

# LEARNING in the OUTDOORS

IN MATHEMATICS

TOOLKIT 8



# TEACHER TOOLKIT SCHEDULE

Outdoors Victoria, in partnership with the Australian Council for Health, Physical Education and Recreation (ACHPER Victoria), Environment Education Victoria (EEV), Geography Teachers Association (GTAV) and Parks Victoria (Parks Vic) will produce 15 Teacher Toolkits between 2018 and 2020. These toolkits will be delivered to the following order:

## 2018

- 1 Introduction to Outdoor Learning
- 2 Outdoor Learning in the Play Ground
- 3 Outdoor Learning in Water-Based Environments

## 2019

- 4 Outdoor Learning in Physical Education
- 5 Outdoor Learning in Art
- 6 Outdoor Learning in Geography
- 7 Outdoor Learning in Science
- 8 Outdoor Learning in Mathematics
- 9 Outdoor Learning in Urban Environments

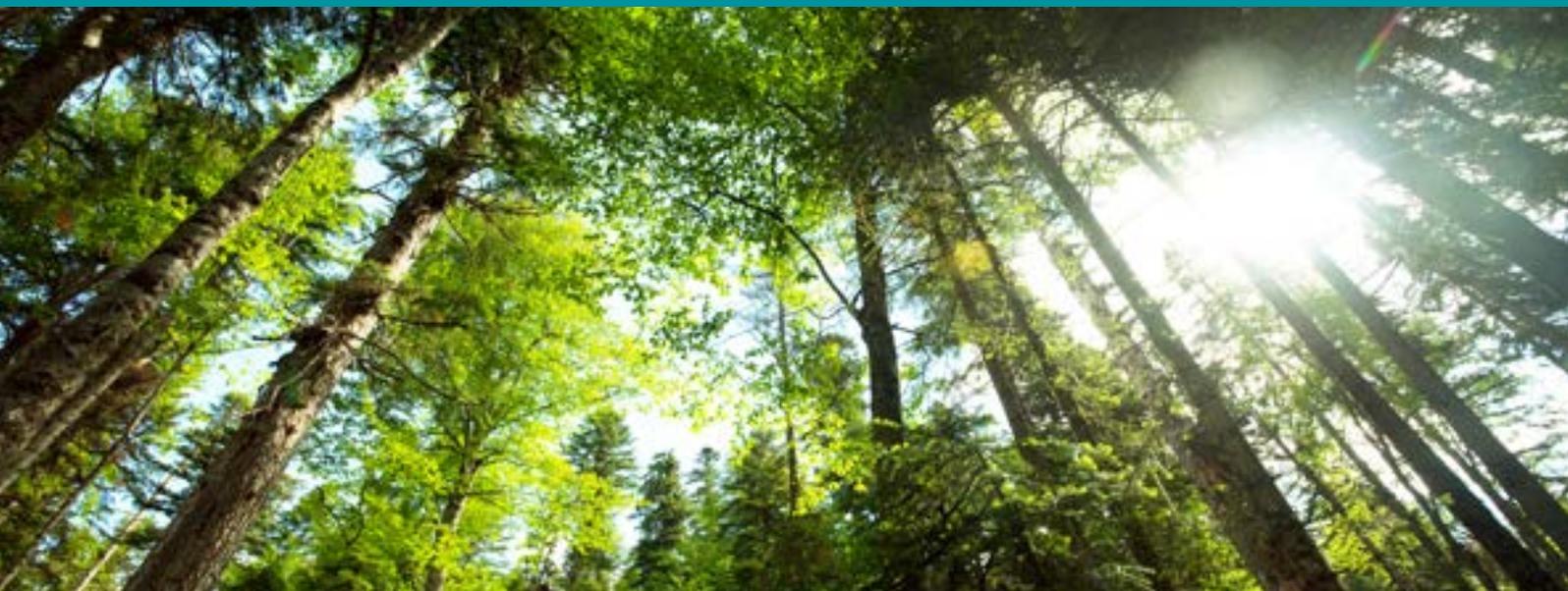
## 2020

- 10 Outdoor Learning in Health
- 11 Outdoor Learning in Sustainability
- 12 Outdoor Learning in History
- 13 Outdoor Learning in Reading & Writing
- 14 Outdoor Learning in Speaking & Listening
- 15 Outdoor Learning in Indigenous Activities

Outdoors Victoria, in partnership with ACHPER (Victoria), EEV, GTAV and Parks Victoria, are always interested in finding out what is occurring in the outdoors in your school.

If you are proud of a new program you have implemented or would like to be involved in, or contribute to any of the Teacher Toolkits, contact any of the above organisations. (Contact details are provided on the final page of this document)

Outdoors Victoria, in partnership with ACHPER (Victoria), GTAV, EEV and Parks Victoria, respectfully acknowledges the Traditional Custodians of the land and their Elders past and present, for the important and enduring role that Aboriginal and Torres Strait Islander peoples play in Australia regarding the land, water and sky used for learning in the Outdoors.



# LEARNING IN THE OUTDOORS

## IN MATHEMATICS

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This Teacher Toolkit is offered as a framework for developing your own curriculum specific ideas and activities for Outdoor Learning. It is quite flexible and should be adapted to suit your needs. Remember to note the benefits of Outdoor Learning in your teaching area, and to provide tips wherever you can for embedding Outdoor Learning into the curriculum. Include relevant research, case studies and examples that might assist teachers. Teacher Toolkit 1 Benefits of Outdoor Learning presents research that will help you argue the case for taking students out of the classroom.

# Outdoor Learning in Mathematics

Maths and the outdoors are subjects that do not traditionally go hand in hand although many maths teachers use practical activities to provide a deeper level of learning to their students. It is important that everyone feels comfortable in integrating the outdoors into their lessons.

This document offers more than ten activities that can be used at any year level to promote outdoor learning in Maths. In 2020 further activities activities and research notes will be added to this document.

## Benefits of Outdoor Learning in Mathematics

Integrating Outdoor Learning into the classroom is extremely important to students' knowledge and understanding of not only the natural environment but also themselves. By integrating mathematics and the outdoor environment students that learn through various learning and teaching styles have further avenues to learn in addition to students gaining exposure to outdoor learning within their schooling.

The outdoor environment is filled with formal and informal opportunities to embed math learning, Integrating Mathematics and Outdoor Learning has been shown to have a variety of benefits for the students. The foundation of Outdoor Learning is Outdoor Play, this play is often characterised through problem solving, building huts, playing games and experimenting with a range of experiences. Within these experiences students will be solving mathematics problems without knowing be that through completing measurement tasks or using estimation.

Adam Harvey (A primary school teacher) found that by taking a Math's class into the outdoors students who were traditionally not engaged in solving problems on paper became hands on with sticks and branches solving the same issues they were unable to previously. [Learning Outside the Classroom](#) 

Additionally, Cornish College (Located in Melbourne, Victoria) Year 1 teachers Alexandra Parrington and Samantha Millar find that:

“

**learning with and in nature provides authentic inquiry and teaching opportunities across the curriculum and across all year levels. Outdoor learning provides many opportunities for students to engage with their natural environment and to be challenged mathematically.**

”

[The Primary Journal of the Mathematical Association of Victoria](#) 

Teaching aspects of Mathematics outdoors allows students to expand their learning and understanding, We hope this toolkit provides you with a range of example activities that you can use within a variety of year levels and environments.

# Thermometer Analysis

Students are to complete a thermometer analysis using an older style (Mercury/Alcohol) thermometer, digital thermometer and computer Apps.

First, prepare a graph with the horizontal axis recording the temperature and the vertical axis showing the type of thermometer used.

Ask students go outside to estimate the temperature (Often referred to as feels like).

Note the estimate beside the graph.

Secondly, ask students to read the temperature with the mercury/alcohol thermometer and then plot this on the graph. Discuss the difference between the two results, why do you think that you suggested it was warmer or colder than it was?

Thirdly, have the students using a digital thermometer (Plot this onto the graph), Discuss the difference between the three results, why would there currently be a difference between the results?

Lastly, ask students to use a computer app. (The Bureau of Meteorology is one of the most accurate national weather services) on any type of device (Plot this onto the graph) Discuss the difference between all of the results, why would there be a difference between the results?

Once the four temperatures have been plotted on the graph, ask students to compare findings:

- Why do the temperatures vary?
- Where was the app. temperature taken?
- Was it close to school?

## Curriculum Outcomes

- F**
- Represent practical situations to model sharing (VCMNA074)
- 1**
- Measure and compare the lengths, masses and capacities of pairs of objects using uniform informal units (VCMMG095)
- 2**
- Identify questions or issues for categorical variables. Identify data sources and plan methods of data collection and recording (VCMSP148)
- 3**
- Conduct chance experiments, identify and describe possible outcomes and recognise variation in results (VCMSP147)
- 4**
- Select and trial methods for data collection, including survey questions and recording sheets (VCMSP178)
- 5**
- Describe and interpret different data sets in context (VCMSP207)
- 6**
- Interpret secondary data presented in digital media and elsewhere (VCMSP236)

## Additional Resources:

Temperature Activities: <https://educators.brainpop.com/lesson-plan/temperature-activities-for-kids/>



## EXTENSION SUGGESTION

Discuss positive and negative temperatures and learning to add and subtract positive and negative numbers.

## Equipment & Materials

- Thermometer/Digital Thermometer
- Phone Application and device.

# Distance Calculations

Students are to measure and compare distances. Research shows that students often find estimation difficult to learn in the classroom, but the outdoors provides a fantastic opportunity to bridge this learning gap.

Firstly, ask students go outside and estimate a millimetre, a centimetre, a meter and 5 meters on the ground. Make a chalk mark or place a stick to represent the estimated distance.

Then ask students to use a measuring tape or wheel to measure the actual distance. Mark the actual distance beside the estimated one.

Thirdly, compare the difference between the estimated and the measured distance. Why do these differences occur? Complete a statistical analysis of the differences between estimation and measured distances. (mean, median, mode etc)



### Equipment & Materials

- Chalk to mark distance
- Tape or wheel to measure distance

### Curriculum Outcomes

- F-2**
  - Use informal measurements in the collection and recording of observations (VCSIS052)
  - Collect and record geographical data and information from the field and other sources (VCGGC060)
  - Interpret data and information to draw conclusions and describe the direction and location of places, using terms such as north, south, opposite, near, far (VCGGC062)
- 3-4**
  - Interpret maps and other geographical data and information to develop identifications, descriptions, explanations and conclusions, using geographical terminology including simple grid references, compass direction and distance (VCGGC076)
- 5-6**
  - Represent the location of places and other types of geographical data and information in different forms including diagrams, field sketches and large-scale and small-scale maps that conform to cartographic conventions of border, scale, legend, title, north point and source; using digital and spatial technologies as appropriate (VCGGC089)

### Additional Resources:

Distance Worksheets: <http://www.mathblaster.com/teachers/math-worksheets/distance-worksheets>

## ACTIVITY 3

# Trigonometry in the Outdoors

A clinometer is a tool that is utilised to measure the angle of elevation and or the angle from the ground (in a right-angled triangle). Common uses for Clinometers include measuring the height of tall things that you cannot reach, buildings, trees etc.

Students are to create a clinometer (also known as a inclinometer) and then measure angles within the school ground area (Trees, Ground, benches etc)

**Step 1:** Create a Clinometer (That you will use to measure the angles). To create the Clinometer you will need a protractor (You can print this online), a piece of string, a straw, transparent tape and a small weight such as a binder clip) (There is a step by step photo guide within the resources section)

**Step 2:** Using the transparent tape you are going to tape the string to the horizontal (Straight) side of the protractor.

**Step 3:** At the opposite end of the string (the end not attached to the protractor) attach your weight (bulldog paper clip)

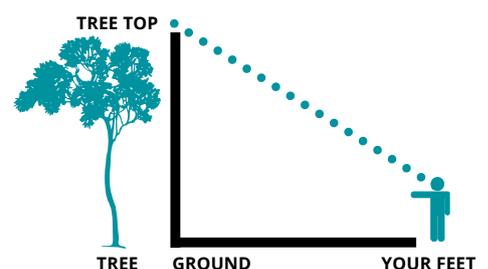
**Step 4:** Tape the straw on the horizontal (Straight) side of the protractor.

To use the clinometer students will be in pairs, then get them to:

1. Find a Tree or a tall object (With plenty of space to move away from the object you are measuring) (Open Space)
2. Look through the straw on your clinometer and find the top of your object (Tree)
3. Have the students partner read the angle recorded on the clinometer (where the string is touching the protractor)
4. Have students move backwards and forwards until the clinometer is at 45 Degrees
5. Once at 45 Degrees have students measure the distance between their feet and the base of the tree
6. Have the students partner to measure the distance from their eyes to the ground
7. Add these two distances (Feet To Tree & Eyes to ground) together
8. This two distances together will provide you a close approximate height of your tree

### Equipment & Materials

- Protractor
- Piece of tin string/strong thread of about 25cm
- Drinking Straw
- Bulldog paper clip
- Transparent tape
- See Resources for step-by-step photo instructions)



### Curriculum Outcomes

- 5
  - Estimate, measure and compare angles using degrees. Construct angles using a protractor (VCMMG202)
  - List outcomes of chance experiments involving equally likely outcomes and represent probabilities of those outcomes using fractions (VCMSP203)
- 6
  - Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles (VCMMG231)
  - Describe probabilities using fractions, decimals and percentages (VCMSP232)

### Additional Resources:

*Make a Clinometer:* <https://nrich.maths.org/make-a-clinometer>

*Make a basic clinometer from classroom materials:* <https://www.instructables.com/id/Basic-Clinometer-From-Classroom-Materials/>

*Clinometer:* <http://www.cif-ifc.org/wp-content/uploads/2014/06/Clinometer.pdf>

# Maths Kebabs



Students will create a Maths Leaf Kebab. This activity is great for learning to count and organise.

Firstly, ask students to go out to the school ground, collect a stick, ideally straight and small, and choose a number between 10-20.

Once they have selected their stick, ask them to collect their chosen number of leaves.

Then students thread their leaves onto the stick. Students can place these leaves straight onto the stick or arrange leaves into colour piles or ask students order these into the colours of the rainbow.

This activity provides students with the opportunity to count, organise and engage in nature through the counting of leaves, organisation of leaves into select categories.

### Equipment & Materials

- Sticks
- Leaves

### Curriculum Outcomes

- F** • Subitise small collections of objects (VCMNA071)
- 1** • Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays (VCMSP102)
- 2** • Collect, check and classify data (VCMSP127)
- 3** • Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (VCMSP149)
- 4** • Create symmetrical patterns, pictures and shapes with and without digital technologies (VCMMG173)
- 5** • Pose questions and collect categorical or numerical data by observation or survey (VCMSP205)
- 6** • Pose and refine questions to collect categorical or numerical data by observation or survey (VCMSP237)

### Additional Resources:

*Example image of a maths Kebab:* <https://i.pinimg.com/originals/cf/0b/05/cf0b05d0b5f2252b4dbd94fbfc2f73db.jpg>

# Leaf Count

In this activity, students will reinforce counting skills.

Firstly, you need to provide a blank template for students to complete the leaf count. An example of the template is provided below.

Hand the worksheets out to students and ask them to go outside to collect leaves and to sketch them on their worksheet so they can keep track of them.

Once students have tallied and collected their leaves, ask them to put all of them into a pile. Now ask them to estimate the number of leaves in the pile. Find out what the actual number of leaves is.



## Leaf Counting

<b>1</b>	<input type="text"/>
<b>2</b>	<input type="text"/>
<b>3</b>	<input type="text"/>
<b>4</b>	<input type="text"/>
<b>5</b>	<input type="text"/>

### EXTENSION SUGGESTION

Extension activities could include how counting the number of leaves that can be thrown in the air at once, or the number of leaves it would take to cover your body.

### Equipment & Materials

- Template
- Pencil

### Curriculum Outcomes

- F**
- Subitise small collections of objects (VCMNA071)
- 1**
- Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays (VCMSP102)
- 2**
- Collect, check and classify data (VCMSP127)
- 3**
- Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (VCMSP149)
- 4**
- Create symmetrical patterns, pictures and shapes with and without digital technologies (VCMMG173)
- 5**
- Pose questions and collect categorical or numerical data by observation or survey (VCMSP205)
- 6**
- Pose and refine questions to collect categorical or numerical data by observation or survey (VCMSP237)

### Additional Resources:

Leaf Counting: <https://www.kidssoup.com/craft-and-resource/leaves-counting-and-estimation>

# Chalk Clocks

Students will use chalk to make clocks. This is fun and can be done very quickly and helps number recognition.

**Step 1:** Choose how you want the students to make the clocks, either with chalk or with found sticks. Our suggestion is a combination of both - chalk outline, sticks for hands.

**Step 2:** Now name a specific time, for example 9:00 am, and ask students to move their clock hands to show that time.

With current digital timepieces, many students are losing the skill of telling analogue time - use this activity to help children familiarise with analogue time telling.



## Equipment & Materials

- Chalk Sticks

## Curriculum Outcomes

- F** • Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond (VCMNA070)
- 1** • Describe duration using months, weeks, days and hours (VCMMG097)
- 2** • Tell time to the quarter-hour, using the language of 'past' and 'to' (VCMMG117)
- 3** • Tell time to the minute and investigate the relationship between units of time (VCMMG141)
- 4** • Convert between units of time (VCMMG167)
- 5** • Compare 12- and 24-hour time systems and convert between them (VCMMG197)
- 6** • Measure, calculate and compare elapsed time (VCMMG227)

## Additional Resources:

Chalkboard Clocks: <https://teachbesideme.com/chalkboard-clock-learning/>

# Maths Connections

Within this activity, students are going to try and make connections between mathematics and the playground / outdoor environment.

Firstly, have students go into outside with their note book and try and identify and record a range of objects – (This can be through free exploring to see what things students will find)

- The amount of benches
- The amount of drink taps
- The number of steps on the playground
- The height of a bin (Using a measuring tape)
- How many steps is it from one end of the playground to the other end
- The amount of people on the playground?
- How many teachers can they see?

Once students have collected all the data have them come back into the classroom and use this data as the foundation for the next activity, be that plotting on a graph, using subtraction and multiplication, dividing the amount of steps by the amount of benches etc (This is explored in the next activity)

By using real world objects students may start to make a stronger connection with numbers to real life as opposed to being on the whiteboard

## Curriculum Outcomes

- F** • Subitise small collections of objects (VCMNA071)
- 1** • Represent practical situations that model sharing (VCMNA090)
- 2** • Recognise and interpret common uses of halves, quarters and eighths of shapes and collections (VCMNA110)
- 3** • Identify and describe slides and turns found in the natural and built environment (VCMMG145)
- 4** • Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (VCMMG165)
- 5** • Use a grid reference system to describe locations. Describe routes using landmarks and directional language (VCMMG199)
- 6** • Solve problems involving the comparison of lengths and areas using appropriate units (VCMMG224)

## Additional Resources:

**Angles in Nature:** <https://creativestarlarning.co.uk/maths-outdoors/outdoor-maths-looking-at-different-angles-in-nature/>



## Equipment & Materials

- Pencil
- Paper

# Schoolground Maths Problems

As the teacher observe the school ground environment and create a series of real world mathematic activities for the students to complete.

These questions could be the same questions as noted in Activity 8 that include "How many benches are in the playground", "How many drink taps" "How many bins are in the playground".

Now pose a variety of questions to students, for example;

- "If you found 15 benches and each bench had eight legs how many bench legs are there in the playground?"
- "How many triangles were located on the table structure?"
- "If you found 10 bins and each bin take fit 50 pieces of rubbish how many bits of rubbish can the 10 bins take?"
- "If there is 10 meters between the classroom and the playground and it costs 50 cents to paint a meter line. How much would it cost to paint a line from the door of the classroom to the playground?"

## Equipment & Materials

- Pencil
- Paper

## Curriculum Outcomes

- F** • Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond (VCMNA070)
- 1** • Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts (VCMNA089)
- 2** • Apply repetition in arithmetic operations, including multiplication as repeated addition and division as repeated subtraction (VCMNA114)
- 3** • Measure, order and compare objects using familiar metric units of length, area, mass and capacity (VCMMG140)
- 4** • Select and trial methods for data collection, including survey questions and recording sheets (VCMSP178)
- 5** • Describe and interpret different data sets in context (VCMSP207)
- 6** • Pose and refine questions to collect categorical or numerical data by observation or survey (VCMSP237)

## Additional Resources:

Counting Activities: <https://www.education.com/activity/counting/>



# Surveying



Students are going to investigate the school ground and larger area by observing and analysing everyday occurrences.

Ask students to suggest things that they would like to survey. Now go outside and make the surveys. They might have chosen to count the number of trees in the playground, the number of cars in the car park, the people walking around between classes - adults, students, male, female.

Secondly, you can have younger students collect data on specific items or with older students they can come up with their questions to answer e.g. what is the most common car colour?

Back in class, challenge students to represent the data collected in some way. **e.g.** – *Bar graphs, Histogram scatterplots, Piecharts*

## Equipment & Materials

- Pencil
- Recording Sheet

## Curriculum Outcomes

- F**
  - Interpret simple data displays about yes/no questions (VCMSP085)
- 1**
  - Choose simple questions and gather responses (VCMSP101)
- 2**
  - Identify a question of interest based on one categorical variable. Gather data relevant to the question (VCMSP126)
- 3**
  - Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (VCMSP149)
- 4**
  - Select and trial methods for data collection, including survey questions and recording sheets (VCMSP178)
- 5**
  - Pose questions and collect categorical or numerical data by observation or survey (VCMSP205)
- 6**
  - Construct, interpret and compare a range of data displays, including side-by-side column graphs for two categorical variables (VCMSP235)

## Additional Resources:

Conducting Survey's: <https://www.mathsisfun.com/data/survey-conducting.html>

# Spotting Shapes & Angles



This activity will help students identify shapes and angles within the contours of the outdoors.

This activity can be done in two ways:

**Method 1:** Take students outside and collect bits of nature in the schoolyard like small sticks, rocks, leaves, etc. and then get students to create shapes with the materials. (Using glue to tick them to a piece of paper, or page in a book is most effective) As students create their shapes, make sure that they can identify and write their name on the page.

**Method 2:** Take students outside with paper and pencils. Get students to identify shapes and angles in various parts of nature, then draw the items they find on the worksheet, highlighting and identifying the shapes and the type of angle and where it was found in the schoolyard.

Shapes may include: polygons, three-dimensional shapes, Angles may include: Acute, Right, Obtuse, Straight, Reflex and full rotation, etc.

 **TIP:** You might make templates of the angles and ask students to match them.

**In upper maths, students could take measurements of specific angles.**

## EXTENSION SUGGESTION

An extension activity for a cross-curricular link to ICT could be to photograph the shapes, identify angles and present photos to class.

## Equipment & Materials

- Pencil
- Recording Sheet

## Curriculum Outcomes

- F**
  - Sort, describe and name familiar two-dimensional shapes and three-dimensional objects in the environment (VCMMG081)
- 1**
  - Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features (VCMMG098)
- 2**
  - Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units (VCMMG115)
- 3**
  - Identify symmetry in the environment (VCMMG144)
- 4**
  - Compare the areas of regular and irregular shapes by informal means (VCMMG169)
- 5**
  - Estimate, measure and compare angles using degrees. Construct angles using a protractor (VCMMG202)
- 6**
  - Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles (VCMMG231)

## Additional Resources:

**Angles in Nature:** <https://creativestarning.co.uk/maths-outdoors/outdoor-maths-looking-at-different-angles-in-nature/>

# Natural Measurement



Within this activity students are going to go into the school ground environment and collect measurements using natural measurement techniques.

Firstly, estimate different distances and lengths of objects in the classroom.

Go outside and ask students to estimate the height and width of different objects in the playground.

Now ask students to estimate the distance between one spot to another.

Now ask students to take accurate measurements using tapes or measured sticks.

Finally, challenge students to analyse the differences between their estimates and the measured distances.

## Equipment & Materials

- Measuring Tape
- Ruler

## Curriculum Outcomes

- F-2**
  - Describe position and movement (VCMMG082)
  - Use informal measurements in the collection and recording of observations (VCSIS052)
  - Compare observations and predictions with those of others (VCSIS054)
- 3-4**
  - Use formal measurements in the collection and recording of observations (VCSIS068)
  - Use a range of methods including tables and column graphs to represent data and to identify patterns and trends (VCSIS069)
- 5-6**
  - Use formal measurements in the collection and recording of observations (VCSIS068)
  - Use a range of methods including tables and column graphs to represent data and to identify patterns and trends (VCSIS069)

## Additional Resources:

**Measurement Activities:** <https://www.mtiinstruments.com/knowledge-center/15-measurement-activities-for-students/>

# Conclusion

There are countless possibilities to learn Mathematics in the outdoors. These activities provide a starting point and you are encouraged to develop more teaching outdoors. Most importantly, take as many opportunities as you can to take your classes outside to learn.

As educators we are continually seeking development. If you have feedback or would like to share your experiences or activities please add a comment on the FUSE Webpage or email [outdoorlearning@outdoorsvictoria.org.au](mailto:outdoorlearning@outdoorsvictoria.org.au) and we will review it and get back to you as soon as possible.

# Acknowledgments

This teacher toolkit could not have been created without the work and dedication of educators throughout Australia. Educators often need to look at their local environment and create activities that suit their needs for that day, we thank you for sharing your activities and hope others reading this document can utilise your creative thinking and implement these activities.

Furthermore, the following organisations and staff have assisted in the creation of this document including;

- Outdoors Victoria
- ACHPER (Victoria)
- Environment Education Victoria
- Geography Teachers' Association of Victoria (GTAV)
- Parks Victoria

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