Creating Science – Quadrats

What lives in the back yard? *#CreatingScienceQuadrats*

Suggested Outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Science understanding

- Biological sciences 1: Living things live in different places where their needs are met.
- Biological sciences 4: Living things, including plants and animals, depend on each other and the environment to survive.

Science inquiry skills

- Questioning and predicting, Planning and conducting, Processing and analysing data and information as they use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS068).

Science as a human endeavour

- Use and influence of science 4: Science knowledge helps people to understand the effect of their actions (ACSHE062) as students use this knowledge today to estimate insect population dynamics at their home or school.

Cross curricular outcomes

- Maths, measurement and geometry 4: Compare objects using familiar metric units of area and volume.

Science vocabulary words

Tier 1 (Everyday words) – Insect, ant

Tier 3 (Specialised vocabulary)

- Quadrat – a small square used to explore various forms of life.
- Estimate – a reasonable guess at a result, rather than the actual result.

Preparation

- Students will be lying on the ground looking for bugs and other creatures. Depending on your students' needs and personalities you may like to supply picnic blankets, insect repellent, hats, etc.
- Students will need something to write with and something firm to write on.
- Magnifying glasses might be helpful, if students can be trusted.

And finally;

- String or sticks to mark out small square plots on the ground (usually 10cm^2 is sufficient). Older children may feel more challenged by larger plots, such as a meter squared, but will need more time to participate.

Also,

- You can prepare a mathematics lesson on perimeter and area, having students design and create their own box plots. A lesson unto itself, it is left up to you to design. But can I recommend you don't tell them what the square is for – leave it a mystery for now…

Disposal

- Quadrats should be entirely biodegradable, and make great landfill or kindling for fire.

Warning!

- Make sure you prepare students against handling insects. Have insect repellent and bug bite kits on hand as a bare minimum. Allergic students will need to be warned how to act appropriately.
- Likewise, while it may be fun to set up this activity on or near an insect nest, such as a wasp home or ant hill ("look how many insects I found miss!") strongly discourage students from doing this. Not only is it dangerous, it will give false readings to any hopeful future biologist regarding the possible distribution of creatures in the area.
- Students are not expected to be digging in the dirt for this activity, simply observing. Some students may need repeated reminders of this.
- Don't use magnifying glasses on sunny days. The temptation to set fire to something is going to be just too great for at least one pair of students in your class.
- Quadrats can be quite boring. You NEED to prepare students for a quiet, thoughtful watching (as opposed to the drama and excitement of hunting insects with the Bug Sukka)

Notes

Marking out plots can be tricky. Some places have very little insects, while wet, damp places will be crawling with them. Be careful and examine your spaces before setting students loose.

DO NOT reward students for FINDING insects – reward them for TRYING; for watching carefully, for listening to instructions. Celebrating a find can be fun, but the goal is NOT to find insects; it's to find out if there are any insects there. If there aren't any insects in a quadrat - GREAT, that's something we wanted to know! That's IMPORTANT scientific knowledge!

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students' questions can and should guide student learning, more material is presented for your convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

This activity is well suited to this age group. Children at this age can have difficulty with focus. Avoid tangents if you're attempting to make a key point.

Help them to avoid dangerous places to study insects.

Middle:

This activity is ideal for this age group.

Teen:

Challenge older learners to calculate irregular areas rather than estimating the entire school oval, for instance.

Rather than being an abstract concept, Quadrats are actually used by real scientists every day.

Learning Intent (student friendly)

'We are learning to' (WALT) – estimate the number of ants in our land by using quadrats.

Success criteria

'What I'm looking for' (WILF) – an estimate of ants on the land, by correct use of a quadrat and correct application of maths.

Student learning goals

Help students make a self-monitored learning goal for this lesson, such as 'find out how many ants live in our yard.'

Evidence of learning

How will you know when the learning goal is achieved? What EVIDENCE do you have that your students have met or exceeded the learning expectations?

- A quadrat.
- A description of any other insects.
- An estimate of ants on the land.

Engage

Ask students what they think lives right outside their door, for example, on the school oval or their own front yard.

Allow students the chance to lie down and study what is 'under the grass' for a few minutes.

Encourage students to discuss and share what they find, including rubbish or interesting plants.

- Ask how many ants do students think live at the school?
- Ask students how scientists might estimate an answer that question – given that gathering and counting every single ant is waaay too expensive, and arguably impractical.

Explore

Explain that: Scientists who study nature are called biologists. Often biologists like to know what kinds of animals live in a certain area. But sometimes it is impossible to examine the *entire area*, so they have to *estimate:* they take a small area and count the creatures there, then use that to guess how many creatures are in the entire area.

Have the students explore more thoroughly using a quadrat (see activity 'quadrats' in our book Creating Science or at www.drjoe.id.au), looking specifically for the kinds of living creatures that are in their area. Have them write down the insects they find within. Have them note number, kind, and whether they stayed or wandered right on through. Students may use small sticks to move plants around, and may be impressed to find very small insects on the underside of leaves. Have them draw a picture of the creatures they find.

You may need to demonstrate the kind of care and attention to detail it takes. Some wonderful creatures are incredibly small! Students will need:

- A square around 20cm on each side. Wooden skewers tied together are great.
- Shaded areas, a little away from walking paths, are best.
- Give them about 20 minutes.

We recommend using a skewer and allowing them to move things around a bit, but to discourage digging. That is an entirely different study, used to reveal completely different kinds of creatures!

Explain

Explain, "Now we will use what we've learnt to estimate the kinds of creatures we found in the area. We're going to become biologists!"

Have students count one particular kind of creature they found. Ants are often a good example.

Wash hands, and go back to the classroom.

Estimate the total amount of creatures in the area by:

Total number of that creature found in the plot, multiplied by the total number of plots that would fit in the entire area = approximate number of creatures in the area.

For example:

Miss Penswhistle and her class have 20cm^2 plots. Their school yard, according to the groundskeeper, has about two square kilometres of oval and a square kilometre of gardens. The class decides to check out the gardens only.

Jake and Jane find 14 ants, two moths, and a ladybug in their plot over the time allowed.

One kilometre squared, divided by 20cm^2 is equal to 25,000,000, which is the total possible quadrats on the school gardens (since there are 100,000 centimetres in a kilometre, then we square it, then we divide it by 20cm squared or 400 = 25,000,000. That's a LOT of quadrats.)

So the number of ants in the school is approximately 350,000,000, or seven hundred million (or 14 ants times 25 million possible quadrat locations). And if each ant weighs 0.004 grams then they all weigh about 1400000 grams or 1.4 tonnes… about the same as an average car!!!) *That's huge!*

The mass of ants in the average suburban back yard can weigh as much as a small child!

Fair testing warning!

Since we, no doubt, put our quadrats where we were more likely to find insects (away from paths and concrete) we are likely to OVER ESTIMATE how many insects there are. Ideally;

- We would not use a square to estimate our final area. Take away paths, buildings, and other places the insects can't live.
- Are they being too noisy and scaring bugs away? Are they digging things up, and actually studying burrowing worms?

Can you think of other ways to help us create better scientific knowledge?

- Note, in real quadrat science, we'd never use just 1 quadrat plot to estimate the results of the entire area. We average our results beforehand!

But we didn't find anything!

Did you find NO crawling insects in your plot? THAT'S GREAT!!! The purpose of this activity is not to *find insects*; it's to find out **how many** insects are in the area. If you've done a proper job and it turns out that the answer is NONE – than don't worry, you're a great scientist who's created some very important information about what is in the world. The answer **is** *none* - Kudos!

Imagine how great it would be to be studying the spread of a new and terrible weed, only to find that there were NO weeds now because the control measures were succeeding. That's great news!

Elaborate

So who uses quadrats?

Explore real life applications of quadrats. They are being used constantly around the world to help with science.

- Ecologists use them to estimate the spread of weeds[1].
- Biologists can use them to explore the changing positions of ant colonies.
- Knowing how much fuel for a forest fire accumulates over time.
- Knowing if the number of endangered animals in a forest are increasing or decreasing.
- Entomologists can use this to explore what kinds of environments a new insect prefers.

What other uses are there?

Other ways of studying life

There are loads of other ways scientists have had to invent to learn about the life forms living in their area.

- Transects are a string stretched through a forest or grassland, and each kind of a species can be counted and measured over time.
- Trapping and tagging can be used for animals like wolves, where not only can we estimate where they go and what they do, but from the number of animals we recatch each time we can estimate the total number of animals of that kind in a given area. Very clever mathematics!

More to explore

Allow students to explore the opportunities this knew knowledge gives them. For example:

- Does the number and kind of creatures found in their plot change over time, say at day and at night? Can you estimate their numbers at that time? If you do notice a change, or not, why do you suppose it is there?
- Can students use this process to find out how many frogs live at their local pond? Are the frog numbers decreasing, or increasing?
- What other techniques are used to help scientists find out what kinds of life are in a certain area? For instance, would the plot work for birds? How about animals that live underwater or under the ground? What techniques could you *invent* for finding out about the creatures that lived there?

[1] A biologist friend once confirmed this fact for me, and shared an interesting anecdote. Among the many things we do to try and create the best science possible, we try to avoid bias when we can. But when looking at a field of plants, how do you avoid picking a spot with lots of weeds (since you are, unconsciously, looking for them). They decided one quick, easy, and adequately effective way to ensure this was to **throw the quadrat** over their shoulders, without looking. What do you think? Random enough?

Evaluate

- ⇨ Review with students what they felt they learnt from this lesson. Did they have any questions at the start that they feel were answered?

Success criteria

- ⇨ Review the Learning Intentions of this lesson with students. Was it met?

At the end of each class, review the learning objective and see how we did. Ask:

- ⇨ Did you achieve your learning goal?
- ⇨ What did You learn?
- ⇨ What worked to help you achieve it?
- ⇨ What might you do better next time?
- ⇨ (If needed) where can you go for extra help or information?

Assessment

Prior learning:

Take time to focus on planned content material during the engage phase, for example,

- Ask how many ants do students think live at the school?
- Ask students how scientists might estimate an answer that question – given that gathering and counting every single ant is waaay to expensive, and arguably impractical.

Formative:

As students are learning, help them self-monitor their own learning and achievements.

- Help students to maintain the focus for the entire time.
- Help them consider their technique. Are they being too noisy and scaring bugs away? Are they digging things up, and actually studying burrowing worms?

Summative:

Help students consider ways they can communicate their new understanding to others, just as scientists need to do. Can they include quadrats as part of their study into another animal?

- Help students to make up a board game of a little ant trying to get back to its nest. At certain points along the trail players have to answer interesting multiple choice trivia questions about ants, such as how many body parts they have, or roughly how many ants live at the school (according to the study done by your students on such and such a date).
- Encourage students to explain and enact this activity with a younger class. Use this as a formative assessment as they learn through teaching.
- Have students write up a report *describing* and *estimating* the number of their favourite insect in the school.

Now, if you want to be really connected, have students submit their report to the local government environment management facility. They may not be able to use the information, but then again: they might[2]. In either event they're likely to be impressed and let's hope they let the students know it.

So what?

Rather than being an abstract concept, quadrats are actually used by real scientists every day.

Creating science

Science understanding

As students explored life using quadrats, they learnt that;

- Biological sciences 4: Living things, including plants and animals, depend on each other and the environment to survive – what places did, and didn't, we find insects?

Science inquiry skills

As students calculated the total number of insects such as ants living on their land, they;

- Questioning and predicting, Planning and conducting, Processing and analysing data and information as they use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS068) – how many ants do you think live at your home?

Science as a human endeavour

As students realised they could use quadrats to track the spread of invasive species, they;

- Use and influence of science 4: Science knowledge helps people to understand the effect of their actions (ACSHE062) as students use this knowledge today to estimate insect population dynamics at their home or school – we can use quadrats to help us manage life on earth, such as the spread of an invasive weed, or distribution of an endangered insect.

Also, rather than saying 'the number of ants at the school outweighs a small car,' it is more scientific to say '*according to* ***our*** *research*, the number of ants at the school outweighs a small car,' – or similar. Remember – science is people!

Cross curricular outcomes

As students used maths to calculate area and mass, they;

- Maths, measurement and geometry 4: Compare objects using familiar metric units of area and volume – as we made quadrats work for us.

[2] And, if they do, TELL ME, so I can celebrate with you too! – creatingscience@drjoe.id.au

Tips from the masters

- Shady places are not only more sun safe, many insects prefer the shade as well!

Quadrats are very simple to set up and use.

Use a skewer to help look closer.

Spread out to cover more ground