



Toilet Paper Scale - Teacher's Notes

It is difficult to imagine the immense distances between the planets of our solar system. Compared to these distances planets are small.

So much of Space is, well space.

Astronomers use astronomical units (AU) (the distance of the earth from the Sun) to minimise the size of the numbers concerned but it is still difficult to get a sense of scale.

"The numbers are hard to reach and still harder to grasp" E Bertram.

The distance flying direct from Perth to Sydney is 3,290km.

The distance from the Sun to the Earth is 149,597,890km.

The distance from the Sun to the outermost planet, Neptune, is 4,498,252,900km.

My mind just boggles.

A fun way of realising the relative distance from the Sun to each planet and their relative sizes requires a toilet roll and a dry day or access to a long veranda or corridor if the weather is windy or rainy.

Toilet Roll Data

1. Toilet rolls usually have 1,000 sheets if one ply (1 thickness) or 500 sheets if 2 ply.
2. Thicker or 2 ply toilet paper is not necessarily more absorbent than 1 ply.
3. The large rolls found in public toilets usually have 2,000 sheets. This is not only because they are used more but also the extra thickness of the roll will dissuade the public from stealing them, as they do not fit into household dispensers. (In some tertiary education institutions in the 1970s, it was suggested that more than one third





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- of toilet rolls disappeared off campus).
4. Each year the average first world adult uses 49 rolls of toilet paper or 49,000 sheets.
 5. The average sheet of toilet paper is 10cm by 10cm.



Teachers may wish to visit

<https://au.whogivesacrap.org> to find more information on how buying toilet paper can fund building toilets in third world countries.

When scientists find data difficult to represent or explain, they may use simple models. We will discuss the good points and bad points of this model we are about to use after the experiment.

A 'Toilet Roll' Model of the Solar System

Materials/situation

- A dry, relatively windless day on the school oval or access to a long corridor or school veranda.
- At least one toilet roll is required if this is to be a teacher demonstration or one for each group. If students wish to use their own rolls they may bring one from home to minimise cost.
- A pencil or rod to place in the core of the toilet paper to enable it to be rolled out or dispensed easily.
- Books, rocks or even willing students to hold down the paper and mark the location of each planet and of the Sun.
- A pair of scissors.
- A calculator.





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Method

1. Weigh or fix the end of the roll to the ground and mark this location as the Sun.
2. Place the rod or pencil in the hollow cardboard tube of the roll and start unrolling.
3. Using the table provided, count out the sheets and mark the position of each planet.
4. Leave the unrolled strip and answer the first set of questions. Keep any unused sheets for the second activity.

Estimate the number of sheets of toilet paper which are needed to represent these distances.

PLANET	Distance from Sun km	Sheets of toilet paper
Mercury	57,909,175	6
Venus	108,208,930	11
Earth	149,597,890	15
Mars	227,936,640	23
Asteroid Belt		
Jupiter	778,412,020	78
Saturn	1,426,752,400	140
Uranus	2,870,972,200	290
Neptune	4,498,252,905	450

1. What scale (roughly) is this model? **One sheet of toilet paper represents about 100 million km.**
2. Did this model help you realise the immense distances between planets and our Sun? Explain your answer. **Yes. There is a lot of empty space between the planets.**
3. What problems did you have with this model and how can they be fixed? **The model should work well unless wind, rain, stray dogs, birds**





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and stray students affect the laying of the paper. If you have a large gymnasium or undercover area these might be better options.

Extending the 'Toilet Roll Model' to Demonstrate Differences in Planet Size

This can be done inside.

One sheet of toilet paper represents about 100 million km.

I have worked out the diameter of the largest planet for you. It is 1/10 of a sheet of toilet paper.

PLANET	Diameter of planet Km	Part of one sheet of toilet paper which would represent the diameter of each planet
Mercury	4,879	0.0035 or 3.5 thousandths
Venus	12,104	0.0085 or 8.5 thousandths
Earth	12,756	0.0089 or 8.9 thousandths
Mars	6,786	0.0048 or 4.8 thousandths
Jupiter	142,984	0.1 or 1/10 th
Saturn	120,536	0.084 or 8.4 hundredths
Uranus	51,118	0.042 or 4.2 hundredths
Neptune	49,528	0.035 or 3.5 hundredths

Which planets could be represented relatively accurately at this scale?

Only the biggest planets such as Jupiter and Saturn can be represented. The others would be tiny scraps of paper you would need a microscope to see.

Since at this scale the planets are too small to see from a distance, can we change to a different scale of size but keep to old scale for size and make



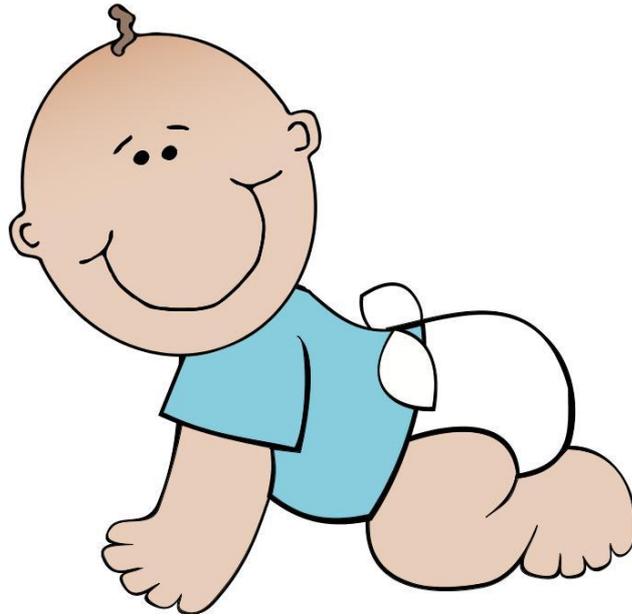


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accurate comparisons? (Hint - The diagram below may help you with your answer). No



The baby girl
Scale 1 cm = 90 cm



The baby boy
Scale 1cm = 45cm

Are the boy and girl the same size? Both the boy and girl are the same size. The picture of the girl has been scaled down to half the size.

Please clean away the used toilet paper into a recycling bin.
Another interesting piece of information on toilet paper was published in the West Australian on March 22 2017. China is attempting to prevent the theft of toilet paper from one of its busiest public lavatories by installing facial recognition cameras. Visitors will only be provided with 60cm of paper. They will be denied access to the toilets within 9 minutes of their first scan.





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This activity is based on one by Dynamic Earth.

<http://www.dynamicearth.co.uk/media/1246/toilet-paper-solar-system.pdf>



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