any organisms are caught in the net.

For the rocky biotope:

- Pick up stones or small rocks and gently pick off any insects with your fingers, or let the river water wash them off the rock into your net – be careful not to squash them!

For GSM biotope:

- With boots on, drag your feet through the sand or mud. Run your net through the muddy water. Try not to collect too much sand in the net.

For the vegetation biotope:

- Collect your sample from plants that grow in the water.

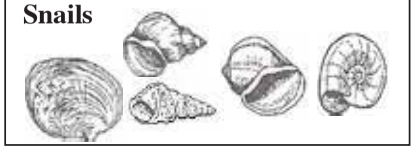
Dichotomous key: A flow chart which has two (or more) options at each stage. You choose one and it leads to further options until it identifies a particular organism.

DICHOTOMOUS KEY

Start !

Shell

Snails



No shell

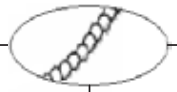
Legs

No legs

Unsegmented body

Flatworms

Segmented body

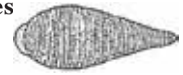


Long, thin body

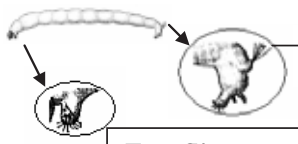
Worms

Suckers on both ends

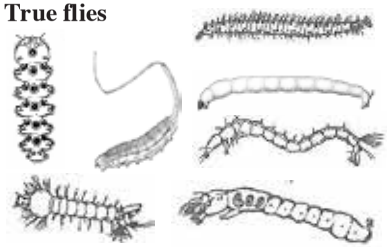
Leeches



Short, stubby legs (prolegs)



True flies

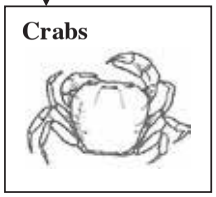


Clearly defined legs

4 plus pairs of legs

Pincer-like front legs

Yes



Crabs

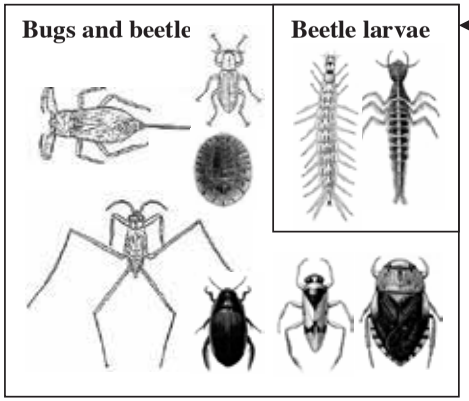
No

Shrimp

3 pairs of legs

Wings

Hard, leathery front wings (NB. Wings may be folded)



Bugs and beetle

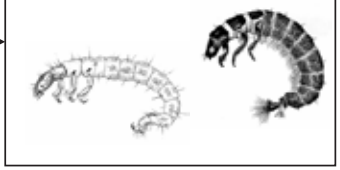
Beetle larvae

No wings

Tail

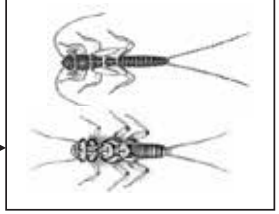
Tufted tail

Uncased caddisflies



Elongated tail

Stoneflies



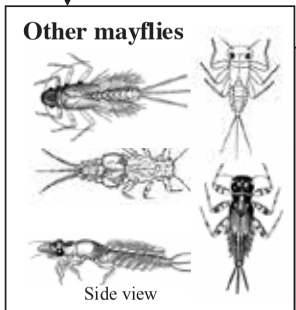
Generally 3 tails

2 tails

Feathery or plate-like gills on abdomen

Humped back, fish like way of swimming

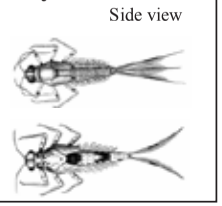
Other mayflies



Side view

Minnow mayflies

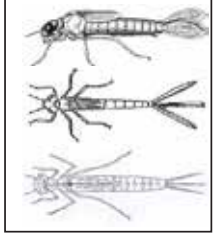
Side view



No feathery gills on abdomen

Long body

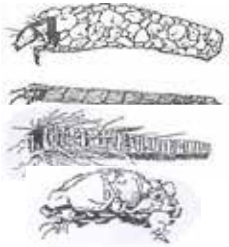
Damselflies



No Tail

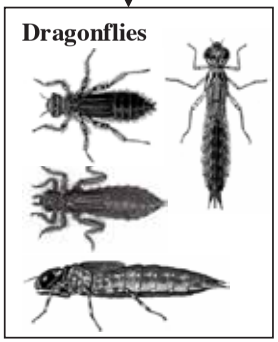
Portable shelter/ covering (made of sand, leaves, sticks)

Cased caddisflies



Bulging eyes

Dragonflies



Flat worms

Flat worms are characterised by their flattened shape and soft bodied, worm-like form. They have an arrow-shaped head with two dorsal eyespots and are generally mottled or dark grey in colour. Flatworms move with a gliding action and are generally scavengers or carnivores.

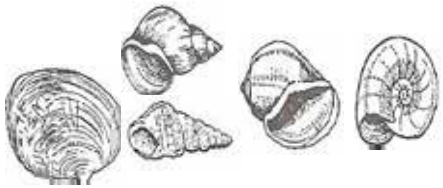
Leeches

Leeches are segmented organisms that have very flexible bodies. When moving they expand to become long and thin, and then contract to become short and stubby. They have suckers on both ends of the body that are used for feeding and locomotion. Leeches are variable in colour, from grey, to red-brown and black. They swim with a fast, snaking movement and are found under stones, vegetation and debris.

Worms

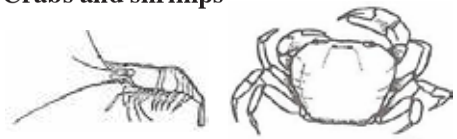
Worms are long and segmented and have a cylindrical shape much like small earth worms. Their colouring is usually pink to brown. They are usually seen writhing around in debris digesting the substrate they fed on.

Snails



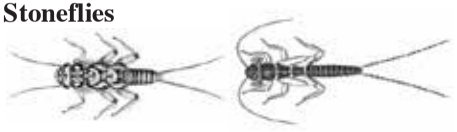
Snails are molluscs with hard shells that vary in size, shape and colour. Habitats vary, with some snails such as limpets clinging to rocks, whereas clams and muscles are found in sand. The more common snails move over stones and vegetation. Some snails are host to bilharzia, a serious health hazard for humans.

Crabs and shrimps



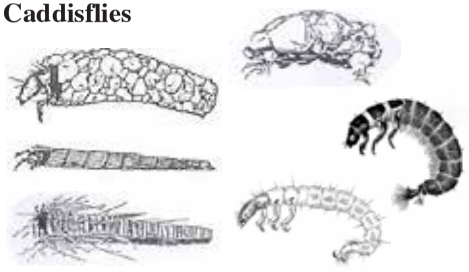
Crabs and shrimp form part of the order Decopoda (ten legs) and have bodies and legs hardened to form a tough shell. They have four or five pairs of legs and eyes that are carried on stalks and are movable. Crabs are scavengers that feed mainly on leaf litter but will feed on animals when given the chance. Shrimps are mostly scavengers or deposit feeders.

Stoneflies



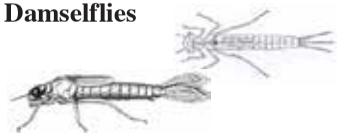
The nymphs of adult stone flies usually have two long tails and three pairs of legs each having two claws at the tip. A characteristic feature of stonefly nymphs are the tufts of gills on the side of the body as well as gills between the two tails. Wing pads on the thorax are often dark and obvious. Some species run across the substrate very efficiently and are potent predators on other invertebrates. Other species are smaller and feed on plant material. Most live in well oxygenated, clean water.

Caddisflies



The aquatic larvae of adult caddisflies have a hard head with three pairs of legs which are attached to an elongated, soft body. Finger-like gills on the abdomen and anal appendages can be seen with the naked eye. Some caddisflies construct portable shelters/cases from sand grains, bits of vegetation and/or silk that are glued together to form a characteristic case shape. Most of the case-building types cannot swim whereas the case-less type swim freely across the substrate. Some feed on algae and detritus whereas others are predators.

Damselflies

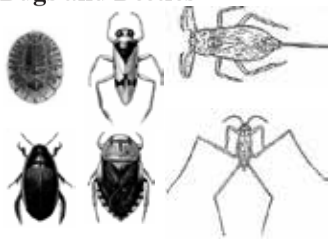


Damselflies have elongated bodies with generally three broad tails/gills on the tip of the abdomen. Damselflies are carnivorous and have a 'mask' over the lower part of the face which hinges out to reveal a pair of pincers with which they catch their prey. They are often to be found in vegetation growing on the edge of rivers.

Dragonflies

Dragonflies are robust creatures that are stout and have a large head and protruding eyes. Some have short legs whilst others have long legs. They do not have tails, but swim using 'jet propulsion' by forcefully ejecting water from the abdomen. Dragonfly nymphs are usually the largest organisms found in a sample and are the most powerful invertebrate predators in the water.

Bugs and Beetles

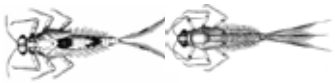


Bugs can be defined as having a piercing and sucking beak for mouthparts, and two pairs of membranous wings. Beetles on the other hand have 'jaws' and outer wings that are hardened to protect the inner wings. Some bugs and beetles are well adapted to swimming, such as water boatmen, backswimmers, pond skaters and water striders. Most bugs and beetles are carnivorous, but some feed on algae.

Mayflies

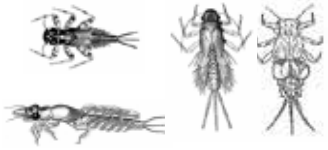
Mayfly nymphs vary greatly in shape and size and live only for a day or two. In this time they will never feed and live to mate and lay eggs in the water. Mayflies fly close to rivers and lakes, usually swarming in the early evenings.

Minnow mayflies



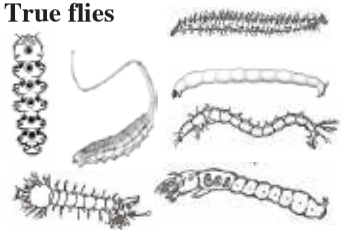
These mayflies have a narrow head and a small, slender, but not flattened body. They have leaf shaped gills on both sides of the abdomen and two but more commonly three tails, depending on the species.

Other mayflies



Other mayflies are characterised by an elongated body, large head, well-developed mouthparts and stout legs. They live in a variety of habitats including burrowing in mud, crawling amongst decaying leaves, and scurrying over stones in fast flowing currents.

True flies



Most fly larvae have a fairly indistinct head but elaborate tail ends. They often have small, soft legs (prolegs), segmented bodies and have the appearance of maggots. Some have bristles/ spines and antennae. True flies live in a variety of habitats including sand, mud and stones in fast flowing water. They can either be carnivorous or filter feeders.

6 Once you have circled the correct sensitivity score for each group, return all the organisms to the river. Wash your hands when you are done.

Use the table below to mark the groups of macro-invertebrates your team found in your sample. Circle the sensitivity score for each group you found. Add up the sensitivity scores (the circled numbers) and write the total in the correct space. Then write down how many groups you found and divide the total sensitivity score by the number of groups. This will give you the **average sensitivity score (miniSASS Score)** for the river.

Remember always to give a table a heading, for example: *Table 1: Types of organisms found in the rocky Berg River*

Table 1: _____

Groups	Sensitivity Score	Example
Flat worms	*3*	*3*
Worms	*2*	*(2)*
Leeches	*2*	*2*
Crabs or shrimps	*6*	*(6)*
Stoneflies	*17*	*17*
Minnow mayflies	*5*	*5*
Other mayflies	*11*	*11*
Damselflies	*4*	*(4)*
Dragonflies	*6*	*6*
Bugs or beetles	*5*	*5*
Caddisflies (cased & uncased)	*9*	*9*
True flies	*2*	*(2)*
Snails	*4*	*(4)*
Total Score		*2 + 6 + 4 + 2 + 4 = 18*
Number of Groups		*5*
Average Score (Total/Number of groups)		*18 / 5 = 3.6*

WHAT DO YOUR RESULTS MEAN?

Analysing data means looking at the data for an answer to your research question. There are many different ways of analysing data. Choosing the right one depends on your research question.

Let's analyse!

Use this table to work out what your scores mean, i.e. what is the quality of the water in your river? Use the 'Sandy type' column if you collected samples from a river with a sandy base, and the 'Rocky type' column if your river has a rocky base .

Table 2: Interpretation of miniSASS score

Ecological category (Condition)	River type	
	Sandy type	Rocky type
Unmodified (Natural)	> 6.9	> 7.2
Largely natural/few modifications (Good)	5.9 to 6.8	6.2 to 7.2
Moderately modified (Fair)	5.4 to 5.8	5.7 to 6.1
Largely modified (Poor)	4.8 to 5.3	5.3 to 5.6
Seriously/critically modified (Very poor)	<4.8	<5.3

Fill in the following sentences:

The river we sampled is a _____ *(sandy type or rocky type)* **river.**

The total score is_____ *(add sensitivity scores of groups found)*

The number of groups is_____ *(total number of groups found)*

The miniSASS score for our river is _____ *(divide total score by number of groups).*

This means that the condition of our river is _____ *(refer to Ecological Category table)*

Once you have analysed your data, you will be able to draw conclusions. This means explaining what you think your results mean. To make real conclusions, you need to answer the question: 'why?'

For example, in our table we have an example score of 3.6. From Table 2 we know that this means our river has very poor quality – it is very polluted.

Try to work out **why** it is so polluted. You need to use any evidence that you have found to help you think of reasons; for example, things you observed during your sampling or ideas that you came across during your knowledge review.

OVER TO YOU....

Use the space below to write down any conclusions you and your group have come up with.

Recommendations are suggestions about what you think should be done next. This is a very important part of any research project because this is a chance for you to put your research into action and make a difference to your community.

There are a number of ways that research can make a difference. Here are a few.

- **Future research.** Remember the research cycle on page 2? Research usually leads to more questions and the need to find out the answers. You can be part of this by going on to the miniSASS website (at www.minisass.org) and uploading the results of this study. This will help the team at miniSASS get a good idea of the condition of rivers all over the country.

  Do you have questions about this research that you still need to find answers to? Write them here.

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- **Innovate.** This means to come up with a new idea!

  Do you have ideas for innovations that can help solve the problem? Write them here.

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- **Advocacy.** 'Advocacy' means to speak up! You can make people aware of the problem and tell them what needs to be done.

  How will you get people to take notice of the problem?

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  A good example of advocacy is the Thirsty Three comic book, Issue 2, sponsored by the Water Research Council (WRC). It can be downloaded from the miniSASS website (**www.minisass.org**) along with lots more information about miniSASS.

Telling people about what you learned in your research is called dissemination. Why not write a song to spread the word!

How to write a good hip hop song

LYRICS – The first thing you need is content. Choose some facts from your Hip Hop Health activity and write some lyrics to share a key message with people. Rhyming and clever use of words can be a good way to do this. Get your teacher or an expert to check that your science facts are correct, and write some rhymes!

Remember: using swear words and words that put other people down (e.g. women) are not cool!

BEAT – Next is the beat. Remember, rapping is all about rhythm. In the same way that singing adds a melodic layer to a song, rapping adds a rhythmic layer. Use rhyming words to try to give your lyrics some flow, and add a beat! You can create your own beat with beatboxing, download a beat, or even get a friend to make you a beat.

EMOTION – Finally, you need emotion. You want the audience to sense how you feel about your message, and you want them to feel it too. This is a chance for you to truly express yourself. Let your emotions come through in your song and everyone will want to listen!

A few more tips:

- You don't want to confuse the audience or make it too hard for yourself, so keep it simple.
- If you're enjoying it, the audience will enjoy it; so enjoy it!
- This is your own creation, so don't try to mimic someone else. No one can do YOU better than YOU.

Keep it simple, have fun, and be yourself!

Why not get some friends together and put on a show! You can even enter your songs in our annual **Hip Hop Science Spaza competition**. Find out more at www.sciencespaza.org.

Hip Hop Health and Hip Hop Science Spaza are an initiative of Jive Media Africa. For more information, visit www.jivemedia.co.za.